NON-METRICAL CRANIAL ANALYSIS OF THREE IROQUOIAN POPULATIONS

A COMPARATIVE ANALYSIS OF THREE IROQUOIAN INDIAN POPULATIONS EMPLOYING NON-METRICAL CRANIAL TRAITS

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A Thesis
Submitted to the School of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree
Master of Arts

McMaster University
May, 1973

MASTER OF ARTS (1973)　　McMASTER UNIVERSITY
(Anthropology)　　Hamilton, Ontario

TITLE: A Comparative Analysis of Three Iroquoian Indian Populations Employing Non-Metrical Cranial Traits

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NUMBER OF PAGES: viii, 170

ABSTRACT

This study is a comparative skeletal analysis of three Iroquoian Indian populations. More specifically, it utilizes an established methodology for examining selected non-metrical traits found on the skull. The statistical distribution of non-metrical traits (having an underlying genetic component) supplies information regarding biological affinities among the three populations under study. These include two Neutral Indian populations and one Huron Indian population, all dating from the seventeenth century. It may be expected that the Neutral populations, being culturally and linguistically homogeneous and of a similar period in time, would be genetically similar. The Huron population, being slightly dissimilar culturally from the Neutral populations may show a corresponding genetic dissimilarity. Because the three populations are of a homogeneous Iroquoian base, however, the degree of dissimilarity would be expected to be small. It was in order to clarify the biological affinities between the populations that this study was undertaken.

It has been concluded, through multivariable statistical testing, that a major distinction between Neutral and Huron populations does not exist on the basis of the traits examined. While differences between the three pairs of populations do exist, it has been concluded that the magnitude of these differences is small. Furthermore, of the seventeen variants showing statistical significance at the 0.05 level, eight of these may appear statistically significant because of sampling bias in such factors as age, sex, laterality, and correlation of variants. It appears that statistical significance may imply real biological difference for such variants as frontal grooves, zygomatic facial foramen, paramastoid process, parietal notch and parietal bone, chin form, gonial eversion and accessory mandibular foramen. Suggestions for methodological review have been offered in conclusion of this study.

ACKNOWLEDGEMENTS

This research could not have been completed without the help and encouragement of many people. First, I would like to thank those involved in the researching and computation of data: McMaster University for supplying research materials and financial assistance during the course of this study; the University of Toronto, Department of Physical Anthropology for access to the Carton and Ossossané ossuary material; Mrs. Lillian Giavedoni of McMaster University, Department of Sociology and Anthropology, for invaluable assistance in computer programming and use; and Dr. R. Dean Axelson, who, through Mr. Phill Wright, supplied the pertinent information regarding the Carton ossuary. In addition, I wish to acknowledge the members of my thesis committee--Dr. G. Gaherty, Dr. E. Glanville, and Dr. W.C. Noble. Finally, I must thank my friends for their continual encouragement and most gratefully appreciated assistance.

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CHAPTER 1

INTRODUCTION

(1) Introduction

The usefulness of the methodology of osteological studies has been reinforced since the 16th century, when comparative skeletal studies were instigated. After 1800, osteology, as a component of human biology, gained greater recognition with its concentration or cranial studies. Works of this time included _Crania Americana_ and _Crania Egyptica_ (S.G. Morton), _Crania Britannica_ (J. Bernard Davis and J. Thurnam), _Crania Selecta_ (K.E. vonBaer), and _Crania Germaniae Meridionalis_ (A. Ecker).* Most of these metrical studies involved the use of crude techniques although the nature of such metrical studies seemed to have improved up to the 1930's. At this time, the whole osteometric scheme came under censure for its value in racial assessment.

A shift in emphasis from dead to living populations

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* This list of works is presented by Brothwell in "Introducing the Field", _The Skeletal Biology of Earlier Human Populations_, (1968: 1).

occurred prior to World War II, gaining in popularity and sophistication up to the present. However, Brothwell (1968: 2) states that a resurgence of work on prehistoric and historic populations is evident and that "...the outlook is far more mature and critical, and the breadth of investigations far greater than in pre-war days". Brothwell (1968: 2) stresses the significance of skeletal studies by stating that excavated series provide the only "...direct avenue for temporal studies of human groups". As well, he feels valuable knowledge regarding population changes may be gained in the absence of documented literary evidence or early cultural information (Brothwell 1968: 3).

It is in part a response to statements of this nature that the present study involving Iroquoian skeletal material has been undertaken. It is the aim of this study to examine biological affinities among three Indian populations living within selected temporal and spatial zones. It must be noted as well, that the study presented itself as an academic exercise in methodology--which, in retrospect, proved to be most enlightening in terms of suggestions for methodological review.

(11) Studying Human Variation

W.W. Howells (1943) states that physical anthropology fulfills one of the requisites of an experimental science by having established a controlled way of differentiating natural groups of people. Regarding the system of physical anthropology, Howells (1943: 357) states:

> Its basis is the understanding of normal variation and its mark is the use of statistical methods.

Human variation, as an analytical or theoretical concept, offers itself as a thesis around which scientists operate; yet, the essence of human variation demands constant scutinizing. That is, appreciation of human variation is a starting point for understanding population or individual differences and yet, the range of variation is a constricting element or bounded framework within which the scientist must operate. Species parameters exist which establish *Homo sapiens* as *Homo sapiens*, for example. However, within these parameters, subparameters must be established and recognized if the study is to be meaningful.

Examining the issue from a slightly different viewpoint, it is worthwhile to review Mayr's (1959: 1-5) discussion of evolutionary theory in biology. Mayr considers

Darwin's most overlooked contribution to evolutionary theory to be the replacement of typological thinking by population thinking. When most theoreticians of the 17th, 18th, and 19th centuries were influenced by Plato's idealistic philosophy which was based on the idea of a "limited number of fixed, unchangeable 'ideas' underlying... observed variability", typology was in its heyday (Mayr 1959: 2). Evolution, under this scheme, was not only a contradiction of the very nature of typological thinking, but could not be accommodated within the scheme. "Evolution, if it occurs at all, has to proceed in steps or jumps" (Mayr 1959: 2).

Population thinking, on the other hand, stresses the uniqueness of all things in the organic world. "All organisms and organic phenomena are composed of unique features and can be described collectively only in statistical terms" (Mayr 1959: 2). Typologists then, see reality only in terms of ideal types, while variation is an illusion. Populationists, on the other hand, see reality in variation; type is an abstraction.

Human population biology must go beyond a static examination of taxonimies to dynamic studies of etiology, distribution, function and persistence of variants as related to "size, fitness, ecology, and history of the human group" from which they are drawn (Weiner 1957: 27).

Determination of human population biological affinities may be approached methodologically by metrical or non-metrical morphological studies. Referring to the expression of characters at the phenotypic level, metrical traits are those for which the plotted distribution of observed values follows a continuous curve. The "values" of non-metrical traits phenotypically fall into a limited number of distinct categories and a distribution curve would therefore not follow the same pattern as for metrical traits. This distinction between metrical and non-metrical traits is not an absolute one, rather is dependent upon the method of observation employed.

Anderson (1968: 135) distinguishes between "the non-metrical description of continuous characteristics" and the recognition of presence or absence of variants called "anomalies" or discrete variations. It seems that the designation of certain traits as "anomalies" tends to prejudice their status as "abnormal". Perhaps this terminology biases towards ignoring such traits. For purposes of this study, variants which occur in present or absent states upon initial observation, are termed "discrete" variants.

With the development of human genetics, assessments of population affinities based on the frequency of genes and phenotypes of genetically determined traits became possible. However, the assessment of biological affinity between populations from phenotypic expression must take into account factors other than the genetic component. Much of the quantitative variance* may be due to factors other than genetic.

Quantitative genetics, stemming from the parental branch of Mendelian genetics, is concerned with the expression of traits resulting from gene differences at many loci. The effects of gene differences at many loci are not individually distinguishable (Falconer 1961: 1). Stated concisely (Falconer 1961: 3):

> The theory [of quantitative genetics] consists of the deduction of the consequences of Mendelian inheritance when extended to the properties of populations and to the simultaneous segregation of genes at many loci. The premiss from which the deductions are made is that the inheritance of quantitative differences is by means of genes and that these genes are subject to the Mendelian laws of transmission and may have any of the properties known from Mendelian genetics. The property of 'variable expression' assumes great importance and might be raised to the status of

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* Falconer(1961) distinguishes between quantitative and qualitative differences. Qualitative differences are those of kind; quantitative differences are those dealing with degree of expression. Variation in both may be genetic.

> another premiss: that the expression of the genotype in the phenotype is modifiable by non-genetic causes.

It is evident that the study of continuous variation is concerned with the partition of variance between genetic and non-genetic components. Included in this latter category are environmental factors such as nutrition, climate and maternal effects. Falconer (1961: 141) states that there is usually a component of non-genetic variation, the cause of which is unknown. This element is referred to as "intangible variation". It can be caused by a number of circumstances, including environmental (those external to the individual) circumstances, in which case characters susceptible to it are those connected with metabolism, and developmental circumstances in which case "accidents" or "errors" of development are the cause. Characters affected by developmental intangible variation are those including skeletal form (Falconer 1961: 141). It is the magnitude of all of these components which results in the genetic expression of the population.

The works reviewed for this thesis, relevant to the study of population affinities (including Laughlin and Jørgensen 1956 and Rightmire 1972), generally stated that traits for which the mode of inheritance was most clearly known would contribute most to understanding of population affinities. Bennett and Hulse (1966: 375) assume that certain traits which show discontinuous variation (discrete traits) are monogenic in nature, and hence are most informative regarding genotypic frequencies. It has been stated however, that monogenic traits are much more likely to be subject to the effects of selection, mutation and drift.* While the mode of inheritance of certain traits is assumed to be under simple genetic control, other traits seem to depend on an underlying continuous mode of inheritance. That is, some phenotypically discontinuous traits are, in actuality, "quasi-continuous" (Grüneberg 1952). This term refers to the developmental status of discrete traits. Some discontinuous traits, when subjected to genetic analysis, show that they are under the influence of many genes as well as extrinsic factors. However, thresholds or points of discontinuity operate on their phenotypic value. The threshold acts as a "marker", delineating phenotypic expression above the threshold as one category and phenotypic expression below the threshold as another category. In summary, discrete traits may have either a monofactorial or polyfactorial mode of inheritance. Only detailed genetic analysis can elucidate the underlying genetic mechanism.

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* The controversy regarding resistance to processes modifying characteristics of a population for polygenic as opposed to monogenic traits is mentioned by Rightmire (1972) and DeVilliers (1968). The latter author reviews the literature.

It has been stated that non-metrical variants are of little importance in themselves. That is, from a functional point of view, their contribution is negligible. Berry's (1963) study on mouse populations led him to question whether non-metrical variants are "affected by effectively 'neutral' genes" (Berry 1968: 122). Further study led him to conclude that "alleles which have survival value also affect the incidence of non-metrical variants as part of their pleiotropic action" (Berry 1968: 125). This conclusion supports the utility of non-metrical variants as genetic markers.

It is upon these underlying assumptions that this research rests, and it is the purpose of the following chapters to assess population affinities based on the manifestation of non-metrical variants.

CHAPTER 2

THE POPULATIONS

(I) Historical Background

The region from which the three Iroquois populations under study have been drawn is northeastern North America--more specifically, southern Ontario. The prehistoric and historic events occurring in this area have been dealt with by many authors, of which the works by MacNeish (1952), Wright (1963), Ritchie (1965), Wright (1966), Tooker (1967), Noble (1968), Trigger (1969), and Webb (1969) are the most definitive and will consequently be relied upon for this brief overview.

On the basis of archaeology, physical, linguistic and ethnohistoric data, a unified Iroquois culture pattern is discernible throughout the Northeast for the time period after 1300 A.D. In this respect, it is pertinent to point out that the term "Iroquois" often refers solely to the League of the Iroquois (the League or Five Nations)--a confederation of Seneca, Cayuga, Onondaga, Oneida, and Mohawk tribes. However, other authors employ the term

Iroquois to refer more generally to all of the Iroquois-speaking tribes who did and do occupy the Northeast culture area. In this broader definition, tribes of the Huron, Petun, Neutral, Erie, Seneca, Cayuga, Susquehannock, Oneida, Onondaga and Mohawk are included. As Wright (1966) has pointed out, the Iroquois recognized close kinship ties that cut across political confederations, and common ancestry with specific degrees of consanguinity were recognized between various tribes. In line with these statements then, "Iroquois", for purposes of this thesis, will refer to all of the Northeastern Iroquoian-speaking tribes. It should be noted at this time that the ten Iroquoian nations have been grouped into three archaeological traditions (Wright 1966; Noble 1968), namely, the Mohawk-Onondaga-Oneida-St. Lawrence Iroquois, the Seneca-Cayuga-Susquehannock Iroquois, and the Huron-Petun-Neutral-Erie Iroquois. This latter group, also known as the Ontario Iroquois Tradition, developed from the Middleport Horizon dated circa 1350 A.D.

Although differences between the Northeastern Iroquois tribes have been recognized for the contact period, Wright (1966: 5) points out that the differences between these closely related tribes are of degree rather than kind. Furthermore, he states that the cultural interplay between tribes "almost appears to be circular" and therefore taxonomic categories referring to the Iroquois should be viewed as interpretative devices rather than "absolute pigeon-hole realities" (Wright 1966: 6).

Briefly, hypotheses and theories of Iroquois origins fall into two broad categories--migration and *in situ* developments. The migration hypotheses, now largely abandoned, have a long history stemming from the works of Nicholas Perrot, Colden and Lewis H. Morgan (Ritchie 1961). Other theories regarding migrations of the Iroquois into northeastern North America have been postulated by Lloyd, Boas, Parker and Speck (see Wright 1966, pp. 8-19).

The Iroquois *in situ* theory, initially conceived by Griffin (1943) but first developed and demonstrated by MacNeish (1952), argues in favour of indigenous development. MacNeish's (1952) initially simplistic hypothesis has now attained a full theory status, and provides a first premise for the works of Emerson (1954), White (1961), Ritchie (1965), Wright (1966), and Noble (1968). Such is also the case for the present study.

Archaeological evidence points to the fact that Iroquois origins in both New York and Ontario can be traced back to the late Middle Woodland period, that is, circa 200-500 A.D. However, it is within the latter part of the succeeding Late Woodland period that the three ossuary populations under scrutiny are representative. Wright's (1966) Ontario Iroquois Tradition falls within the Late Woodland, which, for most of Ontario, arbitrarily begins circa 1000 A.D. (Wright 1966). However, in southwestern Ontario, Noble and Kenyon (1972) push this date back to 600 A.D. based upon radiocarbon dating for semi-permanent village expressions. The Late Woodland period continues to historic times, terminating by 1650 A.D., at which point all of the Ontario Iroquois tribes ceased to exist as cultural entities.

Regarding the development of the Ontario Iroquois Tradition, Wright (1966: 54) states that between 1000 A.D. and 1300 A.D., two separate complexes corresponding to tribes were developing in southwestern and southeastern Ontario. They were the Glen Meyer and Pickering branches respectively. By 1300 A.D., the termination date of the early or developmental Ontario Iroquois stage, the peoples of the Pickering branch are believed by Wright (1966) to have incorporated the peoples of the Glen Meyer branch. Wright (1966: 223-224) states that "there is a common cultural pattern with close correspondences to be seen in settlement pattern, burial practices, subsistence and general quantitative artifact categories" for these two developmental branches. Generally, the cultural practices included settlement patterns of palisaded villages located on hills or flanked by ravines, and subsistence patterns based on considerable hunting and fishing and some corn horticulture. Pickering burial practices are characterized by primary and secondary bundle burials in and around the villages. Glen Meyer burial practices are virtually unknown (see Noble and Kenyon 1972).

The middle Ontario Iroquois period, dating approximately 1300-1400 A.D., marks the beginning of formalized Iroquois culture, continuing to the historic era. This is a period of further tribal development. Two substages of the middle Ontario Iroquois stage exist, namely Uren (circa 1300 A.D.) and Middleport (circa 1350-1400 A.D.). Characteristic of these times were settlement patterns consisting of small villages and satellite fishing stations. Burial practices involved small ossuaries which probably contained the dead of an associated village only (Noble 1968; 1969). In addition, at this time, corn, beans and squash horticulture first appears as a cultigen complex augmenting the hunting, fishing and collecting subsistence base.

The late Ontario Iroquois stage, commencing 1400 A.D., marks the divergence of Huron-Petun and Neutral-Erie into two separate branches.

The Huron-Petun branch, having developed from a Middleport base, is described as possessing northern and southern branches, which, by 1600 A.D., coalesced. The southern division Huron, prehistorically located along the north shore of Lake Ontario from Toronto to Belleville, moved northward to join the northern division Huron. According to ethnohistoric records, this latter branch was located in Huronia between Nottawasaga Bay and Lake Simcoe (Wright 1966: 232). Historically, this settlement shift is known to have caused altercations, and as one result, the Petun split away to form a separate group located near Collingwood. Cultural similarities do exist between all divisions of the Huron and Petun as evidenced by archaeological data (Noble 1968). Similar cultural features of the Huron-Petun include palisaded villages on promontories away from navigable water, common pipe, bone and lithic assemblages, and ossuaries (Wright 1966: 157).

The Huron or Wendat, as they referred to themselves, were a league of at least six tribes or nations encompassing the Attignawantan or Bear Nation, the Attigneenongnahac or

Cord Nation, the Arendahronon or Rock Nation and the Tohontaenrat or Deer Nation (Fenton 1940; Trigger 1961; Tooker 1967). Champlain reported a population size of perhaps 30,000 people (Tooker 1967: 11), but this figure is probably exaggerated (Trigger 1969). The Hurons occupied the territory which is now the northern part of Simcoe County, including the townships of Flos, Tiny, Tay, and Medonte, and subsisted basically by agriculture. Approximately three-quarters of the Huron diet consisted of corn, while other cultivated plants included red beans, squash and sunflowers (Heidenreich 1967: 25). Fishing and collecting supplemented this agricultural base (Noble 1968).

The Neutral-Erie branch also developed from the Middleport base. However, late prehistoric fusion of Neutral and Erie branches did not occur as it did in the case of the Huron-Petun branch (Wright 1966: 158).

The Neutral Indians were labelled as such by Champlain because of their neutrality in the wars between the Huron and the League of Five Nations Iroquois. Tooker (1967) states that although the Neutral nation was neutral in the Iroquois League-Huron wars, animosity existed between the Neutrals and an Algonkian group, the Fire Nation of Michigan.

Tooker (1967: 13) points out that originally the term "Neutral" referred to a confederation of tribes or nations including the Aondironon (closest geographically to the Huron), the Wenrehronon (located near the boundary with the Iroquois League), and the Ongniaahraronon (located east of the Niagara River toward the Nation of the Cat)--(see Hodge 1969). Current research indicates that historically the Neutral were a confederacy of at least eight separate tribes, distributed from Milton to Hamilton and Brantford, down to St. Catharines and the Niagara River--Port Colbourne region (Noble: personal communication). Wright (1963: 6) states that "the main villages....in historic times lay between Brantford and Hamilton, Ontario (nearer the latter city)", although a few villages were east of the Niagara River.

Historically about forty villages and hamlets comprised the Neutral nation, spanning 40 or 50 leagues in distance and encompassing a population of 20,000 individuals. Wright (1963: 7-8) reviews the discrepancies regarding Neutral population size. He refers to Le Jeune's statement that the Neutral nation was "much more populous" than the Huron (encompassing 30,000 individuals), and Lalemant's estimate of 40 Neutral villages or hamlets, encompassing approximately 12,000 individuals. This latter estimation appears to be too low in light of archaeological evidence.

Wright (1963: 10-12) presents statements regarding the Neutrals' role in trade with the French. It is stated by some authors that this trade was direct (although minimal if such) and by others that trade was indirect, the Hurons being the mediators. Wright (1963: 12) concludes that although the French attempted direct trade with the Neutrals, the Hurons preferred to keep trade indirect. This can be substantiated, for archaeologically, European trade goods are far more numerous on historic Neutral villages than on their Huron counterparts.

Cultural features of the Neutral include all of those known for the Huron, although there are, as might be expected, specific local differences. Notably, the Neutral Indians raised tobacco extensively. The production of maize, tobacco, and hemp (stemming from a partial agriculture subsistence base) sufficed as trade items to the Huron, who appear to have begun their trade with the French about 1580 A.D. (Noble 1971).

Trigger (1969: 39) states that trading was "embedded in a complex network of social relations" and the Huron "cultivated good relations with friendly tribes". As evidence of this, Trigger (1969) refers to the Huron custom of exchanging children with trading partners in other tribes. "Trading partnerships may...account for references to Huron men having kinsmen among Neutral and Tionontati, with whom they sometimes left their children" (Trigger 1969: 40). It may therefore be inferred that the cultural customs propogated population admixture and that a degree of biological homogeneity could be expected.

Presumably, internecine rivalries would increase as trade and economic rivalry grew. However, ethnohistoric reports state that warfare was evident prior to the economic pressures and was "basic to the social organization of all the northern Iroquoian peoples" (Trigger 1969: 53). The brutality with which the Iroquois treated their prisoners following rivalries has been dealt with extensively (Tooker 1967; Driver 1970; Trigger 1969). It is significant to note that "...the terrific mortality from warfare left many widows, [therefore] a young man captive might be taken as a husband and eventually adopted into the tribe..." (Driver 1970: 324), contrary to the customary practice of mutilation and torture to death. It is also significant to note that while the Neutrals alone were known to torture women (Lalemant in Wright 1963: 10), women and children prisoners generally were not mutilated or tortured, rather were "treated as slaves until married or until they were finally adopted into the tribe" (Driver 1970: 324). Such reports further the probability of biological homogeneity.

Concern for defense played an important part in the Huron and Neutral settlement patterns as evidenced by palisaded villages, etc. To reiterate, both Neutral and Huron villages contained fortified living quarters on natural eminences such as hills, old shorelines or meander spurs (Trigger 1969: 15). These living quarters were constructed away from navigable waters, but were always near supplies of spring water. Heidenreich (1967) points out that living quarters were almost always on sandy soil. Ethnohistoric information indicates that the villages were relocated every ten, twenty or thirty years, being moved one, two or three leagues from their former spot (Champlain in Heidenreich 1967: 26). It has been proposed that reasons for the change of village site include depletion of fuel wood, soil exhaustion, population pressure, sanitation factors and perhaps religious motivations. Allied with the shift of village site was the ceremonial ritual called the "Feast of the Dead". This ritual and its relation to burial customs is the subject of the following section.

(II) Dealing with Ossuaries

The Ontario Iroquois ossuary burial is unique in the Northeast, being a secondary communal interment (Noble 1968; 1969). Before delving into a description of ossuary burials, it is necessary to outline relevant cultural practices related to death among the Huron and Neutral Indians. A ritual practice being held approximately every ten to thirty years, ossuary burial followed a "Feast of the Dead". Trigger (1969) points out that feasting was a means of expressing generosity and reaffirming friendships and kinship links. Furthermore, it functioned to promote political and commercial relations (see Trigger 1969: 106-112). Feasting prior to an individual's death permitted an expression of that individual's courage in the face of death. Ethnohistoric evidence indicates that the Hurons did not fear death, but rather, saw it as a transitional stage into an after-life.

While Champlain, Sagard and Lalemant describe various aspects of Huron burial, the best first-hand description comes from Jean de Brébeuf (Jesuit Relations, vol. 8) (see Kidd 1953). It is from his report that most of the following information regarding burial is drawn.

When a Huron died, he was wrapped in his finest robe and then placed in a fixed position on the mat on which he had died, or was wrapped in furs and covered with tree bark (Tooker 1967: 129). The Huron prepared a "feast of souls" to lament the death and usually three days after the death, the body was taken to the primary burial ground. Scaffolds, eight to ten feet high made of bark and supported on four posts held the body. Trigger (1969: 106) points out that this type of burial was reported for the Attignawantan (Bear tribe), of which the Ossossané ossuary is representative. On the other hand, Noble (1968: 71) notes that pit-and-mound primary burials characterized the more easterly Rock nation, another tribe of the Huron.

Tooker (1967: 131) reports that some Huron bodies were buried in the ground, over which were constructed huts or shrines and around which were constructed protective barricades. Great care was taken to protect the dead.

Wright (1963: 19) points out that the Neutral, like the Huron, had great reverence for the dead, and furthermore believed in the resuscitation of the dead. Ceremonies were held during which an individual who possessed the same "virtues and characteristics" as the deceased whom they wished to resuscitate, received the name of the dead man and was from that time on treated as the dead man. Such ceremonies maintained "the memory of worthy people and excellent brave chiefs" (Sagard in Wright 1963: 20). Unlike the Huron custom of burial however, the Neutrals did not immediately carry the bodies of recently deceased to the cemeteries for interment. Rather, bodies were buried at the last possible time "when decomposition [had] rendered them insupportable" (Lalemant in Wright 1963: 19), and it is reported that bodies often remained in the lodgings a whole winter. They were then removed to scaffolds for decay, following which the bones were "expose[d] to view, arranged here and there in their cabins, until the feast of the Dead" (Lalemant in Wright 1963: 19).

Trigger (1969) states that ancestral cults were absent from many of the North American Indian practices, and that the Indians did not look to the dead for support. However, it is stated that the souls of Iroquois dead were feared and that great care was taken to protect the remains of the deceased (Trigger 1969: 102-103).

Whether the Feast of the Dead was an appeasement to the souls has not been explicitly stated. But it is noteworthy that restrictive burial practices are correlated with beliefs regarding the manner of death and the soul of the dead person. Tooker (1967: 132 footnote) states:

> These special modes of burial may be related to the Iroquois rites to expel from the houses the souls of murdered enemies, witches or those who died unnatural, suicidal, or violent deaths....

Individuals having died by drowning, freezing or other violent means were burned and their bones were not removed from the grave and reburied at the Feast of the Dead, as it was held that these persons "had no communication in the afterlife with other souls" (Tooker 1967: 132). Babies having died less than a month or two after birth were buried by the road in the hope of reincarnation (Tooker 1967: 132).

Frequently, the Feast of the Dead corresponded with movement of village sites every eight, ten or twelve years (Kidd 1953). The Feast of the Dead, involving continual feasting, dancing and game playing for approximately eight days, with subsequent ossuary burial, was an observance common only to the Ontario Iroquois Tradition. The Feast also involved a removal of bones or bodies from the primary burials to a common pit called an ossuary. Trigger (1969: 108) reports that historic Huron ossuary burials were not restricted to particular villages, but often involved bodies from neighbouring villages. Ossuary burials, according to Noble (1968), were primarily kinship controlled through extended family, lineage and perhaps clan affiliations. The remains of individuals who died in another part of the country were usually brought back for this ossuary burial.

Trigger (1969: 108) states "the significance of this mingling of the dead from many parts of Huronia in the ossuary of a single village cannot be overstressed".

The preparation of bodies for ossuary burial involved the stripping and burning of flesh and skin, robes and mats covering the bodies (except in the case of individuals who had died recently). The bones, having then been cleaned, were wrapped in new beaver skins and beads and necklaces were often added to this bundle (Trigger 1969: 108). Whole bodies were wrapped in new skins and all remains were taken back to the village (Tooker 1967: 109).

Ossuary pits are usually found close to their respective village sites. Pits are approximately 6 feet deep and up to 24 feet in diameter. Noble (1968) has dealt with the historical development of the Ontario Iroquois ossuary and has concluded that the increase in size of the ossuaries corresponds with a proportionate increase in the number of individuals interred. Archaeological evidence indicates that scaffolding or a platform around the ossuary only began in the early protohistoric (Noble 1968) and might attain sizes "up to 50 feet across and 10 feet high with ladders..." (Trigger 1969: 109). On top of this platform cross poles were placed, upon which the bundles of bones were later affixed. Trigger (1969: 109) states that undecomposed bodies were placed under the scaffold on mats or slabs of bark fastened to stakes about five feet or more in height. One day prior to reburial bone packages were reopened and mourning occurred once again. The resealing of these bundles often involved the inclusion of additional gifts which were to appease the soul.

At the burial ceremony, attendant individuals arranged themselves into village and clan segments and displayed their gifts to honour the dead. The bundles of bones were then placed on the cross poles on top of the platform, following which a redistribution of gifts took place.

Beaver robes were used as lining for the ossuary pit. Covering these skins were grave goods and the half-decayed entire bodies in fur skins. The bundles of bones were usually lowered into the pit at sunrise. Brébeuf mentions that two or more men stood in the pit and, with poles, pushed the bones around. In part, this explains the fragmentary nature of the Ossossané material. The burial pit was filled "to within about two feet of the top, the robes bordering the edge were turned back and the space in the center was covered with mats and bark" (Trigger 1969:

111). Sand and wooden poles sealed the pit and a cover was erected on top of it.

Ridley (1961) and Wright (1966) report that Neutral ossuaries differ somewhat in terms of structure from Huron ossuaries. The Neutral pits were characteristically lined with a smooth layer of clay over which the disarticulated bones were placed in the usual fashion. Ridley (1961) reports the existence in two cases of a second chamber in the ossuary. A second layer of clay or "false floor" was placed over the first layer of bones, and a second deposit of bones filled the upper ossuary chamber. It has been pointed out by Wright (1966: 218) that greater use of grave goods was evident among the historic Neutral-Erie branch than in the historic Huron-Petun branch.

(III) The Ossuary Sites

(a) The Shaver Hill Ossuary (AiHa-1)

The Shaver Hill Neutral ossuary was excavated in the summer of 1968 by Mr. David Stothers, an undergraduate in the Department of Sociology and Anthropology, McMaster University, Hamilton, Ontario. The material analysed in the present study, as well as other skeletal and archaeological remains from Shaver Hill currently reside in the Physical Laboratory of the Anthropology Division, McMaster University.

The ossuary complex is associated with the Christianson village site (AiHa-2), located approximately one-quarter mile to the west. Both date circa 1600-1620 A.D. (Stothers 1972). The village site, first sampled in 1968 by Stothers and extensively excavated by Dr. W.C. Noble in 1969, covers four acres (Noble 1970), and is surrounded by a double palisade. Middens have been located peripherally, as well as inside the village where house pattern data was recovered (Noble 1970). Christianson lies along the east bank of Spencer's Creek, on Lot 34, Concession 6, Beverly Township, Wentworth County, Ontario. The burial complex lies northeast of the village on the summit of a high glacial drumlin on Lot 36, Concession 6, Beverly Township.

The burial complex, containing the remains of at least 195 individuals, revealed two adjacent ossuaries, as well as a series of surrounding primary flexed and extended burials, and secondary bundle burials. The small ossuary contained the remains of at least 18 individuals; the large ossuary contained the remains of at least 163 individuals. Regarding the dimensions of the ossuaries, the larger measured 12 feet in diameter by 3 feet in depth and the smaller (being two feet northwest of the larger ossuary) measured 4 1/2 feet in diameter by 1 foot, 7 inches in depth (Stothers 1972).

A rather large pit containing a large clay vessel was uncovered. In addition, it was noted that bundle burials were associated with hearths, one of which contained burned maize kernels (Stothers 1972).

Skeletal material was arranged in the main ossuary so that skulls and long bones covered one side of the ossuary, and remaining skeletal material of mature individuals covered the other side. Postcranial skeletal material of immature persons was located in one discrete area. It showed evidence of having been charred (Stothers 1972).

Numerous grave goods were found in both the individual as well as ossuary burials. These included strings of discoidal and tubular conch shell beads (over 1200), strings of glass beads, iron knives, clay pots, cut and polished bone tubes, a brass ladle, a clay pipe, an iron axe (French), and a religious medallion (Stothers 1972 and personal observation).

The distinctive glass beads were examined by Mr. Ian Kenyon, and on the basis of this analysis, a dating of circa 1600-1620 A.D. has been established for the Shaver Hill Burial Complex (Stothers 1972).

(b) The Carton Ossuary (AjGx-4)

The Carton Ossuary, located on the farm of Mr. Gerry Carton, Lot 7, Concession 1, Massagaweya Township, Halton County, Ontario, was discovered in 1959 by Dr. R.D. Axelson. The site (dated at circa 1585-1610 A.D.) was excavated as a salvage project in the summers of 1966 and 1967 by Dr. Axelson. He was assisted during the summer of 1967 by Anthropology students from the University of Toronto. The skeletal material obtained from these excavations is now available at the Department of Anthropology, University of Toronto. The archaeological material, which is definitely Neutral, is in the personal possession of Dr. Axelson.

The ossuary is situated in a worked field of the Carton farm, the location of this farm being northwest of the town of Milton, about fifty miles west of Toronto. Axelson (personal communication 1972) reported that the associated village site is located approximately 300 to 400 yards from the ossuary and is about three to five acres in size. The village site has never been excavated, although test pitting in midden areas has been undertaken.

The ossuary is reported to consist of a single pit, exclusive of associated burial pits. The area surrounding the ossuary was skimmed away two bulldozer-blade widths in an attempt to find associated burials. Axelson (personal communication 1972) gives the dimensions of the Carton ossuary as 11 feet in the north-south diameter, 11 feet 10 inches in the east-west diameter and 3 feet 3 inches in depth. The clay lined pit shows evidence of further lining with bark and fur pieces. No evidence of structures either in the pit or around the periphery were found (Axelson: personal communication).

It is estimated that the ossuary contained the remains of at least 250 individuals (Axelson: personal communication). Skeletal material was disarticulated and mixed throughout the pit. However, crania appeared to have been placed in a number of small groupings. Remains of mature and immature individuals were not segregated. None of the skeletal material showed signs of having been burned.

Regarding grave goods, a limited number were found. These include strings of discoidal and tubular shell beads, tubular brass beads, strings of glass trade beads (over 700), brass armbands, corded wire and band brass rings (over 35), two snake effigy brass pendants, four pot sherds. No clay pipes, pots (except the four pot sherds), worked bone, worked stone, brass kettles or iron goods were found in the ossuary pit (Axelson: personal communication).

The glass trade bead material was examined by Dr. Walter Kenyon of the Royal Ontario Museum. Some of these beads are thought to be early Dutch trade items. Glass trade beads are definitely a post-1580 A.D. phenomenon in the Ontario protohistoric (Noble 1971), and thus, this leads to a dating of the Carton site at circa 1585-1610 A.D. The skeletal remains of the ossuary would, therefore, represent a population who probably died between the years circa 1570-1610 A.D.

(c) The Ossossané Ossuary

The Ossossané or Brébeuf ossuary has been identified as representative of a Huron type (Kidd 1953; Noble 1968). The site is located on a sandy plain on the farm of Mr. Charles Daoust. More specifically, it is located on the promontory in the north half of Lot 14, Concession 7, Tiny Township, Simcoe County, Ontario. Excavation was undertaken in the summer of 1947 by the Royal Ontario Museum under the direction of Kenneth E. Kidd with students from the University of Toronto. Associated village sites are reported to exist one mile north and one and one-half miles northwest of the ossuary site (Kidd 1953: 359).

Excavation of the ossuary revealed a slight elevation around the rim of this "broad, saucer-shaped depression,..." (Kidd 1953: 359). Clear archaeological evidence of scaffolding is hard to determine, but it is historically documented by Brébeuf. Kidd (1953: 361) reports that the probable posts of this framework surrounded an area 55 feet in diameter.

The ossuary had a more or less flat, but not level bottom.

> The diameter of the pit from rim-crest to rim-crest was 24 feet; that of the bone mass contained within it, 5 feet less. The depth below the rim varied between 5 and 6 feet, but since the pit was dug on slightly elevated ground, the bottom was somewhat less than this depth below the level of the field.
> (Kidd 1953: 361)

Two bundle burials were found in a pocket of the pit wall. Evidence for other bundle burials was found, although these burials were not as clearly delineated as the two previously mentioned. Two extended burials were uncovered on the floor of the ossuary. Kidd (1953: 363) reports that one skeleton was of a young woman who probably died in childbirth, as the skeleton of a young infant lay in the region of the pelvic cavity. The other burial appeared to be incomplete. Groups of long bones were found together especially at the sides of the ossuary. The remaining osteological material was disarticulated and "in extreme miscegenation, best exemplified perhaps by crania lying inside pelvic cavities, ribs perforating eye sockets and... vertebral columns...[lying]...side by side in the most inexplicable association" (Kidd 1953: 363).

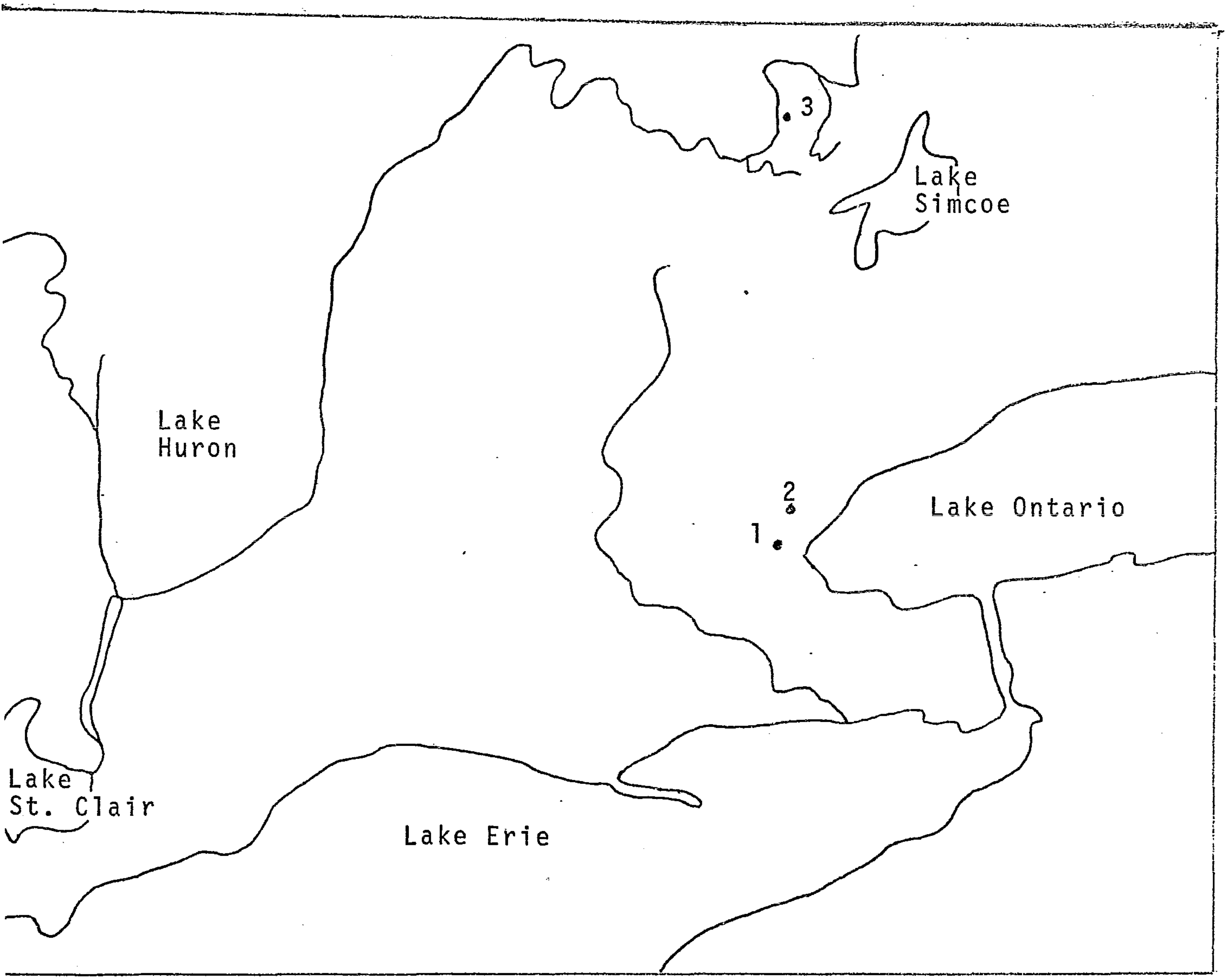
Grave goods and artifacts in general included shell beads, stone projectile points, a triangular bone pendant, pigments, textile fabrics and pipes (Kidd 1953: 364). One large conch shell, thirteen olivella shells, discoidal wampum (numbering 228) and tubular beads (numbering 45) were found. Kidd (1953: 365) states it is noteworthy that only ornaments were made of shell, at least for ossuary use; and that shells of exotic origin were so employed. Part of a large birch-bark basket was found in the bottom of a copper kettle. It is significant to note the preservative action of copper salts--which, in this case, left remains of beaver skin bundle wrappings evident (Kidd 1953: 366).

It is reported by Kidd (1953) that the ossuary contained the remains of at least 1,000 individuals. However, Gruber (1958: 9), upon analysis of the Ossossané dentition, stated that this figure is too high and should be re-evaluated at 250 individuals. Noble (personal communication) has stated that Gruber's analysis relates to a portion of the Ossossané collection only and, therefore, his estimate of 250 individuals is too low. Noble also feels that Kidd's estimate is too high, and that the most probable number of individuals lies somewhere between these two estimates.

Regarding the dating of this ossuary, Kidd (1953: 378) postulates that the material was deposited prior to the great smallpox epidemic of 1639 and to the adoption of the Wenro coincident with that epidemic. That is, he feels the remains represent individuals of the western branch of the Huron, the Bear tribe, who died circa 1624-1636 A.D. Brébeuf witnessed this ossuary burial in May 1636.

FIGURE 2.1

APPROXIMATE LOCATIONS OF THE THREE OSSUARIES



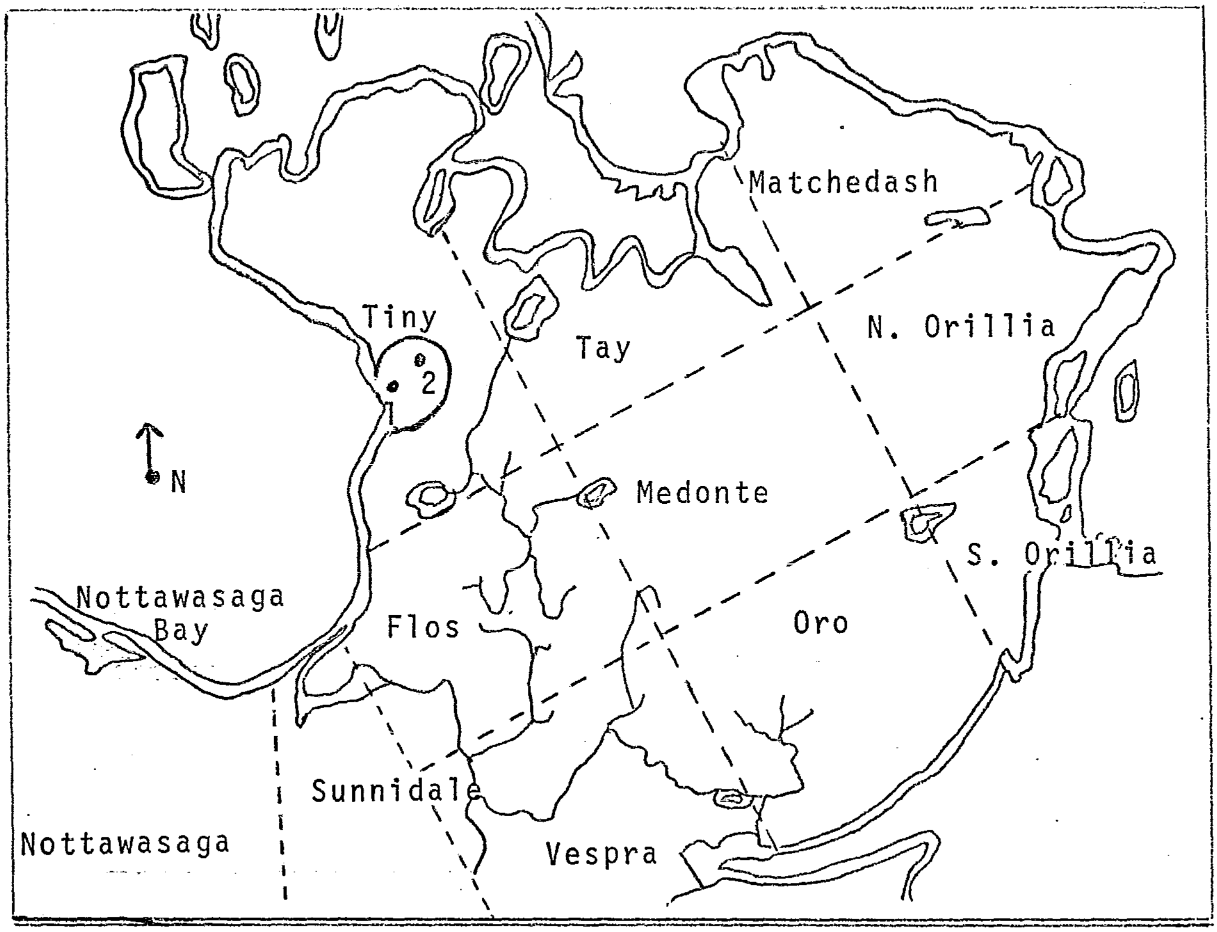
1 = Shaver Hill Ossuary
2 = Carton Ossuary
3 = Ossossané Ossuary

Scale of Miles
0 10 20

FIGURE 2.2

MAP TO SHOW LOCATION OF THE OSSUARY IN TINY TOWNSHIP

OSSOSSANÉ OSSUARY



1 = Ossossané
2 = Site of Ossuary

In the circled area, the supposed village site of Ossossané is at 1 and the ossuary at 2. Scale: about 3/10 of an inch to the mile (Kidd 1953: 360).

CHAPTER 3

NON-METRICAL FEATURES

(I) Introduction

This chapter is concerned with descriptions of 52 non-metrical features, including brief statements on the possible expressions of traits and a discussion of etiology, where applicable. The presentation is not intended as an exhaustive study, rather a survey of the literature relevant to the non-metrical features under observation here. The traits examined are those listed on portions of the University of Toronto standard data codification form, relevant to the present study (see Chapter 4). The subsections of this chapter follow the card data identification system of the codification form. A further explanation of this codification form, along with scoring for the individual traits, appear in the following chapter.

(II) Cranial Morphology

Metopism or retention of medio-frontal suture: The ontogenetic union of the two portions of the frontal bone begins in the second year post-natally (Brothwell 1963: Gray's Anatomy 1969; DeVilliers 1968; Limson 1924). Webb (1969) and Gray's Anatomy (1969) state the suture is usually obliterated by the eighth year, although Limson (1924: 318) states that the two lateral halves of the frontal bone fuse completely along the midline of the forehead not later than the fourth to sixth year of life.

In some cases, the suture is distinguishable into adult life. DeVilliers (1968: 82) states that a persistent metopic suture has very definite characteristics.

> It is typically dentate, the edges of the two bones being finely serrated from nasion to a point some two centimetres anterior to the coronal suture when its course becomes simple and direct. The simple portion is the area included within the anterior fontanelle.

In some cases the suture may persist at nasion, the lower remnant usually being linear (DeVilliers 1968: 82). Limson (1924: 317) states the suture may be continuous from nasion to bregma or there may remain "unossified portions at the upper, middle or lower parts of its course".

Brothwell (1963: 95) states that Montagu (1937) postulates genes for metopism and non-metopism. Torgersen (1951: 193) states that a familial incidence was reported once between two brothers in 1862. Torgersen (1951: 193) supposes "that the incidence of metopism depends on a simple genetic mechanism and hybridization". Regarding the results from his Oslo sample, Torgersen (1951: 198) states the suture "behaves as a dominant trait with a varying penetrance, and in many cases is sporadic in its appearance". Hess (1945) (see Berry and Berry 1967) considers the suture a component in a "metopic syndrome", rather than a localized "peculiarity".

Brothwell (1963: 95) states that metopism shows geographical variation and refers to Sullivan's study (1922) for support of this contention.

Frontal grooves: These linear depressions found uni-or bilaterally on the frontal bone may accommodate the supra-orbital arteries of the forehead (Ossenberg 1970).

Ossenberg (1970: 362) refers to Dixon's (1904) explanation for frontal grooves as "the result of insufficient growth in length of the ophthalmic nerve branches in relation to the expansion and increased curvature of the frontal bone, whereby the nerves act as constricting cords and leave their impression upon the growing bone".

Brow shape: Supraorbital ridges may be absent or present in various degrees. In the latter case, expression may be continuous, (V-shaped, arc-shaped or straight) or discontinuous. Wright and Anderson (1963: 106) designate V-shaped supraorbital ridges as one of the ten morphological features characterizing the Iroquois physical type. Melbye (1969) notes that a V-shaped form overlying the root of the nose and medial to the orbits, seems characteristic of Northeast crania.

Brow rugosity: The expression of supraorbital ridges ranges from total absence of the trait to a well marked presence. This trait exemplifies sexual dimorphism, the male skull possessing a higher degree of brow rugosity than the female skull (Brothwell 1963; Anderson 1969). Anderson (1969: 111) states that brow ridge prominence is a guide to the determination of 'racial type' as well.

Supraorbital notch and foramen: Supraorbital nerves and vessels may pass across the supraorbital margin in a single foramen or multiple foramina, in a single notch or multiple notches, or in combination on right or left sides of the skull. In addition, vessels and nerves may pass over the surface of an unmodified supraorbital margin.

Foramina or notches are situated "at the junction of the lateral two-thirds and the medial third of the superior orbital margin" (DeVilliers 1968: 122). Anderson (1969: 112) notes that the position of supraorbital foramina or notches "may vary somewhat in relation to other bony landmarks", thus implying that DeVilliers' specific location of supraorbital openings by scrutinized. Melbye (1969) points out that a complication in the assessment of location of this trait is the existence of supratrochlear foramina and/or notches. In addition, the presence of frontal notches or foramina may complicate assessment. Berry and Berry (1967: 369) locate these openings "in the vicinity of (usually lateral to) the supraorbital foramen". According to Gray's Anatomy (1969) however, frontal notches or foramina are located medial to the supraorbital foramen. Assessment on the basis of this latter location could conceivably confuse supraorbital, supratrochlear and frontal foramina and/or notches. For purposes of this study, then, DeVilliers' statement of location of the supraorbital foramina or notches has been followed. Although not included in this study, frontal notches or foramina would be located in the area delineated by Berry and Berry (1967).

Bennett and Hulse (1966: 374) state that supraorbital foramina are among those traits which are "commonly accepted as genetic rather than environmental in origin". Brothwell (1963: 94) points out that studies by Wood-Jones (1930-31) and Wunderly (1939) deal with such traits as supraorbital foramina, yet do not list frequencies for various groups. DeVilliers (1968: 279) lists, in table form, the percentage frequencies of supraorbital foramina and supraorbital notches in man.

Supratrochlear notch and foramen: Ossenberg (1970) locates these openings at the superomedial angle of the orbit. During life, a supratrochlear notch or foramen carries the supratrochlear vessels and nerve. Although Melbye (1969) records the existence of supratrochlear grooves, these were not found in the present study. Trochlear spurs (incomplete foramina) were recorded in this analysis. These usually occurred in the medial wall of the orbit, slightly posterior of the supero-medial angle of the orbit. They are formed by ossification of part of the superior oblique muscles of the eyeball (Ossenberg 1970). Although Ossenberg (1970) denotes trochlear spurs as being distinct from supratrochlear variances, they have been included under the rubric of "supratrochlear notch and foramen" for purposes of this analysis. It is suggested that supratrochlear spurs be examined as separate variants in further studies, due to the differences in origin of supratrochlear notches and/or foramina and supratrochlear spurs.

Extra ethmoidal foramen: The anterior ethmoidal foramen "pierces the medial wall of the orbit [and] normally lies on the suture between the medial edge of the orbital plates of the frontal and ethmoid bones" (Berry and Berry 1967: 370). The posterior ethmoidal foramen lies "behind the anterior ethmoidal foramen on the same suture line" (Berry and Berry 1967: 370). Any foramen accessory to these is scored as an extra ethmoidal foramen.

Riesenfeld (1956: 93) states that racial groups exemplifying a larger than average number of infraorbital foramina (American Indian, Indonesian, Melanesian) also exemplify a larger number of ethmoidal foramina than do groups showing a smaller number of infraorbital foramina (Hungarians, African Negroes). Riesenfeld (1956: 93) concludes that it seems to follow that the factor determining numerical variability of infraorbital foramina also determines numerical variability of ethmoidal foramina. "...ethmoidal foramina follow infraorbital foramina in terms of their racial distribution and unilateral asymmetry" (Riesenfeld 1956: 94). Riesenfeld (1956) finds the incidence of ethmoidal foramina higher on the left than the right side.

DeVilliers' study (1968) does not corroborate these findings of Riesenfeld. DeVilliers (1968: 126) does state, however, that when individual crania are considered, a tendency to multiple foramina in one area is often accompanied by "similar tendencies in one or more of the other areas". Thus, the underlying mechanism operates, it would seem, on the total skull. DeVilliers (1968: 126) concludes that duplication of foramina including parietal, infraorbital, ethmoidal and mental is "produced by a genetic mechanism".

Anterior ethmoidal foramen position: The anterior ethmoidal foramen, as mentioned, usually lies on the fronto-ethmoidal suture. It may, however, be located superior to the suture (on the frontal bone) or on the ethmoid bone. In certain cases, the fronto-ethmoidal suture may be fused or obliterated, in which case location of the foramen is indeterminate.

Nasal aperture form: Morphological observations as to whether this trait exemplifies itself as pyriform, inverted-heart shaped or equilateral-triangle in shape are frequent. Wood-Jones (1930-31: 187) offers the categories of pyriform, ovoid, oval, almost parallel sided, and circular for the nasal aperture form. In many cases of the present study, the nasal bones were not intact and it was often difficult, if not impossible, to assess nasal aperture form.

Nasal profile: DeVilliers (1968: 128) suggests assessment of nasal profile follow the method proposed by Virchow and quoted by Martin and Saller (1957). This method involves assessment of profile in relation to a straight line joining nasion to rhinion. Several categories for assessment have been established; DeVilliers employs seven of them. The categories used in this study are fewer in number than those employed by DeVilliers. This study involves the assessment of a straight, concave, convex or concavo-convex (a combination of the two previously mentioned forms) nasal profile. In many cases, nasal bones were not intact, therefore assessments have been limited.

Birdsell (1949) (see DeVilliers 1968: 131) suggests growth patterns of the nasal bones are inherited independently of growth patterns of the frontal processes of the maxilla. Nasal overgrowth (in which the genetic growth tendency of the nasals exceeds that of the maxilla), is responsible for a convex nasal profile according to Birdsell (1949) (see DeVilliers 1968). Nasal undergrowth results in a concave nasal profile. DeVilliers (1968) reports that Birdsell found sex differences in American Indian nasal profiles. Birdsell suggested that the "relative growth patterns of the nasal bones were hereditarily determined by sex-influenced factors" (DeVilliers 1968: 131).

Infraorbital foramen: This trait, accepted as genetic in origin, (Schultz 1954 in DeVilliers 1968; Bennett and Hulse 1966; DeVilliers 1968) is defined as an opening which transmits the infraorbital vessels and nerve. The trait may occur in a multiple state (usually the number is two (DeVilliers 1968: 123)). Wood-Jones (1930-31: 186) states the "typical pithecoid condition is for the foramen to be multiple rather than single whereas in Homo the single orifice is normal".

DeVilliers (1968: 123) states that Adachi (1904) and Le Double (1906) point out the significance of distinguishing accessory foramina from nutrient foramina.* It seems that this distinction must be made not only for infraorbital foramina, but all foramina. In order to achieve this end, standardization of assessment must occur. In this study, a fine probe as well as a fibre from a nylon hairbrush were employed to test foramina. The flexibility of the fibre allowed the foramina to be better penetrated.

DeVilliers (1968: 280) arranges in table form the distributional differences of infraorbital foramina between

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* Nutrient foramina may be defined as structures permitting entrance of nutrient arteries to the interior of bone. They usually end in bone. Accessory foramina are "structural" foramina - the term "accessory" is usually reserved for these identifiable morphological features.

races. Mongoloids and African Negroes mark the extremes. DeVilliers (1968: 124) states that the distributional differences seem to indicate that "the frequency with which multiple infraorbital foramina occur is a racial trait, on the other hand, the intra group variability of this feature is appreciable". Schultz (1954) has found familial incidence of multiple infraorbital foramina, suggesting an underlying genetic basis (DeVilliers 1968: 124).

Regarding side differences for this trait, it has been noted (Riesenfeld 1956; DeVilliers 1968) that the number of infraorbital foramina is greater on the left than the right.

The relation of infraorbital foramina to ethmoidal foramina has been discussed in a previous section.

Zygomatic-facial foramen: This is usually a small foramen which pierces the zygomatic bone opposite the junction of the infraorbital and lateral margins of the orbit (Berry and Berry 1967: 369). This foramen carries a small artery and nerve. Its variations include a single foramen, multiple foramina or complete absence of an opening.

This trait has been included for study by Berry and Berry (1967) and Rightmire (1972). These researchers do not discuss a genetic etiology for this trait, but in their conclusions, do discuss results obtained from computations of this and other variables in terms of "genetic" divergence or distance. It would appear, then, that an underlying genetic component is assumed for zygomatic-facial foramina.

Os Japonicum: Gray's Anatomy (1969) states the zygomatic bone is normally undivided, having ossified from one centre which appeared in membrane about the eighth week of intrauterine life. The zygomatic bone, however, may show a horizontal suture separating the superior from the inferior portion. The latter (inferior) portion is called the os japonicum "since it was believed to be characteristic of the Japanese cranium" (DeVilliers 1968: 137). This bone is also referred to as os ainonicum, divided zygomatic or bipartite zygomatic.

DeVilliers (1968: 137) states that Martin and Saller (1957) attribute the os japonicum to a modification in "secondary deposits of bone", whereas Frazer (1958) attributes the source of the os japonicum to a secondary centre of ossification.

Birdsell (1949) suggests that the os japonicum and metopic suture are among those traits whose determination is genetic but he states that "the mode of inheritance would be difficult to establish, since age changes affect these characters" (DeVilliers 1968: 137).

In her discussion of Torgersen's (1951a) article, DeVilliers (1968: 137-138) states two categories of "anomalous sutures" may be observed. These include regularly occurring sutures which fail to close early, and irregularly occurring sutures. The latter category, into which the zygomatic suture falls, may be caused by "genes determining the situation of the ossification centres and the sutures" (DeVilliers 1968: 138).

DeVilliers (1968: 145) suggests that the occurrence of an os japonicum may be dependent on a "fairly simple genetic mechanism". The reader is referred to DeVilliers' table of the incidence of os japonicum in man (DeVilliers 1968: 290).

<u>Malar tubercle</u>: This variant is defined as a "bony elevation on the anterior surface of the zygomatic for origin of the zygomaticus major and levator labii superioris muscles" (Melbye 1969).

Zygomaxillary tubercle: This protuberance is found on the inferior border of the zygomaxillary suture, at the origin of the masseter. Since, by definition, tubercles give attachment to muscles or ligaments, and more powerful musculature is characteristic of males, a corresponding higher scoring of zygomaxillary tubercle would seem to be expected for males. It is expected that a degree of sexual dimorphism should be exemplified for all tubercle variants.

Marginal tubercle: This trait is found at the lateral border of the zygomatic bone, immediately below the zygomatico-frontal suture. The scoring of this trait followed the established "+" system. A single "+" state corresponds with a slight bulge, a "++" state, a bulge which is certainly discernible by sight, yet the contour of which is not hooked. A "+++" or more state is one for which the traced outline would follow a hooked pattern.

Palatine torus: The torus palatinus, a "specifically hominid character" (Woo 1950: 98) is a bony prominence along the median line of the hard palate (Brothwell 1959: 105). Brothwell (1959: 105) refers to Miller and Roth's work (1950) in which they claim that the palatine torus is a post-natal hyperostosis, growing progressively. Woo (1950) contradicts Miller and Roth's work, stating the palatine torus does not increase with age. This variant appears in young and old individuals, in both sexes and in all races, although frequencies vary (Woo 1950:85). The incidence of palatine torus seems to be variable among populations (see DeVilliers (1968: 294-295) for documented evidence of the overall incidence of torus palatinus in man). Whereas Brothwell (1963) reported presence of the trait in 10% of British skulls, Berry and Berry (1967) reported its presence in one Burmese skull out of approximately 600 skulls from eight different localities. In their discussion of the incidence of this trait, Berry and Berry (1967: 376) point out that discrepancies between values for this variant may be attributed to "two distinct entities that can be scored as 'palatine torus'".

Bennett and Hulse (1966) report that the etiology of the palatine torus is not certain. The results of their study on populations from Mesa Verde, Point of Pines, and Pecos support the notion of Klatsky (1956) (see Bennett and Hulse 1966: 374) that genetics is involved in the expression of this trait. Lasker (1947), cited by Brothwell (1963: 100) and Rightmire (1972), also supports the idea that the palatine torus is under genetic control. Suzuki and Sakai (1960: 266) assume this trait may be explained by a Mendelian dominant gene, although they admit this assumption may not "exactly reveal the true mode of inheritance". Brothwell

(1959: 105) adds etiological hypotheses of mechanical stress, diet and disease, although he states these factors have given way to a genetic explanation. DeVilliers (1968: 142) states the torus palatinus is a characteristic which "appears to be determined by heredity but is influenced by environment".

Woo (1950: 97) feels the palatine torus to be a "hereditary character" and adds that some literature supports its incidence as familial. It is "a normal anatomical variation and has no connection with any pathological condition" (Woo 1950: 98).

The palatine torus

> ...may extend anteriorly to the incisive foramen and in rare cases even on both sides of it, and posteriorly to the posterior border of the palate bones. In general it tapers gradually anteriorly, but more abruptly posteriorly opposite the glandular depression of the palate bones (Woo 1950: 85).

DeVilliers (1968: 139-140) presents Campbell's (1925) classification of the torus in relation to the sutures of the hard palate. These classifications include torus maxillaris medianus, torus palatinus medianus, torus palatinus transversus and crista palatina transversa. The first three categories constitute what writers other than Campbell refer to as palatine torus. DeVilliers

(1968: 140) outlines Hooton's (1946) classification based on shape of the torus as mound, ridge and lump. The present study ignores palatine torus shape.

Assessment of this trait corresponds, in part, with that proposed by Suzuki and Sakai (1960). A trace (+) is not discernible by sight but clearly recognized by touch. A slight degree of expression (++) is discernible by sight. A moderate degree of expression (+++) is discernible by sight but is not well marked, as is a ++++ state.

Maxillary torus: DeVilliers (1968: 143) describes this trait as "an occasional hyperostosis on the alveolar portion of the maxilla...usually confined to the lingual aspect in the molar region". It consists of very compact bony tissue (Brothwell 1963: 100). Woo (1950: 95) states this trait appears in the form of small "uneven tuberosities or a tuberous welt", which may extend to the second premolar or rarely as far as the canine.

Regarding the frequency of incidence of this variable, Suzuki and Sakai (1960) note that it is more common among populations in the northern hemisphere than among populations in southern regions.* These authors report the documented evidence of higher incidence among males than females, but cite Akabori's study (1939) (see Suzuki and

Sakai 1960) in which the reverse was reported. Suzuki and Sakai (1960) conclude that the validity of sex differences has not been established.

Suzuki and Sakai (1960) present several statements regarding etiology of the maxillary torus. They are summarized as follows (see Suzuki and Sakai 1960: 263-272): Kajava (1912), Hooton (1918) and Hrdlička (1940) offer functional hypotheses. Chewing results in stress on the jaws. If hyperfunctional stress is the case, this variant should rarely appear in children, should show an increasing incidence with age, and should be directly correlated with attrition. Schreiner (1935) attributes sensitivity of bone conditioned by "deficient diet or avitaminosis" as the cause, whereas Van den Broek (1943; 1945) attributes "chemical irritation of mucous membrane" as the cause. DeVilliers (1968: 144) states "...the evidence suggests that the maxillary, palatine and mandibular tori are inherited, but may require the coordinated activity of genetic and environmental factors for their development and that the genetic factors involved may be dependent or independent of one another".

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* DeVilliers (1968: 297) also presents the percentage incidence of torus maxillaris in various cranial series.

Lesser palatine foramen: According to Berry and Berry (1967: 369) the lesser palatine foramina "...lie on both sides of the posterior border of the hard palate immediately posterior to the greater palatine foramen, and transmit the lesser palatine nerves". DeVilliers (1968: 145) states that evidence to present indicates that the tendency to multiple foramina is dependent on a "fairly simple genetic mechanism".

Pterygo-foramen: The variations in this region include pterygo-spinous foramen or foramen of Civinni, pterygo-alar or pterygo-basal foramen or porus crotopithecobuccinatorius of Hrytl, and pterygoid spurs.

Wood-Jones (1930-31: 193) states that the variation in Mammals is wide with respect to the development and disposition of the lateral and medial pterygoid processes. He states that the "caudal continuation of the lamina lateralis and the relation of this extension to the foramen ovale" ought to be examined (Wood-Jones 1930-31: 193).

The presence in varying degrees of completion of a pterygo-spinous bar is equated with those variations including foramen of Civinni. Complete ossification of the pterygo-spinous ligament between the posterior margin of the lateral pterygoid plate, and the angular spine of the sphenoid constitutes the pterygospinous foramen. DeVilliers (1968: 107) states that "the bar of bone is usually a vertically flattened structure passing medial to the foramen spinosum and transecting the foramen ovale". It has been postulated that the foramen so created transmits nerves and vessels to the medial pterygoid muscles. The codification form employed in this study permits recognition of both pterygospinous foramina and pterygospinous spurs (partially ossified ligaments).

Ossification of the pterygo -alar ligament, extending between the inferior surface of the greater wing of the sphenoid near the antero-lateral margin of the foramen spinosum and the root of the lateral pterygoid process constitutes the pterygo-alar bar (DeVilliers 1968: 107). Total ossification constitutes a foramen; partial ossification constitutes a spur. This structure lies lateral to the foramen ovale and foramen spinosum. In her discussion of the pterygo-alar foramen, DeVilliers (1968: 107) refers to the documented evidence that most of the motor branches of the mandibular division of the trigeminal nerve as well as some veins from the pterygoid plexus pass through the foramen. For purposes of this study, the pterygo-alar spur or foramen is referred to as a basal spur or foramen. The pterygo-spinous foramen or spur is referred to as a spinous foramen or spur.

DeVilliers (1968: 106-107) attributes the formation of pterygo-spinous and pterygo-alar bars to partial ossification of the pterygoid fascia "which lies between the medial and lateral pterygoid muscles and extends posteriorly, inferiorly and laterally from the posterior margin of the lateral pterygoid plate". DeVilliers (1968: 107) cites Woodburne's (1957) statement that the reinforced upper border of the fascia represents the pterygo-spinous and pterygo-alar ligaments.

DeVilliers (1968: 108) states the incidence of pterygo-foramina or spurs is more frequent on the left than the right side among the American Negro, White, Hawaiian and Mongoloid series.* The reason for ossification of ligaments is uncertain, although DeVilliers (1968: 108) states there is an association between the ossification of both pterygospinous and pterygoalar ligaments. She goes on to say that a genetic factor may possibly be involved, causing some individuals to show a greater tendency for ossification of certain ligaments which normally do not ossify (DeVilliers 1968: 108).

Ossenberg (1969: 18) records other variations in this area including spino-basal foramen, a large foramen (probably for a diploic vein) opening out of the sphenoid bone just

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* DeVilliers (1968: 270-271) has indicated in chart form the percentage incidence of pterygo-spinous and pterygo-alar bars in man, incorporating statistics from previous studies of this variant.

lateral to the root of the pterygoid process and lamina situated antero-laterally to the foramen ovale. In the present study the incidence of a bony bar bridging foramen ovale from its medial to lateral aspect has been noted. This variation was present in the Ossossané population.

Vesalian foramen: Wood-Jones (1930-31: 190) attributes the presence of a vesalian foramen to the following factors: a subdivision of the foramen ovale by a narrowing of the orifice into posterior and anterior compartments, the latter of which constitutes the vesalian foramen, a replacement of the venous outlet of the foramen ovale by the vesalian foramen (in which case a small foramen ovale exists) or simply, the addition of a medial venous foramen (vesalian foramen). Wood-Jones (1930-31: 190) goes on to say that if the vesalian foramen (which occurs in no primate other than man) exists as a subsidiary venous channel, it may assume a variety of forms, both in size and location.

The Vesalian foramen, otherwise known as the sphenoidal foramen, is usually situated anteromedially to the foramen ovale and may communicate by various degrees with the foramen ovale. The vesalian foramen may exist on one or both sides of the skull. Wood-Jones (1930-31: 190) notes that the foramen ovale is usually smaller on the side or sides on which the vesalian foramen is present. It is also noted by Wood-Jones (1930-31: 189) that the asymmetry in size and shape between the foramen ovale on the two sides of the skull depends upon the same factors or is correlated with asymmetry of the vesalian foramen.

Ovale-spinosum: (Incomplete foramen ovale)

Normally, the foramen ovale and foramen spinosum are two separate structures. It may happen, however, that the postero-lateral wall of the foramen ovale is incomplete, making this foramen continuous with the foramen spinosum (Berry and Berry 1967: 369). After Wood-Jones (1930-31) the intermediary stages range from a mere notch to an almost complete foramen.

Anterior condylar canal: (foramen hypoglossi)

By looking inside the foramen magnum, one may observe a canal which pierces the anterior portion of the occipital condyle. This anterior condylar canal transmits the hypoglossal nerve (Berry and Berry 1967: 368). As well, it constitutes the entrance for the meningeal branch of the ascending pharyngeal artery. The canal may be split into separate segments by one or more bony septa. Separation may be incomplete. Berry and Berry (1967) state that embryologically the hypoglossal nerve originates from several segments and may be responsible for the division of the canal.

Posterior condylar canal: Immediately posterior to the occipital condyle lies the condylar fossa. The posterior condylar canal, transmitting an emissary from the sigmoid sinus, pierces this fossa. Berry and Berry (1967), examining this variant for its being patent or open, note that the canal may end "blindly in the bone" and have therefore scored it as patent only when a seeker can be passed through it. Other observers including Anderson (1968) and Webb (1969) have scored for the presence or absence of this variant. Such has been the approach taken in this study.

Wood-Jones (1930-31: 195) states that the "posterior condyloid foramen is a distinctive human possession" and its existence is independent of the condylar fossa. Wood-Jones (1930-31: 195) goes on to say that a well developed fossa may exist without perforation and that these two variants may therefore be recorded independently. No recognition of the condylar fossa was made in this analysis.

Berry and Berry (1967: 368) note the fragile nature of the condylar fossa and state that scoring for a patent canal is often difficult in damaged skulls, since a patent canal and broken fossa may be confused.

Occipital Condyle form: The articular surface of the occipital condyle may be variable in shape. These forms include oval, hour-glass shape, or a complete division into two discrete condyles. Anderson (1968) and Berry and Berry (1967) record double-faceted condyles. Webb (1969) notes the incidence of hour-glass condyles.

Precondylar tubercle: Berry and Berry (1967: 368) define a precondylar tubercle (in the area of attachment for the atlanto-occipital membrane and the anterior longitudinal ligament) as a bony prominence lying immediately anterior and medial to the occipital condyle. Occasionally, this prominence is a facet for articulation with the anterior tubercle of the atlas.

Broman (1957), after Le Double (1903), notes the various relationships of the precondylar tubercle to the occipital condyle. As well, he states "...a review of the literature shows that there may be more than one type of tubercle called precondylar, and that all types have not been included by each author" (Broman 1957: 126).

Various theories have been put forward regarding the factors of causation of the precondylar tubercle. These include the following: that the precondylar tubercle is formed during the development of the occipital bone (postulated by Kollman 1905*; Bolk 1921*), that the ossification of certain ligaments during adult life results in a precondylar tubercle (postulated by Charles 1893*), that artificial cranial deformation may lead to the formation or alteration of size of the precondylar tubercle. Broman (1957) notes that the theories regarding formation are not mutually exclusive. He postulates that a discrete precondylar tubercle, showing no predilection for race or sex, appears during adult life (presumably the result of ossified ligaments) and that a precondylar tubercle continuous with the occipital condyle is manifested in the early development of the occipital bone. This latter type shows varying incidences for race and sex (Broman 1957: 125-135).

Ossified apical ligament: Occasionally, the apical ligament, extending from the tip of the dens to the anterior margin of the foramen magnum, ossifies. Usually this protuberance is very small, although Melbye (1969) notes its presence, among the Robinson People, in the form of a tubercle.

That there appears to be a general inherited tendency in some individuals for certain ligaments to ossify, may explain the occurrence of this trait (DeVilliers (1968: 119).

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* These works have been referred to by Broman (1957). Full bibliographic information may be obtained from the article in the American Journal of Physical Anthropology, volume 15, no. 1, pp. 125-135.

Paramastoid process: DeVilliers (1968: 96) defines this variant as an "occasional process which descends from the jugular process of the occipital bone to the transverse process of the atlas". It ranges from a small tubercle to larger processes, some bearing a facet for articulation with the atlas (Ossenberg 1970). These are reported to occur as a constant feature in the 21-82 mm. embryo(Ossenberg 1970: 362 after Ingelmark 1947).

DeVilliers (1968: 97) cites Le Double's work (1906) in which he states that this process occurs both in males and females and in "all races". DeVilliers (1968: 97), summarizing the works regarding percentage incidence of this trait, concludes "...the paramastoid process is extremely rare in the Negro, Caucasoid and American Indian series thus far examined". It is added that Shima's study (1955) results in an incidence of 90.9% for a series of 188 Mongoloid crania, suggesting that he has perhaps included a large jugular process of the occipital in his scoring of the paramastoid process (DeVilliers 1968: 97).

Regarding the etiology of this character, DeVilliers (1968: 119) attributes a "fairly simple genetic basis".

Sagittal sinus direction: It was Laughlin and Jørgensen (1956) who first employed this non-metrical feature in studies of inter-group relationships. The direction of the superior sagittal sinus on the endocranial aspect of the occipital bone may be right, left or divided (Laughlin and Jørgensen 1956: 7). The sinus turns at the level of the external occipital protuberance to become the transverse venous sinus. If the direction is divided, a confluens sinuum is formed, with common right and left lateral venous senuses (Street: personal communication). In this study, a right directed sagittal sinus was employed as a trait for population comparison.

Parietal foramen: The parietal foramen transmits a small emissary vein from the superior sagittal sinus and sometimes a small branch of the occipital artery (Berry and Berry 1967: 366; DeVilliers 1968: 103). It is located on the parietal bone near the sagittal suture, "a few centimetres in front of the lambda" (Berry and Berry 1967: 366). The point "obelion"--dependent on the presence of the parietal foramina--is defined as "the meeting point of the sagittal suture with the transverse line connecting the two parietal foramina" (Olivier 1969: 179).

Parietal foramina, if present, may exceed one in number. DeVilliers (1968: 103) notes that for the South African series, three or four foramina on both sides are rare. It is also noted that intertribal and sex differences occur in the South African series, but the differences are not significant by chi-squared testing at the 0.01 level (DeVilliers 1968: 104). Observations on the incidence of parietal foramina in "racial groups" and anthropoid apes are made by DeVilliers (1968: 269). Generally, the pattern of parietal foramina in man and anthropoid apes is one or two foramina, the former being on one side or the other rather than the midline.

Regarding the etiology of this trait, DeVilliers (1968: 105) states that Pepper and Pendergrass attribute the recurrence in successive generations of very large parietal foramina to "an erratic hereditary anomaly of ossification". DeVilliers (1968) suggests a similar genetic mechanism could be responsible for the presence or absence of normal foramina. Hertzog (1968) refers to Hess' (1946) work in which he suggested that the presence of "inconstant foramina and accessory ossicles represent manifestations of the same phenomenon" (Hertzog 1968: 398). Hertzog (1968: 398) after Padget (1956) accepts the presence of parietal foramina as representing imperfect closure of the sagittal fontanelle.

In his study regarding the associations between discontinuous cranial traits at circumparietal areas, Hertzog (1968: 400) noted that parietal foramina have little, if anything, in common with the other variants including presence or absence of an ossicle at asterion, presence or absence of a parietal notch, presence or absence of an ossicle at lambda, presence or absence of ossicles in the lambdic suture between asterion and a point in the suture half-way between asterion and lambda, presence or absence of ossicles in the lambdic suture between lambda and a point half-way between asterion and lambda, and finally the presence of an epipteric ossicle and/or fronto-temporal articulation.

<u>Coronal wormians</u>: Brothwell (1963: 97) defines wormian bones as accessory (sutural) bones of the skull. They may be referred to as supernumerary or sutural bones, ossicles or inclusions. The number of wormian bones may vary from one to many. These inclusions are usually most common in "complicated sutures", for example the lambdoid.

Bennett (1965: 256) quotes Inkster's (1953) definition of wormian bones as

> ...isolated bones of variable size and shape occasionally met with in the sutures and at the fontanelles. They are ossified from independent centers and usually include the whole thick-

> ness of the cranial wall, but
> they may involve only the outer
> or the inner table.

Melbye (1969: 72) makes a distinction between accessory bones, arising from "separate centres of ossification" and wormian bones "in which the suture has interdigitated and left small islands of bone". Melbye (1969) records as accessory those bones which are apparent on the inner table of the skull. Kellock and Parsons (1970: 412) define sutural bones or ossicles as those arising from "extra centres of ossification" or from "increased segmentation of the membrane and cartilage anlages of the cranium". Bones arising from both causes are included in Kellock and Parson's (1970) study and are not distinguished.

Wormian bones occurring in the coronal suture are said to be "quite rare" (Brothwell 1963; Bennett 1965). DeVilliers (1968: 106) states that, as a rule, coronal wormians are of a small size.

Regarding the etiology of wormian bones in general, it has been proposed that "stressful conditions" result in the expression of wormian bones (Dorsey 1897 quoted in Bennett 1965: 255). Kwakiutl cranial bandaging supposedly prevented normal fronto-parietal development and caused elongation of the skull along with a higher percentage frequency of wormian bones.

Hess (1946) offered an explanation of "metabolic disorder of the mesoderm" and stated that wormians and other "abnormalities of the skeleton" could be included under the rubric of "hypostosis" or bone formation deficiency (Bennett 1965: 255). Both Angel (1952)(cited by Brothwell 1959: 105) and DeVilliers (1968) claim that wormian bones are dependent upon a genetic background. Torgersen (1954) claims that wormian bones are inherited as dominant traits with a penetrance of about 50% (Brothwell 1963: 97). Bennett (1965) however, does not support Torgersen's claim, stating that penetrance, as an explanation, is inconclusive and that evidence of wormian bones acting as genetic equivalents is lacking. Bennett (1965:255) suggests that wormian bones are not under direct genetic control but "represent secondary sutural characteristics which are brought about by stress".

Bregmatic bone: Supernumerary bones occurring at the junction of the coronal and sagittal sutures are referred to as bregmatic bones. They occur at the point bregma, the original site of the frontal, bregmatic or anterior fontanelle. Although Berry and Berry (1967) refer to the bregmatic bone as the interfrontal bone, Brothwell (1963: 98) depicts the interfrontal bone as a distinct entity occurring on the metopic suture.

In Hertzog's (1968: 401) discussion of overlapping regionalism of factors producing discontinuous variants in the skull, he suggests that "variation in the volume of the contents of the neurocranial capsule" may be a factor in producing variation in the anterior portion of the skull. Hertzog goes on to say that anterior brain size affects the size of the anterior fontanelle and fontanellar ossicles (at bregma) are more likely to be found in "unusually large fontanelles" (1968: 401 after Schultz 1923).

Hertzog (1968: 401) refers to Schultz's (1923) and Girdany and Blank's (1965) observations that there is a marked sex difference in the occurrence of bregmatic ossicles.

Sagittal wormians: These are inclusions in the sagittal suture. Regarding their frequency, Brothwell (1963: 97) states sagittal wormians are rare. DeVilliers (1968: 106) observes that sagittal wormians are not large and are commonly paired.

The etiology of these wormians has been dealt with in the section on "coronal wormians".

Lambdoid wormians: One or more ossicles may occur in the lambdoid suture. Berry and Berry (1967: 366) state that up to twelve distinct bones may be present on either side of lambda. Bennett (1965) points out that lambdoid wormians are usually not evenly distributed along the entire length of the lambdoid suture. Even distribution may be the case in a hydrocephalic cranium, however, "where normal ossification of the membraneous bones of the skull is prevented by an abnormal increase in the amount of cerebral fluid" (Bennett 1965: 259). It is important to note that those supernumerary bones occurring at lambda and asterion are excluded from the observations of lambdoid wormians.

Bennett (1965) notes that basi-occiput length as a stress factor apparently affects variants at sites along the posterior margin of the parietal bone. It has been noted that the "variable expressivity" as well as the formation of the lambdoid wormians may be due, generally, to the type and amount of stress on the lambdoid suture during late fetal and early post-natal periods of growth (Bennett 1965: 259). Bennett and Hulse (1966) and DeVilliers (1968) accept that lambdoid wormians are genetic in origin. Bennett (1965: 259) qualifies his earlier claim (1964 published 1966--see Bennett and Hulse 1966), stating that it is doubtful whether lambdoid wormians are inherited per se, but that their existence depends on the genetic factors controlling growth and development of the cranial base--especially the basi-occiput.

Lambdic bone: Bones occuring at the junction of the sagittal and lambdoid sutures or the position of the posterior fontanelle are lambdic bones. Anderson (1963) defines the lambdic bone as a small triangular accessory bone. Ossenberg (1970) includes median wormians and the large triangular os apicus (os triquetrum sui apicis) in this category. Hertzog (1968) and Bennett (1965) state there are probable etiological and genetic differences between lambdoid wormians and lambdic bones.

The Os Inca or inter-parietal bone is a variation occurring at lambda, resulting in a separate bone isolated by "an anomalous biasterionic suture" (Ossenberg 1970: 360). Berry and Berry (1967) have made no distinction between wormians occurring at lambda and a "true interparietal" or Inca bone resulting from ossification of the membraneous portion of the occiput. Hertzog (1968) notes that various types of incomplete interparietals exist. The categories for observation in this study allow for a distinction between a lambdic bone and an Os Inca, however, the present analysis takes into account the occurrence of any ossicle at lambda.

Bennett and Hulse (1966) employ the Inca bone as a non-metric trait to test interpopulation similarity. They state that the incidence of the trait in a comparative series of four populations tends to point out microevolutionary change. Their speculations are based on the established claim of Hepburn (1908) that the trait has a genetic basis (Bennett and Hulse 1966: 375). Torgersen (1951a: 382) states that "interparietal bones and the metopic suture partly behave as manifestations of the same hereditary factors".

Pterion shape: The pterion is the region of contact of the frontal, parietal, sphenoid and temporal bones (Anderson 1969: 111). The observation made in this and other studies regarding pterion shape is the form of contact on the external surface of the skull.

DeVilliers (1968) discusses six sutural patterns at pterion, including the most common "H" form (when parietal and sphenoid bones are in contact and separate the other two bones from each other), an "H"-narrow (when contact occupies only a few millimetres rather than one centimetre as in pterion "H" outlined above), an "X" type of arrangement or stellate form (when sphenoid, parietal, temporal and frontal contact at one point), an "I" form (when frontal and temporal bones meet, excluding parietal and sphenoid), a "K" type of arrangement (when temporal and frontal bones contact) and finally, an epipteric ossicle form (in which a separate bone is formed in the anterolateral fontanelle. It is held that an epipteric bone, rather than being a sutural bone, is formed from its own centre of ossification (Murphy 1956). Four of these specific arrangements have been examined in this study--an "H" form, an "X" form, a "K" form, and an epipteric ossicle form. As well, a category for "other observations" has been included.

Brothwell (1963: 95) states that age, sex and side of the skull observed appear to have no influence on the type of contact. Murphy (1956: 239) regards both genetic and mechanical factors as contributing to the pterion shape. He states "the type of pterion is determined by the degree of relative growth of the pteric bones, forming varying sutural patterns" (Murphy 1956: 239). Brothwell (1959: 105) refers to Torgersen's (1954) claim that the occurrence of an epipteric bone "seems to be genetically controlled".

Berry and Berry (1967) employ the presence or absence of a fronto-temporal articulation as one of their epigenetic variants. Webb (1969) records for presence or absence of an anomalous pterion, whereas Melbye (1969) records for an "H" pterion. The latter observation was controlled for in this study. As well, an observation for "epipteric bone" was made; hence, the conditions pterion shape (A) and pterion shape (B) may be observed in this analysis.

Parietal notch: At the intersection of the parieto-mastoid and squamous sutures, a notch of bone or a separate ossicle may be observed. Laughlin and Jørgensen (1956: 7) refer to Weidenreich's (1943) and Akabori's (1933) studies in which both employ observations on the occurrence of parietal notches. Laughlin and Jørgensen (1956) state that the presence of a separate bone may be "more objectively reported" and have included it in their study of Greenlandic Eskimo crania. Observations of both notches and parietal notch bones have been made in the present study.

Brothwell (1963: 97) states that nothing is known of the etiology of parietal notches or parietal notch bones. Hertzog (1968), in his study of circum-parietal variants, states that there may be factors which are intermediate in scope between being general and site specific resulting in the production of discontinuous variants. These factors may operate, for example, on posterior regions of the cranium but"probably would not be shared in common with anterior sites", and vice versa (Hertzog 1968: 401-402).

Asterionic bone: This bone is located at asterion, the former mastoid fontanelle area. More specifically, it is located at the junction of the posterior inferior angle of the parietal bone with the occipital and the mastoid portion of the temporal (Berry and Berry 1967: 368).

(111) Cranial Morphology concluded

Mastoid foramen: Berry and Berry (1967) and Webb (1969) give the most common location of the mastoid foramen as in the suture between the mastoid portion of the temporal and the occipital. The variants of this trait include absence of a foramen and presence of single or multiple foramina. In the latter case, two is the usual number.

Regarding the underlying cause of multiple foramina, DeVilliers' (1968: 126) statements are noteworthy. In a discussion of Riesenfeld's (1956) claims regarding ethmoidal, infraorbital and mental foramina, DeVilliers states that if one examines individual crania, "it is clear that a tendency to multiple foramina in one area is often accompanied by similar tendencies in one or more of the other areas" (DeVilliers 1968: 126). She goes on to say: "This finding suggests that the mechanism responsible for the occurrence of multiple foramina probably affects the skull in general" (DeVilliers 1968: 126). An experimental procedure for examining the relationship of multiple foramina in individual skulls has not been undertaken here, but is recommended as a worthwhile study for future investigations of this nature.

Mastoid foramen position: The most common location of this foramen, as mentioned, is on the suture between the mastoid part of the temporal bone and the occipital bone. Berry and Berry (1967: 368) state that "less frequently it lies exsuturally, piercing the mastoid part of the temporal, or, more rarely, the occipital bone". In this study one occurrence of the foramen piercing the temporal bone proper has been recorded.

Divided mastoid: The mastoid process of the temporal bone may be bisected by a suture separating the bone into anterior and posterior segments.

An explanation for the retention of this suture may follow from Torgersen's (1951 a) statements. He suggests that, from the point of view of genetics, the sutural pattern of the skull must be considered as a whole. He further postulates that there are two groups of genes influencing this sutural pattern; "one determining the situation of the ossification centres and the sutures and another determining the rate of obliteration" (Torgersen 1951 a: 381). It follows, therefore, that certain sutures may tend to remain open if they have not closed at a particular stage in development.

Tympanic dehiscence: The floor of the canal of the external auditory meatus is formed by a tympanic plate. This plate may show a defect or error of ossification called a tympanic dehiscence, foramen of Huschke or perforation of the tympanic plate. DeVilliers (1968) gives a somewhat detailed statement regarding the formation of the tympanic dehiscence. Prior to birth, the temporal bone consists of a squamous portion, a petromastoid portion and a tympanic ring. After birth, the tympanic ring grows backwards and laterally to form the tympanic part of the temporal bone. Growth occurs most rapidly on the anterior and posterior portions of the ring, hence the distal parts meet and blend, while there remains a gap between the proximal parts. This gap usually obliterates by the fifth year, but may persist, being known as the foramen of Huschke (DeVilliers 1968: 109). Ossenberg (1970) states there is a decrease in the incidence of this trait in individuals from eight to twelve years, after which the incidence remains stable.

The presence or absence of the foramen of Huschke or tympanic dehiscence on one or both sides of the skull has been recorded. Wood-Jones (1930-31: 195) states that the foramen of Huschke is "an anomaly that is very variably developed in different racial types". Anderson (1962: 152) states that the incidence of this "defect in the tympanic plate" varies from zero to 55% in different populations studied. Among the Fairty population, Anderson (1962) found a 39% incidence. DeVilliers (1968: 119) attributes "a fairly simple genetic basis" to the tympanic dehiscence. Anderson (1962: 152) states that the trait is "presumably due to a genetically determined error of ossification".

Tympanic thickening: The external opening of the external auditory meatus may be round, oval or slit-like. The tympanic plate, forming the floor of the auditory canal "may be unduly massive or unduly thin...; in the one case forming a thick bony mass surrounding the lower aspect of the meatus; in the other being present merely as a linear edge of a thin bony wall of the tube" (Wood-Jones 1930-31: 195).

DeVilliers (1968) notes that various degrees of development ranging from a delicate tympanic to a massive variety exist for the South African samples. Whereas females are more likely to display a delicate variety, males are more likely to display massive tympanic plates. DeVilliers (1968: 93) notes, however, that these sex differences are not significant by the chi-squared test at the 0.01 level.

DeVilliers (1968) refers to Stewart's (1933) study in which he found distinct racial differences in the form of the plate. Stewart's (1933) cited conclusions (see DeVilliers 1968: 94) are as follows:

> ...the thickened tympanic plate of the Eskimos and related groups is a hereditary character. Similarly, the varying development of this plate in other groups is also hereditary, although possibly secondarily influenced by irregular ossification resulting from diet or disease.

Arthritis--condylar fossa: Arthritis, a degenerative bone disease, is a manifestation of pathological changes in bone. According to Brothwell (1963), trauma may explain a few cases. As well, diseases, dietary disturbances, ageing and general "wear and tear" may be causative factors.

Brothwell (1963) points out two types of arthritis--rheumatoid and osteo-arthritis. The former, showing no clear cause, is perhaps associated with infection and manifests itself in individuals between twenty and forty years of age. It is more common in females. Sandison (1968: 219) states that rheumatoid arthritis "appears to have an entirely different aetiology" from osteo-arthritis. Brothwell (1963: 144) states that joints of the hands and feet are most commonly affected by this form of arthritis. It may safely be assumed therefore, that the type of arthritis being examined in this study is of the second class-osteo-arthritis.

This form is characterized by bony "lipping" known as osteophytosis. In advanced grades, osteoarthritic changes also include eburnation, osteophyte formation, alteration of articular surface contour and sclerosis of subchondral bone (Sandison 1968: 219).

Brothwell (1963: 145) reports that osteo-arthritis of the temporo-mandibular joint was found in Neanderthal man.

Brothwell goes on to say that "the main features are a flattening and roughening of the glenoid fossa and condyle of the mandible". Reported causes are "mechanical" and include severe dental wear, rigorous mastication and sometimes malocclusion (Brothwell 1963: 145). Presumably a statistically high incidence of arthritis would be indicative of cultural factors.

Arthritis--occipital condyle: The possible causes for arthritis have been dealt with in the previous section. Presumably "wear and tear" would cause strain on the occipital condyles and articulating vertebra (the atlas). It is doubtful that osteo-arthritis is hereditary. It is significant in a study of this sort however, as a possible indicator of cultural habits.

(IV) Mandible

Chin form: The chin form may be expressed as one of the following: median (tapered to the midline), bilateral or squared (with bilateral terminal prominences) and medio-bilateral (a combination of the two previous types). Wright and Anderson (1963) characterize the Iroquois physical type as possessing a median type of chin, while the pre-Iroquoian type (eg. Donaldson) is said to possess a bilateral form.

DeVilliers (1968) outlines the determination of chin form as follows:--the external surface of the mandible is marked by a faint ridge which indicates fusion of the two mandibular halves. Inferiorly, the ridge divides to enclose the trigonum mentale. "The mental protuberance is the median upward prolongation of this mental trigone, the base of which is raised at the sides to form the mental tubercles" (DeVilliers 1968: 146). Above the protuberance is a marked hollow which deepens on either side of the midline into the "fossa mentalis". "The relative development of the components (mental protuberance and mental tubercles) of the trigonum mentale and of the fossa mentalis determines the shape of the chin" (DeVilliers 1968: 146).

DeVilliers (1968) has found that chin form displays a sexual dimorphism in the South African samples. Generally, a square chin was found to be a feature of males, while a "round chin" (corresponding with "medio-bilateral") was characteristic of females.

Mandibular torus: Woo (1950: 96) defines the torus mandibularis as an "hyperostotic formation on the lingual surface of the mandible between the alveolar border and mylohyoid line". It may occur uni- or bilaterally and is usually restricted to the premolar and molar regions, although Moorrees *et al*. (1952) report its occurrence near the roots of the canine and premolars. Brothwell (1963: 97) after Broek (1943) states that the mandibular torus consists of compact osseous tissue with a restricted number of Haversian canals.

Moorrees *et al*. (1952) state that the dimensions of this trait increase with age. It therefore seems plausible that environmental factors (including functional demands) may affect its expression (eg. Hrdlička 1940--see DeVilliers 1968). However, the study carried out by Moorrees, Osborne and Wilde (1952) tests the concept of a hereditary rather than a functional basis for the exostosis. Moorrees *et al*. state that studies carried out in the first half of this century suggested that genetic rather than environmental factors were responsible for the causation of the mandibular torus, but these studies "offered no evidence in support of [this] point of view" (Moorrees *et al*. 1952: 320). The study of Moorrees *et al*. (1952), dealt with familial incidence of the trait and led to the conclusion that "a complex rather than a simple mode of inheritance is indicated" (Moorrees et al. 1952: 327). Bennett and Hulse (1966: 374) after Klatsky (1956) support the contention that genetics is involved in the expression of this trait. DeVilliers (1968: 160) states that the exact mode of inheritance for the torus mandibularis is not yet known. She supports Scott's (1957) suggestion that environmental and hereditary factors are components in the expression of this variant (DeVilliers 1968: 160). Besides genetic and functional factors, pathology and deficient diet and avitaminosis have been offered by Mellquist and Sandberg (1939) and Van den Broek (1945) respectively as causes for the mandibular torus (DeVilliers 1968: 159).

DeVilliers (1968: 159) reports Hrdlička's (1940) findings that the trait is most common in the Mongoloid groups and the rarest in the Caucasoid, Australoid and Negroid groups.

Gonial eversion: "The angle of the mandible may be curled inwards (inversion), flat, or flared outwards (eversion)" (Anderson 1969: 114). The degree of outward flare has been scored in this study, following the "+" system of coding.

Mylo-hyoid arch: Ossenberg (1970: 363) states that this trait, along with the pterygo-spinous bridge represents ossification of ligaments in the infratemporal fossa. Laughlin and Jørgensen (1956) were the first to study this variant. The mylo-hyoid arch is a result of ossification of the spheno-mandibular ligament at its insertion on the medial side of the mandibular ramus (Ossenberg 1970: 363). Ossenberg (1970) states the arch may range from 2-25 mm. in length, whereas Laughlin and Jørgensen (1956) state it ranges between 2 and 1 mm. in length.

Ossenberg (1970) offers an hypostotic-hyperostotic dichotomy as an analytic framework for understanding non-metric traits of the skull. The mylo-hyoid arch is an example of hyperostotic traits. These are characterized by "an excess of ossification over the non-anomalous condition; ie., ossification into structures normally cartilage, ligament or dura" (Ossenberg 1970: 358). Perhaps a genetic basis may be ascribed to the mylo-hyoid arch, if this information and the following statement of DeVilliers are taken into account. "...a genetic factor may be involved, inducing in some individuals a greater tendency towards ossification of specific ligaments which normally do not ossify" (DeVilliers 1968: 108).

Accessory Mandibular foramen: The mandibular foramen on the ramus of the mandible, provides entrance for the inferior alveolar vessels and nerve. Frequently, the foramen may be duplicated and in that case, is scored as accessory.

Accessory mental foramen: Brothwell (1963: 97) defines mental foramina as "two elliptical holes on the outside of the mandible situated about twelve millimetres below the second premolar on each side". The number of foramina on each side of the mandible is usually one, although there may be more. These accessory foramina are of two types which Murphy (1957) calls major and minor (DeVilliers 1968: 148). The minor variety, which Le Double (1906) postulates results from ossification of a fibrous ligament, commonly lies on or within the rim of the main foramen and is separated from it by a "tongue of bone" (DeVilliers 1968: 148). Often this form is not easily visible (DeVilliers 1968: 148). The major foramen is a distinct structure located antero-superior, postero-superior, posterior or inferior to the main foramen (DeVilliers 1968: 148). Le Double (1906) suggests a persistence of the "canal de Serres" as the causative factor for the major variety (DeVilliers 1968: 148). The present study does not distinguish a major from a minor variety of accessory foramina, rather includes any observable accessory structure.

Riesenfeld (1956), in a study of multiple infraorbital, ethmoidal and mental foramina in man, concluded that the numerical variability of mental foramina is much less than that of ethmoidal and infraorbital foramina. He states that the latter two foramina may vary in number from one to five, whereas the mental foramina vary from one to three only (Riesenfeld 1956: 96). Because of this discrepancy, and a further one with respect to "side" occurrence, Riesenfeld (1956: 98) concludes that the number of foramina in the facial and mandibular area is determined by different causes.

DeVilliers (1968: 150) refers to earlier works in which it has been postulated that the presence of accessory mental foramina is evidence of "primitivity".

DeVilliers (1968: 300) summarizes, in chart form, the incidences of multiple mental foramina for various ethnic and racial groups and for the great apes. African, American and Oceanic Negroids, and Australian aborigines share the highest incidence of multiple mental foramina in man, while the Caucasoid groups show the lowest incidence. Mongoloid series display frequencies intermediate to these two categories (DeVilliers 1968: 149-150).

Regarding the genetic component of this trait, DeVilliers (1968: 150-151) states she has found "no reference to genetic studies on this character" but states that the racial incidence of the trait may suggest a genetic basis.

Other morphological observations of the mental foramen include direction and position. DeVilliers (1968), incorporating the findings of Montagu (1954), has included discussions of these observations in her study. These observations have not been included in the present analysis.

Arthritis-mandibular condyle: see section on Arthritis--Condylar fossa

CHAPTER 4

METHODOLOGY AND TECHNIQUES

Methods and techniques used in this study are considered under the following headings:

(I) General Techniques
(II) Statistical methods

(I) General Techniques

The present study of non-metrical morphological traits employs an established University of Toronto (Physical Anthropology Laboratory, Skeletal Biology Division) data codification form. This form includes accepted and selected cranial traits and a corresponding system of coding including both alphabetics and numerics (0-9 inclusive). This coding form allows recording of continuous and discontinuous (discrete) traits. The data acquired in the course of this study will be available at the University of Toronto data bank for future study.

The scoring of traits was transferred to data cards for future computer use. In all cases, there was one trait to a column. A column-count computer programme established by James Webb (University of Toronto) was used in this study.

Analysis of the data involved collapsing, or reducing, to a two-state present/absent dichotomy for Chi-squared tests. Data were collapsed by obtaining the median of all observations for a particular trait. Observations were then distributed so as to maximize the value in each cell.

In the following section are described the columns of the data card indicating method of recording and coding into two-state characters where necessary. Some traits were recorded as having more than two states but these were all subsequently reduced to two states only. It will be noted that in many instances not all of the possible codes were used. This is because the material analysed did not exemplify all of the possible conditions. The code represents all of the conditions found in the three Iroquoian populations.

Three cards (C,D, and E in University of Toronto usage, allowing for morphological observations on the skull) were used in this study. Columns 1-10 are the same for cards C, D, and E. Differences in card content after column 10 will be dealt with separately. For each specimen the following information was recorded when possible.

Column 1: Card Data Identification

The programme includes data sets from A-Z. This study involved the use of the following:

C=Cranial Morphology (continuing)
D=Cranial Morphology (concluded)
E=Mandible

Column 2: Sex

0-Indeterminate
1=Male
2=Female

Column 3: Age

0=Indeterminate Child
1=under 2 years
2=2-6 years
3=6-12 years
4=12-18 years
5=young adult (18-35 years)
6=middle aged adult (35-55 years)
7=old adult (older than 55 years)
8=indeterminate adult
9=unknown or indeterminate

Both ageing and sexing followed the patterns outlined by Brothwell (1963), Anderson (1969), and Olivier (1969).

Columns 4-7: Group Number

This indicates the number assigned to the site and is "roughly equivalent of a component of a site". (Data Codification Form)

5035=Shaver
5043=Carton
5044=Ossossané

Columns 8-10: Burial

In this study these columns designate individuals within the group or more commonly individual fragments.

Columns 11-76: Card C=Cranial Morphology

9=trait present without qualification
no punch=area absent or trait indeterminate

Column 11 Metopic suture (met.)

0=absent
1=trace
2=half
3=complete

two-state code: 1 + 3/0: Metopism/no metopism

The "2" code did not apply in this analysis and has therefore been omitted from the two-state code.

Columns 12 and 13: Right Frontal Grooves (fr. gr.)
Left Frontal Grooves

In all cases where traits may occur bilaterally, the coding form allows a column in which the presence or absence may be recorded for each side. This study does not control for side differences, consequently pooled values are referred to in subsequent analyses and incidences are given in terms of "sides" rather than "skulls".

9=present
0=absent

This system of coding will be used for other bilaterally occurring discrete traits.

Column 14: Brow shape (br. shpe)

0=absent
1=discontinuous
2=straight
3=V-shaped

two-state code: 3/0+1: V=shaped/no V-shaped Brow Ridge

Once again, the "2" code did not appear in this data, and has therefore been omitted from the two-state code.

Column 15: Brow rugosity (Brow rug.)

0=absent
1=+ (trace of rugosity, more often felt than seen)
2=++ (slight degree of rugosity)
3=+++ (moderate degree of rugosity)
4=++++ (marked degree of rugosity)

In this study, the ++++ state was used as an optimal level and consequently never occurred. The limitations of this technique in subjective coding will be dealt with in a later section of this thesis.

two-state code: 2+3/0+1: Presence of rugosity/no rugosity

Columns 16 and 17: Right supraorbital notch and/or foramen (supraorb)
Left supraorbital

0=absent
1=one foramen present
2=two foramina present
3=one notch present
4=two notches present
5=both a foramen and a notch present

two-state code: 2+4+5/0+1+3: Multiple supraorbital openings/single or no supraorbital openings

Columns 18 and 19: Right supratrochlear notch and/or foramen (supratroch)
Left supratrochlear

0=absent
1=notch
2=spur
3=foramen

two-state code: 1+2+3/0: Presence of supratrochlear notch or foramen/no supratrochlear notch or foramen

Columns 20 and 21: Right extra ethmoidal foramen (extra eth. for.)
Left extra ethmoidal foramen

0=absent
1=one foramen
2=two foramina
3=three foramina
4=four foramina

This system of coding will be used for other bilaterally occurring traits.

two-state code: 1+2+3+4/0: presence of foramina/absence of foramina

Columns 22 and 23: Right anterior ethmoidal foramen position
Left anterior ethmoidal foramen position
(ant. eth. for. pos'n)

1=suture
2=frontal
3=ethmoid
6=fused

two-state code: 1/2: foramen on suture/foramen not on suture

In this study, a "6" code (fused) is interpreted as an indeterminate case and has been ignored. As well, an anterior ethmoidal foramen was never located on the ethmoidal bone, so the "3" code was not included in the two-state collapsed condition.

Column 24: Nasal aperture form (nasal apt. form)

1=pyriform
2=inverted heart

3=equilateral triangle

two-state code: 1/2: pyriform/non-pyriform

In this study, none of the skulls exemplified an equilateral triangle nasal aperture form, this coding therefore being omitted in the two-state condition.

Column 25: Nasal profile (nasal pro.)

1=concave
2=convex
3=straight
4=concavo-convex

two-state code: 1/4: concave/non-concave

Neither a straight nasal profile nor a convex nasal profile were noted for the three populations under study here and were therefore not included in the two-state code.

Columns 26 and 27: Right infraorbital foramen (infraorb. for.)
Left infraorbital foramen

1=one foramen
2=two foramina
3=divided

two-state code: 1/2+3: single opening/multiple opening

Columns 28 and 29: Right zygomatic facial foramen (zygom. fac. for.)
Left zygomatic facial foramen
Coding as for columns 20 and 21

two-state code: 1+2+3+4/0: presence of foramen/absence of foramen

Columns 30 and 31: Right Os Japonicum
Left Os Japonicum
9=present
0=absent
1=trace

two-state code: 9+1/0: os japonicum/no os japonicum

Columns 32 and 33: Right malar tubercle (mal. tub.)
Left malar tubercle
Coding as for column 15

two-state code: For this trait, as for brow rugosity, the ++++ state was employed as the optimal level and codification in this form did not occur.

2+3/0+1: Presence of tubercle/absence of tubercle

Columns 34 and 35: Right zygomaxillary tubercle (zygom. tub)
Left zygomaxillary tubercle
Coding as for column 15

Once again, the ++++ state did not occur.

two-state code: 1+2+3/0: tubercle present/tubercle absent

Columns 36 and 37: Right marginal tubercle (marg. tub.)
Left marginal tubercle
Coding as for column 15 (no ++++ state)

two-state code: 2+3/0+1: Marginal tubercle/no marginal tubercle

Column 38: Palatine torus (palatine tor.)
Coding as for Column 15

two-state code: 1+2/0: palatine torus/no palatine torus

The +++ and ++++ states did not appear and have therefore been omitted from the two-state code.

Columns 39 and 40: Right maxillary torus (max. torus)
Left maxillary torus
Coding as for Column 15

two-state code: 1+2/0: presence of torus/absence of torus

The +++ and ++++ states did not appear in this analysis and have therefore been deleted from the two-state code.

Columns 41 and 42: Right lesser palatine foramen (lesser pal. for.)
Left lesser palatine foramen
Coding as for columns 20 and 21

two-state code: 2+3+4/0+1: presence of lesser palatine foramen/absence of lesser palatine foramen

Columns 43 and 44: Right pterygo-foramen (pterygo. for.)
Left pterygo-foramen

0=absent
1=basal spur
2=basal foramen
3=spinous spur
4=spinous foramen
5=both basal and spinous spur
6=both basal and spinous foramen

A basal spur (foramen) was one which appeared lateral to foramen ovale and foramen spinosum. A spinous spur (foramen) was one which appeared posterior to foramen spinosum.

This trait was collapsed in two ways, hence pterygo-foramen (A) and pterygo-foramen (B). The first condition represents the presence/absence of a basal spur or foramen and the second condition represents the presence/absence of a spinous spur or foramen.

two-state code: (A) 1+2+5+6/0+3+4: basal spur or foramen/no basal spur or foramen

(B) 3+4+5+6/0+1+2: Spinous spur or foramen/ no spinous spur or foramen

Columns 45 and 46: Right vesalian foramen (vesalian for.)
Left vesalian foramen
Coding as for columns 12 and 13.

Columns 47 and 48: Right ovale-spinosum (ovale-spin).
Left ovale-spinosum

1=common ovale-spinosum
2=partitioned

Columns 49 and 50: Right anterior condylar canal (ant. cond. can.)
Left anterior condylar canal

1=single
2=divided
3=spur

two-state code: 2+3/1: multiple opening/single opening

Columns 51 and 52: Right posterior condylar canal (post. cond. can.)
Left posterior condylar canal

Coding as for columns 12 and 13

Columns 53 and 54: Right occipital condyles (occip. cond.)
Left occipital condyles

1=single condyle
2=double condyles
3=hour-glass condyle

two-state code: 1/2+3: single condyle present/single condyle absent

Column 55: Precondylar tubercle (precond. tub.)

0=absent
1=+
2=++
3=+++
4=++++
5=facet

two-state code: 1+3+5/0: tubercle/no tubercle

Column 56: Ossified apical ligament (ossif. apic. lig.)
Coding as for column 15

two-state code: 1+2+3/0: ossified ligament present/ ossified ligament absent

Note the absence of the ++++ state.

Columns 57 and 58: Right paramastoid
Left paramastoid
Coding as for column 15

two-state code: 1+2+3/0: paramastoid/no paramastoid

Once again the ++++ state is absent.

Columns 59-62: These columns represent clino-clinoid and caratico-clinoid variations. They have been omitted from this analysis.

Column 63: Sagittal sinus direction (sag. sin. direct.)

1=right

2=left

3=common

two-state code: 1/2

The "3" code is considered an indeterminate state and is therefore omitted from the two-state code.

Columns 64 and 65: Right parietal foramen (pariet. foramen)

Left parietal foramen

0=absent

1=one foramen

2=two foramina

3=three foramina

two-state code: 1+2+3/0: Foramen/no foramen

Column 66: Coronal wormians (coron. worm.)

0=absent

1=one wormian

2=two wormians

3=three wormians

4=four wormians

5=five or more wormians

6=fused

9=present, but the number is indeterminate two-state code: 1+2+3+4+5+9/0: wormians/no wormians

The "6" state represents an indeterminate condition and has therefore been eliminated.

Column 67: Bregmatic bone (breg. bone)
Coding as for columns 12 and 13

Column 68: Sagittal wormians (sag. worm.)
Coding as for column 66

Column 69: Lambdoid wormians (lambd. worm.)
Coding as for column 66

Column 70: Lambdic bone
0=absent
1=trace
2=Inca
3=lambdic
6=fused

two-state code: 2+3/0: presence of lambdic bone or Os Inca/no lambdic bone or Os Inca

Note that a "1" code did not appear for the material under analysis here; it therefore has been omitted from the two-state code. As well, the "6" code represents an indeterminate state and has been omitted.

Columns 71 and 72: Right pterion shape (pter. shape)
Left pterion shape
1=H
2=K
3=X

4=epipteric
5=other
6=fused

This trait was examined first for the presence or absence of an epipteric bone, and separately for an H-shaped pterion as opposed to some other configuration of the pattern; hence, the conditions of pterion shape (A) and pterion shape (B). The two-state code in each case is as follows:

(A) 4/1+2+3: epipteric bone/no epipteric bone
(B) 1/2+3: Presence of H-shaped pterion/absence of H-shaped pterion

In both states (A) and (B) a "5" code did not occur and therefore has not been included in the two-state code. Note the absence of "6"--an indeterminate state.

Columns 73 and 74: Right parietal notch (par. notch)
Left parietal notch

This trait was examined for the presence of a parietal notch--case (A) and the presence of a parietal bone--case (B). The two-state code in each case is as follows:

(A) 9/0: parietal notch/no parietal notch
(B) 1/0: parietal bone/no parietal bone

where: 9=present
0=absent
1=bone

Columns 75 and 76: Right asterionic bone
Left asterionic bone
Coding as for columns 12 and 13

Columns 11-20, 60-63: Card D Cranial Morphology

Columns 11 and 12: Right mastoid foramen (mast. for.)
Left mastoid foramen

0=absent
1=one foramen
2=two foramina
3=three foramina
4=four foramina
5=more than four foramina

two-state code: 1+2+3/0: Mastoid foramina present/no mastoid foramina

Columns 13 and 14: Right mastoid foramen position (mast. for. pos.)
Left mastoid foramen position

1=occipital
2=masto-occipital suture
3=temporal
4=parietal

two-state code: 1+2/3+4: presence of foramen on occipital or suture/absence of foramen on occipital or suture

Columns 15 and 16: Right divided mastoid (divided mast.)
Left divided mastoid

9=present
0=absent
1=suture trace

two-state code: 9+1/0: divided mastoid/single mastoid

Columns 17 and 18: Right tympanic dehiscence (tymp. dehisc.)
Left tympanic dehiscence

9=present
0=absent

This coding system will be used subsequently.

Columns 19 and 20: Right tympanic thickening (tymp. thick.)
Left tympanic thickening
Coding as for columns 17 and 18, Card D

Columns 60 and 61: Arthritis--right condylar fossa (arth. cond. fossa.)
left condylar fossa

0=absent
1=+
2=++
3=+++
4=++++

Once again, the ++++ state is optimal and has not been included in my observations.

two-state code: 1+2+3/0: arthritis/no arthritis

Columns 62 and 63: Arthritis right occipital condyles
Arthritis left occipital condyles
(arth occip. con.)
Coding as for columns 60 and 61 Card D.

two-state code: 2+3/0+1: arthritis/no arthritis

Columns 49-49, 60-61: Card E Mandible

Columns 1-10: contain data in the same format as outlined previously.

Columns 11-30: contain metrical information, while columns 31-39 are blank. The relevant columns for Card E are indicated above; the information contained therein is indicated below.

Column 40: Chin form

1=median

2=bilateral

3=medio-bilateral

two-state code: 1/2+3: median chin present/median chin absent

Columns 41 and 42: Right mandibular torus (mand. tor.)
Left mandibular torus

0=absent

1=+

2=++

3=+++

4=++++ (optimal state not found in this analysis)

two-state code: 1+2+3/0: torus present/torus absent

Column 43: Gonial eversion

Coding as for columns 41 and 42, Card E

two-state code: 1+2/0: The +++ and ++++ states did not appear in the material under analysis here. The two-state code represents eversion/no eversion.

Columns 44 and 45: Right mylohyoid arch
Left mylohyoid arch

0=absent
9=present

Columns 46 and 47: Right accessory mandibular foramina
Left accessory mandibular foramina
(acc. mand. for.)

0=absent
1=one foramen
2=two foramina
3=three foramina
4=four foramina

two-state code: The greatest number of accessory foramina observed was two, therefore "3" and "4" have been omitted from the two-state code.

1+2/0: accessory foramina/no accessory foramina

Columns 48 and 49: Right accessory mental foramina (Ment. for.)
Left accessory mental foramina

In this case, the "3" and "4" codes have been omitted, due to the fact that the greatest number of accessory foramina was two.

two-state code: 1+2/0: mental foramina present/mental foramina absent

Columns 60 and 61: Arthritis right mandibular condyle
Arthritis left mandibular condyle
(arth. mand. condyles)
Coding as for columns 41 and 42, Card E
two-state code: 1+2+3/0: arthritis/no arthritis
Note: the ++++ state has been excluded here.

DeVilliers (1968: 25) outlines the "general method used for the statistical description of new data" as random selection of a sample or series from a suitable population, description of characters of individuals comprising the sample, inferences from the sample observations regarding the total population, comparisons between evidence so obtained and data for other populations obtained in the same fashion, deductions from these comparisons regarding the anatomical similarity and hence presumed biological affinities of the new population. Such a method has been employed in this study and it is necessary at this point to comment on and assess this approach.

This study concerns itself with cranial material obtained from ossuary burials. It has been noted that such a method of burial ritually excludes certain individuals (Tooker 1967: 132-133) (see Chapter 2). Thus, it may be inferred that a complete ossuary population is not a duplication, in miniature, of the village population.

Furthermore, an analysis of the kind undertaken here does not deal with a total ossuary population, rather a portion of that population. The nature of the sample is one in which the individuals' parts are incomplete, dissociated and most often severely damaged. These factors indicate the somewhat precarious nature of possible interpretations of ossuary analyses. Anderson (1963: 30-31) adds completeness of sample (including efficiency of primary burial transfer to secondary burial and possible disturbance of ossuary prior to excavation) as well as association of individuals (often difficult to assess due to the fragmentary nature) as limiting factors in ossuary analyses.

Anderson (1963: 29) notes that the goals in a study of ossuary material must be redefined. One must deal not with populations of individuals, rather with populations of individual bones. Fortunately, the Carton population of skulls (from which approximately 50 crania and a corresponding number of mandibles were examined), is, for the most part, intact and well preserved. Likewise, a portion of the Ossossané material (approximately 35 skulls) is in comparably good condition. The Shaver Hill material, however, yielded only two complete crania, the rest of the material being fragmented and in fair to poor condition for study. (See Table 5.8, Chapter 5, for a population breakdown of the number of fragments examined.)

My analysis began with the Neutral Shaver Hill population, followed by the Carton site Neutral population. I noticed discrepancies in my coding for material which was intact as opposed to material which was fragmented. In the latter case, traits often appeared more pronounced. For this reason, a recoding of Shaver Hill material was necessary; as well, a selection of fragmentary material from the Huron Ossossané ossuary was chosen as a "control" for observational purposes. These "controls" were not maintained for statistical testing, rather were undertaken to validate and standardize observations within this study only.

The Shaver Hill material afforded the experimental sample and it was originally intended that more be found out about this population with regard to biological affinities. Selection of the populations other than Shaver Hill was made primarily on the basis of availability. The Carton population was chosen because it, like the Shaver Hill population, is Neutral and has a close temporal affiliation with Shaver. The Carton site dates ca. 1585-1610 A.D. or approximately one generation before Shaver--a time span within which microevolution would presumably be negligible. The Ossossané population represents a population of Hurons who died between ca. 1624-1636 A.D. The time span between Ossossané and the other two populations is also expected to have negligible evolutionary significance. Further, Ossossané, being representative of a Huron cultural base, is a geographically and temporally convenient population for biological comparison. An underlying assumption in this study is that each of the three populations is unified biologically.

Description of characters within these samples, by the very nature of the selected methodology, involves an element of subjectivity. The question of scientific validity of such approaches is not to be disputed here*, rather it will be accepted that the "control" procedures undertaken maximize the reliability of analysis. In line with Birdsell's statements (1952: 362), the subjectivity will be accepted not as a damning force, rather as an element contained "in comparable forms at all levels of science".

In a study of this nature, it is imperative that the methods of assessment be standardized as much as possible. Throughout, the "+" system of coding has been utilized for many traits, in line with those standards established with the codification form. The corresponding equivalences have been

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* Wood-Jones (1930-31) discusses the difficulties in attaining scientific accuracy when studying characters for which precise measurements cannot be made.

explained in the preceding section. The difficulty encountered with this methodology occurs at the level of ++++. It is assumed in this analysis that such a state exists as an optimal level or "model form" and hence, is never attained. Perhaps, had there been a +++++ state, it may have represented the optimal state and a ++++ code may have been present. In other words, the analysis seems to have been limited by the existing range of possible codes and standardization was effected by means of this range. It is suggested here that standardization, regardless of the range of possible expressions, be effected, and that this standardization be carried out by means of comparative analyses of codification forms of the type employed here.

(II) Statistical Methods

Statistical testing has been carried out to assess population differences. In order to validate these inter-population differences, certain preliminary tests have been undertaken.

Sex differences for variants were examined. It should be noted that sex differences have not been examined for traits found on the mandibles, as insufficient numbers of mandibles could be sexed. Percentage frequencies of all traits examined (exclusive of mandibular variants) have been calculated for males and females of the Carton sample. Bilaterally occurring traits have been collapsed (i.e. incidences for right and left sides have been summed) and incidences are listed in terms of sides rather than skulls. Chi-squared tests have been applied to test the significance of sex differences. Small sample sizes often required Yates' correction. When the smallest observed frequency was ten or less, but the total sample size was greater than forty, Yates' correction was applied. When the smallest observed frequency was less than ten, and the total sample size was forty or less, both corrected and uncorrected chi-squared values were calculated and the larger of the two values was used (Simpson *et. al*. 1960: 323).

Although lateral differences may indeed bias results, they have not been controlled for throughout this study. Due to the fragmentary nature of the ossuary material (see Part I of this chapter) it was impossible to assess whether fragments belonged to the same individual and tests for laterality therefore may be less accurate. In addition, although intact skulls were available for all populations, the numbers were often extremely small and results from tests for laterality would probably reflect sample size as much as true difference. Gaherty (1970: 94) notes that values for chi-squared tests of right and left sides for bilaterally occurring traits were low. Gaherty included most of the bilaterally occurring traits listed in this study. He concludes that there appear to be no significant differences between right and left sides and pooling of sides for analyses is therefore justified (Gaherty 1970: 94). It must be pointed out that side differences cannot be ignored, however, in that they may explain certain differences existing for incidences of particular traits. Biases resulting from side differences within samples will be discussed briefly in the following chapter, along with considerations of biases resulting from age differences.

Four procedures have been used to test the significance of population differences. These include: A/ calculations of chi-squared values for individual variants within the three populations, B/ subsequent totalling of the numbers of significant differences at a specific level of significance to indicate divergence between populations, C/ summing of chi-squared values to assess the over-all statistical divergence, and D/ the use of the mean square distance statistic to calculate the biological distance.

Percentage frequencies of traits examined have been calculated. Original observations of right and left sides were made, as indicated by the coding form, however, in subsequent analyses, incidences for right and left sides of individual variants were totalled. That is, in line with the previous comments regarding side differences, bilaterally occurring traits have been collapsed and incidences are listed in terms of sides rather than skulls.

Chi-squared tests employ present/absent dichotomies and in this case, as for sex differences, the technique outlined by Simpson *et al*. (1960: 323) for small sample sizes was used. The summing of chi-squared values involved the selection of certain characters beforehand. When the sample size for variants was less than ten, the trait has been eliminated from calculations. As Gaherty (1970: 107-109) has pointed out, if a real biological difference exists between populations, this difference is more likely reflected through statistical significance between two large samples than two small ones. Without a selection of certain values, then, the statistic may underestimate population differences when the sample is small. It should be noted in addition, that incidences of arthritis have been omitted on the basis of their being evidence of pathology.

The mean square distance statistic, derived from an extension of Pythagoras' theorem, represents "the Euclidean distance between two points in n-dimensional space, where n is the number of traits used" (Gaherty 1970: 111 after Sokal and Sneath 1963). Gaherty (1970: 111) gives the following formula for this statistic:

$$d^2{}_{jk} = \frac{\sum_{i=1}^{n} (X_{ij} - X_{ik})^2}{n}$$

where d_{jk} = distance between populations j and k

n = number of traits

X_{ij} = value of i^{th} trait for population j

X_{ik} = value of i^{th} trait for population k

The calculation and interpretation of this statistic rests on the assumption that traits are measured in comparable units and are therefore given equal weight. Raw percentage incidences are used. Such an approach gives greater weight to those traits with a large range and less weight to traits with a narrow range. There is difficulty however, in that small sample sizes may yield high percentage incidences which, in turn, yield very high values for population distances.

To ameliorate this, selected traits have been worked with. Those variants for which the sample size is less than ten were eliminated. Values for arthritis were also eliminated.

CHAPTER 5

RESULTS, COMPARISONS AND DISCUSSION

(I) Sex Differences

A procedure was undertaken to test the validity of a null hypothesis for sex differences, following the claims of Berry and Berry (1967) and Ossenberg (1970) that a large number of non-metrical traits show little sexual dimorphism. The Carton sample was chosen for "sex control" as the skulls in it are more complete than in the other two samples and sexing was therefore most accurate.

The results as seen in Table 5.1 tend to support the claims of Berry and Berry (1967) and Ossenberg (1970) that little sexual dimorphism exists for a large number of non-metrical traits. In this table the data include frequencies (present/total observations) and chi-squared values. It is noteworthy that the sample from the Carton population shows approximately equal numbers of both sexes.

In Table 5.1, those values of chi-squared exceeding

3.84 (probability level 0.05) have been underlined once, values exceeding 6.635 (probability level 0.01) have been underlined twice, and values exceeding 10.83 (probability level 0.001) have been underlined three times. Yates' correction was applied when the smallest observed frequency was less than ten, but the total sample size was greater than forty. When the smallest observed frequency was less than ten and the total was forty or less, both corrected and uncorrected values were calculated and the larger was used (see Gaherty 1970: 90). An unadjusted chi-squared was used when the smallest observed frequency was greater than ten (Simpson *et al*. 1960: 323). In all cases chi-squared tests were calculated with one degree of freedom.

The following traits show sexual dimorphism at the 0.05 level (see Table 5.1):

V brow shape	males higher
brow rugosity	males higher
malar tubercle present	males higher
marginal tubercle present	males higher
parietal foramen present	males higher
tympanic dehiscence present	females higher

It is evident that in five out of the six traits showing significant sex differences, males tend to show higher values. Generally, the sexual dimorphism may be explained by more powerful musculature and heavier buttressing in males (Gaherty 1970: 94). Such an explanation applies to the first four variants listed above.

Ossenberg (1970), in her study of discontinuous morphological traits, has dealt with the presence of the parietal foramen and the tympanic dehiscence and their distribution among males and females. The parietal foramen, according to Ossenberg (1970: 363) "shows a small increase in incidence with age, and a higher incidence in males...". DeVilliers (1968: 104) did not find sex differences in the incidence of parietal foramina at the 0.01 level of significance.

The higher incidence of tympanic dehiscence in females has been explained by Ossenberg (1970: 358) as evidence of an hypostotic trait. She states that this trait is one which represents "relative insufficiency of osseous development" (Ossenberg 1970: 358). Generally, hypostotic traits show a preference for females and for the right side and "follow an age-regressive pattern up to a certain age after which they remain stable" (Ossenberg 1970: 358). Anderson (1962: 150) states that the incidence of tympanic dehiscence is higher in females, but he states that, if unilateral, the trait is more common on the left than the right side.

Since the number of traits showing sexual dimorphism is comparatively few, and since it was not possible to determine the sex of many fragments, data for both sexes were pooled in subsequent analyses.

(II) Population Differences

Table 5.2 contains the frequencies and percentage incidences of the 52 traits and their variations examined. It will be noted that frequencies are listed in the conventional form: present/total skulls or sides.

Table 5.3 lists chi-squared results. Of the 55 chi-squared tests calculated on each population, 26 resulted in significant differences at the 0.05 level. If arthritis (evidence of pathology) is omitted from the chi-squared testing, then 52 tests comprise the total for each population, 24 of which show significance at the 0.05 level. This represents 15.4% of the total. These results are summarized in Table 5.4, where significance at the 0.05 level, 0.01 level and 0.001 level are indicated.

As stated in the previous chapter, an indication of the divergence between populations may be calculated by counting the number of significant chi-squared values. When two groups show a low number of significant values, it may be inferred that the two groups are biologically more similar than if they have a higher number of significant differences. By counting the number of chi-squared differences (excluding arthritis) at the 0.05 level of significance (see Tables 5.3 and 5.4), it is evident that all populations under study are equally distant biologically (all showing eight significant differences). However, at the 0.01 level of significance, Carton and Ossossané appear most distant biologically, followed by Carton and Shaver, then Shaver and Ossossané. These results are listed in the last few lines of Table 5.4.

Gaherty (1970: 124) has pointed out that it is increasingly hard to show significance with the chi-squared test as the sample size decreases. He goes on to say that the results of the significance of chi-squared differences as a measure of population distance may be misleading if sample sizes are disparate (Gaherty 1970: 124). Calculations of the mean sample size show Ossossané to be lowest at 45, then Shaver at 54 and finally Carton at 61. If the mean sample size is taken into account in the interpretation of significant chi-squared values, then perhaps false results have been obtained, in that sample size is reflected as much as biological distance. A further weakness of this method, as pointed out by Gaherty (1970), is that this statistic depends on differences being greater or less than a specific value, while no consideration of the magnitude of differences is taken into account.

The sums of the chi-squared values are listed in Table 5.5. This table includes a sum for all variants exclusive of arthritis (52 in total), and a sum for selected traits (44 variants). To interpret this statistic, it is pertinent to note that the lower the chi-squared values, the closer the populations are in biological distance. It is evident from the statistical calculation that Shaver and Ossossané appear most alike, followed by Carton and Ossossané and lastly Shaver and Carton. Calculations for both selected and unselected traits show this pattern. The results from this statistic conflict with the result based on the crude number of significant differences. It appears through chi-squared testing (counting the number of significant differences and summing chi-squared values) that no consistency with respect to the degree of difference between the three pairs of populations exists.

Regarding the mean square distance statistic, Table 5.6 shows in matrix form the values obtained. They have been calculated from the raw percentages of selected traits (see Chapter 4, part II) as listed in Table 5.2. The results listed in Table 5.6 show that the magnitude of difference between populations is small. It is evident that Shaver and Carton appear most alike, followed by Shaver and Ossossané and lastly Carton and Ossossané. The calculation of the square root of the mean square distance statistic shows that the values are approximately 13.29%, 13.57% and 15.34% representing differences between Shaver and Carton, Shaver and Ossossané, and Carton and Ossossané respectively. It is obvious that the higher the percentage value, the greater the average difference between population incidences (see Table 5.7 and Figure 5.1).

To summarize to this point, this study has not identified a major distinction between Neutrals and Hurons on the basis of the traits examined, rather the individuals from Carton, Shaver and Ossossané appear, through multivariable statistical testing, to be closely aligned. However, statistically significant differences have been observed between all three populations. In order to affirm the observed biological differences between populations, it is necessary to take into account certain factors which may influence the statistical results.

Testing for sex differences for example, has been undertaken in this study and it has been concluded that few differences can be attributed to a sex factor. It should be restated, however, that while the sex factor has been examined in the Carton sample, it has not been examined in the other two samples. Hence, of the seventeen non-metrical traits showing statistical significance at the 0.05 level (see Table 5.4), traits such as brow rugosity, nasal profile, zygomaxillary tubercle, and tympanic dehiscence, which are documented as being sex related, may show statistical significance not because the populations are biologically distinct, but rather because the sample tends to represent more of one sex than the other.

The appearance or expression in varying degrees of certain traits may be correlated with the age of the individual examined. For example, tympanic dehiscence (usually evident prior to the fifth year of life (see Chapter 3) shows a significance at the 0.001 level between Carton and Shaver, and significance at the 0.05 level between Shaver and Ossossané. Upon examination of Table 5.8, it may be seen that the number of fragments of young individuals examined from the Shaver sample is higher than that of the other two populations. Perhaps this factor would explain, in part, the statistically significant values. That is, the trait may show a higher incidence in the Shaver sample because a larger number of young individuals manifesting the trait were examined. In contrast, the Carton and Ossossané samples examined for this variant may represent a sample of individuals who, on the whole, are individually older than the Shaver Hill sample. Because they are older, they may not show evidence of this trait, providing the age correlation is correct.

Hyperfunctional stress has been offered as an explanation for the occurrence of the maxillary torus, leading to the assumption that the expression of this variant should be correlated with age (see Chapter 3). This trait is statistically significant in the present study at the 0.001 level among the Carton and Shaver and Carton and Ossossané samples. Table 5.8 indicates that the number of fragments of adults in the Carton and Ossossané populations is about equal. The percentage incidences of maxillary torus as revealed in Table 5.2 would lead to an expectation that the Carton population would contain the greatest number of fragments representing adults, providing the theory of etiology for this trait is correct. In fact, the results obtained do not corroborate the expectation.

As stated by Moorrees <u>et al</u>. (1952), the dimensions of the mandibular torus increase with age (see Chapter 3). This trait is statistically significant at the 0.01 level between the Carton and Ossossané samples. Examining Table 5.2, it seems that the Ossossané sample should contain the greatest number of fragments representing adults, providing the correlation of age and expression of this variant is correct. Table 5.8 indicates that the number of fragments of adults is equal for the Carton and Ossossané samples. The results are not, in this case as for maxillary torus, in line with the expected.

It must be recognized that the age breakdown (Table 5.8) is a scan of the total number of fragments examined in this study. Those figures cited in Table 5.2 as the "total observations" for frequency listings, in many cases, represent a portion of the total. That is, not all fragments examined manifested all of the traits.

As mentioned in the concluding section of the previous chapter, varying expressions for traits may be related to the side of the skull examined. However, results obtained from previous studies of laterality for specific traits (e.g. Ossenberg 1970; Gaherty 1970) tend to conclude that"...the small frequency differences associated with...side need not, in general, concern the anthropologist who wishes to maximize his sample for population comparisons by pooling data for all individuals" (Ossenberg 1970: 357). For the present study, a control procedure was not undertaken to statistically test side differences, nevertheless, the possibility of side-related factors cannot be ignored.

The incidence, according to DeVilliers (1968: 108), of the pterygo-spinous foramen or spur (basal) is more frequent on the left than the right side. Examining the percentage frequencies for sides for this trait the following results are obtained, where listings include observations of the trait present/total observations and percentage frequencies:

trait	Carton		Shaver		Ossossané	
Pterygo-for. (A)	Right	Left	Right	Left	Right	Left
	16/33	14/34	9/15	8/13	14/20	19/25
	48.5%	41.17%	60%	61.53%	70%	76%

Exclusive of the Ossossané sample, the statement of DeVilliers is not supported. Considering approximately equal numbers of right and left sides have been examined within each sample (see above), some other factor must be operating in the statistical expression of this variant, i.e., the statistical significance may be attributed to real biological differences between the populations.

Ossenberg (1970: 358) states that the tympanic dehiscence, an hypostotic trait representing insufficiency of osseous development, is characterized by a slight preference for the right side. Ossenberg (1970: 358) citing Torgersen (1951) and Kjellgren (1944), states that the slight retardation of ossification on the right side may be due to the "richer innervation on that side, associated with cerebral hemisphere dominance and mediated, at least in part, by the blood supply". Examining the figures for laterality of the tympanic dehiscence obtained in the present study (see below), it is apparent that those obtained for the Shaver Hill sample are the only ones supporting Ossenberg's claim. Similarly the overall percentage incidence is highest for this group and statistical significance is evident at the 0.05 and 0.001 levels (see Tables 5.2, 5.3 and 5.4). It should be noted that the significance of this variant may be due in part to laterality, but the contributions of other factors must be taken into account as well.

trait	Carton		Shaver		Ossossané	
tympanic dehisc.	Right	Left	Right	Left	Right	Left
	13/44	11/37	15/18	10/17	15/36	16/35
	29.54%	29.73%	83.33%	58.82%	41.66%	45.71%

Listings include observations of the trait present/total observations and percentage frequencies.

A limited number of studies have been carried out on the associations of discontinuous cranial traits (eg. Hertzog 1968), and therefore conclusive results have not been obtained. It may be that certain factors operate on the skull to produce a "neighbourhood pattern" of association (Hertzog 1968). From this theory it may, therefore, be inferred that chi-squared values between cranial traits may not be independent. Tests for correlation between variants under study here have not been undertaken, but such a procedure may be worthwhile in future studies. It should be noted however, that non-metrical traits have several components contributing to their expression and it may be that random operation of these factors results in a patterned expression. Hertzog (1968: 402) states "the probability of an ossicle, or the other non-metric variants which are apparently related to these in some way...being present at a given site is the result of the operation, or non-operation, of numerous possible factors, some general in scope, some site-specific and some regional". The problem then, seems to be the assessment of the contributions of the many factors. This issue is discussed in a concluding section of this thesis.

Although the incidence of arthritis (as evidence of pathology) has been eliminated from many of the statistical computations, it remains to explain its statistical significance through chi-squared tests. Arthritis of the occipital condyles is a trait for which statistical significance has been established in this study. The known correlation of age and incidence of arthritis is not supported by this study's results. A difference in frequency of this trait is statistically significant at the 0.001 level between the Carton and Shaver and between the Shaver and Ossossané samples. Table 5.8 indicates that the number of fragments of determinable adults is highest for the Shaver sample. It is expected that this will be reflected in the frequencies and percentage incidences listed in Table 5.2. In fact, Shaver shows the lowest percentage incidence of arthritis. The statistical significance of this trait then, cannot be attributed to a difference in age distribution and may therefore be assumed to represent a real biological difference between populations.

Summarizing, it has been found through statistical testing that seventeen variants show significant differences between two or more populations at the 0.05 level. However, some of these variants, notably brow rugosity, nasal profile, zygomaxillary tubercle, tympanic dehiscence, maxillary and mandibular tori, pterygo-spinous foramen or spur (basal), and arthritis, may show statistical significance because of certain factors contributing to their expression. These factors include age, sex, laterality, and correlation of variants. In many cases where etiology for traits is unknown, it is difficult to assess the possible contributions of these factors. Therefore it seems that the traits including frontal grooves, zygomatic facial foramen, paramastoid process, parietal notch and parietal bone, chin form, gonial eversion, and accessory mandibular foramen, (statistically significant at the 0.05 level) may indicate real biological differences between populations.

A further limitation in the interpretation of population affinities is the small but possibly significant difference in time period of the three populations. The earliest is Carton, dated 1585-1610 A.D., followed by Shaver dating 1600-1620 A.D., with Ossossané the most recent at 1624-36 A.D. Because this dating is not absolute, rather has been made on the basis of glass bead complexes in most cases, the time spread between populations may, in actuality, be greater or less than postulated. A concluding observation based on the data is that developmental trends in the expression of certain traits are implied. These are summarized from Table 5.2 as follows:

Increasing incidence over time (listed in percentage)

trait	Carton	Shaver	Ossossané
zygomatic facial foramen	32.6	56.1	64.5
lesser palatine foramen	33.3	44.9	52.2
pterygo-foramen (A)	44.8	60.7	73.3
vesalian foramen	28.9	31.7	34.0
ovale spinosum	94.5	97.2	100.0
parietal notch	63.2	78.1	87.5
parietal bone	24.2	30.0	75.0
asterionic bone	12.3	13.3	16.7
mastoid foramen position	34.5	34.6	46.2
mandibular torus	18.2	28.2	41.0

Decreasing incidence over time (listed in percentage)

trait	Carton	Shaver	Ossossané
anterior ethmoidal foramen position	16.7	15.4	14.3
zygomaxillary tubercle	72.7	64.1	44.4
maxillary torus	45.8	14.1	7.9
mylohyoid arch	17.0	16.3	9.6
accessory mental foramen	7.1	6.8	1.5

While these trends are not, by any means conclusive, they do imply that the two generation time span between the three populations may be indicative of microevolutionary trends existing for the Ontario Iroquois. Further studies are necessary to firmly establish this claim.

It may be concluded that a conservative statement regarding population relationships seems most appropriate in light of the nature of non-metrical variants and factors contributing to their expression. Despite minor biological differences between populations, the Carton, Shaver and Ossossané samples, it may be assumed, show close biological affinity and represent a homogeneous base.

(III) Suggestions for Methodological Review

Non-metrical studies offer advantages to the investigator in that such a methodology allows for more "accurate" assessments of traits in a shorter time period than metrical studies and, in addition, seldom demand adjustments for age and sex (see Berry and Berry 1967). As well, Berry and Berry (1967) have pointed out that metrical measurements tend to be correlated with one another to a greater extent than non-metrical observations and that interpretations of metrical statistics are therefore more difficult than non-metrical statistics. In line with the positive statements regarding non-metrical studies put forward by Laughlin and Jørgensen (1956), Berry and Berry (1967), Anderson (1968), and DeVilliers (1968), such an approach was adopted in the present study.

It is apparent throughout the text of this thesis, that, despite the methodological advantages of non-metrical studies, the materials offered from ossuary burial demand compromise on the part of the investigator. These allowances do not, however, deny the <u>reliability</u> of the results, including statistical results regarding population relationships. Huizinga (1965: 79) remarks that statistical methods are not to "blame" if affinities or relationships between populations are not as expected. Huizinga feels that if anything is to "blame", it is the anthropologist's use of poor observational data. Huizinga (1965: 79) states:

> We want to study 'affinities' and 'relationships' based on genotypes or at least based on useful manifestations of genotypes. Anthropometry apparently offers 'poor phenotypes', i.e. poor representatives of the differences and resemblances we really want to know.

Huizinga contends that anthropologists ought to improve their observations of phenotypic characters. It cannot be denied that observations must be as "accurate" as possible, and standardized to other studies as often as possible if studies of this nature are to be meaningful. However, it is suggested here that if affinities or relationships between populations are not in line with the expected, the problem may lie, in part, at the level of observation, but more likely is at the level of interpretation. That is, it is suggested that the problem lies in the assessment of the genetic contribution to the phenotype.

It is necessary to explore this idea further, and in order to do so, it must be restated, as it was in Chapter 1 of this thesis, that genetic-evolutionary studies based on skeletal material rely on assessments of phenotypic manifestations and their underlying genetic bases. While gene frequencies of monogenic traits without any environmental components would presumably be most informative, it has been established that most traits do not appear as results of simple genetic processes. Many traits are determined by polygenic rather than monogenic inheritance. As Grüneberg's studies have shown (see Berry and Berry 1967; Berry 1968; Ossenberg 1970), while some traits are "predominantly genetic in their mode of production", non-genetic factors operate on their expression (Ossenberg 1970: 369). It would seem that the issue, then, is one of assessing the contribution of the various components to the expression of the trait in the phenotype. That is, while an underlying genetic factor is known, the assessment of its contribution may add greater meaning to future studies. While inter-trait correlations are said to be either absent or at a very low level (Ossenberg 1970), correlations <u>do</u> occur. Epigenetically correlated characters are not necessarily genetically correlated. Ossenberg (1970) discusses the contributions of components saying that genetic situations may be altered by the effects of environmental components. For example, Ossenberg (1970: 369) states that artificial cranial deformation results in "altered probabilities of the occurrence of minor morphological variants". Furthermore, the influence of such extrinsic factors as maternal diet, parity, litter size, and season of birth for experimental animals have been shown to affect the expression of skeletal variants. To reiterate, greater strides would be made in future studies of population affinity based on traits of polygenic inheritance if the contributions of the components affecting phenotype were to be assessed.

(IV) Conclusions

The aim of the study, as outlined in Chapter 1, is an examination of biological affinities among three Iroquois Indian populations living within selected temporal and spatial zones. It has been shown that the Carton, Shaver and Ossossané samples manifest close biological likeness and that biological distances are not marked between any two populations. The results obtained here are in accordance with historical and archaeological data.

In summation, a review of the important points derived from this study are offered.

1. The hypothesis--that the two Neutral populations and one Huron population, being of a culturally homogeneous Iroquoian base, are expected to show close biological affinity--has been affirmed. Correspondingly, it has been confirmed that non-metrical traits, having a genetic component, can supply useful information regarding biological affinities. Of the seventeen traits showing significance at the 0.05 level, eight of these, including brow rugosity, nasal profile, zygomaxillary tubercle, tympanic dehiscence, maxillary and mandibular tori, pterygospinous foramen or spur (basal), and arthritis may be statistically significant because of sampling bias in such factors as

age, sex, laterality and correlation of variants. Where etiology for variants is unknown, it appears that the statistical significance may imply real biological difference. Such is the case for variants including frontal grooves, zygomatic facial foramen, paramastoid process, parietal notch and parietal bone, chin form, gonial eversion, and accessory mandibular foramen.

Possible developmental trends in the expression of traits have been pointed out. It has been suggested, furthermore, that studies be carried out to elucidate microevolutionary trends among the Ontario Iroquois.

2. It should be pointed out that the statistical results obtained from this study for the Shaver Hill ossuary do not substantiate the published results of Stothers (1972).
3. It has been recognized that material (both fragmentary and intact) derived from ossuary burial demands a methodological approach different from that used when osteological material has not been obtained from ossuary burial. Anderson's (1963) claims that the goals in analysis of ossuary material ought to be redefined, and that the investigator must realize that he is dealing with populations of individual bones rather than populations of individuals, have been adequately reinforced in this study.

4. It has been pointed out that basic to all analyses, standardization should be effected. This includes the standard use of a selected and hopefully perfected coding form, and standardization of coding for particular variants under examination.
5. Finally, it has been suggested that detailed genetic analyses be undertaken in order to elucidate the contributions of the various components in the expression of polygenic characters.

TABLE 5.1

SEX DIFFERENCES
CARTON

TRAIT	MALE	FEMALE	χ^2
metopic suture	0/20	1/25	0.0127
frontal grooves	11/38	13/44	0.0035
brow shape	19/20	12/25	9.3641
brow rugosity	20/20	11/26	14.5969
supraorbital	29/39	33/49	0.2313
supratrochlear	26/33	28/42	0.8126
extra ethmoidal foramen	7/19	11/23	0.1621
anterior ethmoidal foramen position	2/14	6/30	0.0014
nasal aperture form	5/7	5/7	0.3500
nasal profile	2/5	1/5	0.4761
infraorbital foramen	12/13	25/26	0.2635
zygomatic facial foramen	2/13	10/27	1.9590
os japonicum	0/18	0/25	0.00
malar tubercle	13/16	5/25	12.4783
zygomaxillary tubercle	15/18	14/23	1.4958
marginal tubercle	15/16	14/23	5.3504
palatine torus	5/9	7/14	0.0677
maxillary torus	6/19	16/25	3.3347
lesser pal. for.	9/20	5/21	1.2117
pterygoforamen (A)	12/27	16/34	0.0414
pterygoforamen (B)	12/27	11/34	0.9367
vesalian foramen	13/31	8/38	2.5993

Cont'd

TABLE 5.1 continued

SEX DIFFERENCES
CARTON

TRAIT	MALE	FEMALE	χ^2
ovale-spinosum	28/29	34/37	0.0716
anterior condylar canal	23/32	33/42	0.1534
posterior condylar canal	25/29	28/34	0.0050
occipital condyles	32/32	27/27	0.00
precondylar tubercle	2/16	3/21	0.1075
ossified apical ligament	6/16	2/17	2.9724
paramastoid	12/20	10/21	0.2317
sagittal sinus direction	13/17	15/23	0.5894
parietal foramen	16/33	4/43	12.8313
coronal wormians	0/11	1/20	0.5683
bregmatic bone	0/17	1/25	0.0385
sagittal wormians	0/4	1/19	0.7737
lambdoid wormians	6/7	8/18	3.4838
lambdoid bone	2/16	3/22	0.1472
pterion shape (A)	0/14	4/32	0.6655
pterion shape (B)	13/14	28/32	0.0005
parietal notch	22/29	19/34	1.9402
parietal bone	1/8	5/20	0.5303
asterionic bone	3/29	6/37	0.1079
mastoid foramen	25/31	26/38	0.7650
mastoid foramen position	9/25	8/26	0.0098
divided mastoid	6/28	8/39	0.0456
tympanic dehiscence	5/32	19/40	6.7570

TABLE 5.1 continued

SEX DIFFERENCES
CARTON

TRAIT	MALE	FEMALE	χ^2
tympanic thickening	17/27	28/39	0.2387
arthritis condylar fossa	13/30	13/41	1.0088
arthritis--occipital condyles	14/28	17/22	2.8180

NOTE: The values showing a significance at the 0.05 level are underlined once, at the 0.01 level are underlined twice, and at the 0.001 level are underlined three times.

TABLE 5.2

POPULATION INCIDENCES OF CRANIAL MORPHOLOGICAL TRAITS

	Frequency			Percentage Incidence		
Trait	Carton	Shaver	Ossossané	Carton	Shaver	Ossossané
met.	1/52	2/67	0/44	1.9	3.0	0.0
fr. gr.	28/94	35/81	15/69	29.8	43.2	21.7
br. shpe	35/50	24/41	24/36	70.0	58.5	66.7
brow rug.	36/53	38/84	25/38	67.9	45.2	65.8
supraorb.	71/100	67/112	41/69	71.0	59.8	59.4
supratroch.	63/86	59/85	48/61	73.3	69.4	78.7
extra eth. for.	19/46	3/4	12/32	41.3	75.0	37.5
ant. eth. for. pos'n	8/48	2/13	5/35	16.7	15.4	14.3
nasal apt. form	10/14	10/10	7/7	71.4	100.0	100.0
nasal pro.	3/10	4/9	0/12	30.0	44.4	0.0
infraorb. for.	40/42	64/69	28/28	95.2	92.8	100.0
zygom. fac. for.	14/43	32/57	20/31	32.6	56.1	64.5
os japonicum	0/46	2/55	0/31	0.0	3.6	0.0
mal. tubercle	18/44	13/50	9/29	40.9	26.0	31.0
zygomax. tub.	32/44	25/39	12/27	72.7	64.1	44.4
marg. tub.	31/44	32/46	26/30	73.8	69.6	86.7
palatine torus	12/25	10/22	10/16	48.0	45.5	62.5
max. torus	22/48	13/92	3/38	45.8	14.1	7.9
lesser pal. for.	15/45	22/49	12/23	33.3	44.9	52.2
pterygo. for. (A)	30/67	17/28	33/45	44.8	60.7	73.3
pterygo. for. (B)	24/67	5/28	13/45	35.8	17.9	28.9
vesalian for.	22/76	13/41	17/50	28.9	31.7	34.0
ovale-spin.	69/73	35/36	50/50	94.5	97.2	100.0

Cont'd

TABLE 5.2 continued

POPULATION INCIDENCES OF CRANIAL MORPHOLOGICAL TRAITS

	Frequency			Percentage Incidence		
Trait	Carton	Shaver	Ossossané	Carton	Shaver	Ossossané
ant. cond. can.	62/81	38/52	59/70	76.5	73.1	84.3
post. cond. can.	60/70	36/43	49/55	85.7	83.7	89.1
occip. cond.	65/65	47/47	56/56	100.0	100.0	100.0
precond. tub.	5/41	1/26	2/35	12.2	3.8	5.7
ossif. apic. lig.	10/36	4/6	13/31	27.8	66.7	41.9
paramastoid	27/47	9/9	14/32	57.4	100.0	43.8
sag. sin. direct.	33/45	51/70	35/43	73.3	72.9	81.4
pariet. foramen	28/88	31/73	27/75	31.8	42.5	36.0
coron. worm.	1/37	1/8	2/20	2.7	12.5	10.0
breg. bone	1/48	0/26	0/34	2.1	0.0	0.0
sag. worm.	1/26	1/14	0/22	3.8	7.1	0.0
lambd. worm.	16/27	13/20	13/25	59.3	65.0	52.0
lambd. bone	5/41	5/35	2/39	12.2	14.3	5.1
pter. shape (A)	5/50	1/5	1/25	10.0	20.0	4.0
pter. shape (B)	44/50	4/5	24/25	88.0	80.0	96.0
par. notch	43/68	25/32	42/48	63.2	78.1	87.5
par. bone	8/33	3/10	18/24	24.2	30.0	75.0
asterionic bone	9/73	2/15	10/60	12.3	13.3	16.7
mastoid for.	55/76	26/30	39/65	72.4	86.7	60.0
mast. for. pos.	19/55	9/26	18/39	34.5	34.6	46.2
divided mast.	15/76	7/35	12/68	19.7	20.0	17.6
tymp. dehisc.	24/81	25/35	31/71	29.6	71.4	43.7
tymp. thick.	52/75	19/23	39/64	69.3	82.6	60.9
arth. cond. foss.	30/79	13/29	20/70	38.0	44.8	28.6

Cont'd

TABLE 5.2 continued

POPULATION INCIDENCES OF CRANIAL MORPHOLOGICAL TRAITS

	Frequency			Percentage Incidence		
Traits	Carton	Shaver	Ossossané	Carton	Shaver	Ossossané
arth. occip. cond.	32/54	2/43	19/41	59.3	4.7	46.3
chin form	30/47	63/68	28/36	63.8	92.6	77.8
mand. tor.	18/99	37/131	25/61	18.2	28.2	41.0
gonial ever.	10/52	3/74	9/45	19.2	4.1	20.0
mylohyoid arch	15/88	20/123	5/52	17.0	16.3	9.6
acc. mand. for.	13/83	39/108	14/46	15.7	36.1	29.8
acc. ment. for.	7/98	10/146	1/66	7.1	6.8	1.5
arthr. mand. cond.	25/53	36/69	7/19	47.2	52.2	36.8

TABLE 5.3

INTERPOPULATION χ^2 TESTS

TRAIT	SHAVER CARTON χ^2 VALUE	SHAVER OSSOSSANÉ χ^2 VALUE	CARTON OSSOSSANÉ χ^2 VALUE
metopic suture	0.0496	0.1824	0.0070
frontal grooves	3.4022	7.7294	1.3270
brow shape	1.2984	0.5396	0.1079
brow rugosity	6.7334	4.4249	0.0456
supraorbital	2.9054	0.0028	2.4492
supratrochlear	0.3089	1.5611	0.5695
extra ethmoidal foramen	0.6039	2.0571	0.1140
anterior ethmoidal foramen position	0.0970	0.1326	0.0001
nasal aperture form	3.4285	0.00	2.4705
nasal profile	0.4247	6.5882	4.1684
infraorbital foramen	0.0143	0.9137	0.1930
zygomatic facial foramen	5.4873	0.5827	7.4076
os japonicum	0.3472	0.1083	0.00
malar tubercle	2.3536	0.0487	0.3689
zygomaxillary tubercle	0.7148	2.5029	5.6794
marginal tubercle	0.1944	2.0680	1.0610
palatine torus	0.0140	1.0795	0.3448
maxillary torus	16.9082	0.4772	13.0224
lesser pal. for.	1.3143	0.3324	2.2567
pterygofor. (A)	2.0067	1.2736	8.9207
pterygofor. (B)	2.2174	0.6148	0.5847
vesalian foramen	0.0967	0.0535	0.3602
ovale-spinosum	0.0217	0.0275	1.3580

Cont'd

TABLE 5.3 continued

INTERPOPULATION χ^2 TESTS

TRAIT	SHAVER CARTON χ^2 VALUE	SHAVER / OSSOSSANE χ^2 VALUE	CARTON / OSSOSSANE χ^2 VALUE
anterior condylar canal	0.2039	2.3007	1.4138
posterior condylar canal	0.0002	0.2281	0.0848
occipital condyles	0.00	0.00	0.00
precondylar tubercle	0.5289	0.0702	0.3316
ossified apical lig.	1.9687	1.2380	0.9195
paramastoid	4.2481	6.8849	1.4306
sagittal sinus direction	0.0031	0.6499	0.4194
parietal foramen	1.9484	0.6489	0.3167
coronal wormians	0.0746	0.2333	0.3091
bregmatic bone	0.0982	0.00	0.0303
sagittal wormians	0.2082	1.6163	0.0071
lambdoid wormians	0.0093	0.3290	0.2773
lambdoid bone	0.0051	0.8951	0.5217
pterion shape (A)	0.0046	1.7142	0.2038
pterion shape (B)	0.0368	1.7142	0.4923
parietal notch	1.5855	0.6467	7.2664
parietal bone	0.0023	6.0527	12.4564
asterionic bone	0.1033	0.0062	0.2138
mastoid foramen	1.7110	5.5777	2.4118
mastoid foramen position	0.0595	0.4461	1.2883
divided mastoid	0.0501	0.0005	0.1028
tympanic dehiscence	15.8300	6.1815	3.2263

Cont'd

TABLE 5.3 continued

INTERPOPULATION χ^2 TESTS

TRAIT	SHAVER CARTON χ^2 VALUE	SHAVER / OSSOSSANE χ^2 VALUE	CARTON / OSSOSSANE χ^2 VALUE
tympanic thickening	0.9601	2.6670	1.0767
arthritis--condylar fossa	0.4157	2.4384	1.4718
arthritis--occipital condyles	29.0037	17.2955	1.5640
chin form	13.1132	3.4957	1.2798
mandibular torus	3.1379	3.0893	9.9854
gonial eversion	6.0504	6.1872	0.0260
mylohyoid arch	0.0228	0.8310	0.9293
accessory mand. for.	9.9046	0.5820	3.6380
accessory ment. for.	0.0282	1.6564	1.6156
arthritis--mand. cond.	0.3002	0.8550	0.2582

NOTE: The values showing significance at the 0.05 level are underlined once, at the 0.01 level are underlined twice and at the 0.001 level are underlined three times.

TABLE 5.4

SUMMARY OF INTERPOPULATION χ^2 TESTS

TRAIT	CARTON	SHAYER /	CARTON /		TOTAL	
	SHAYER	OSSOSSANE	OSSOSSANE	.05	.01	.001
frontal grooves		xx		1	1	0
brow rugosity	xx	x		2	1	0
nasal profile		x	x	2	0	0
zygomatic facial foramen	x		xx	2	1	0
zygomaxillary tubercle			x	1	0	0
maxillary torus	xxx		xxx	2	2	2
pterygo foramen (A)			xx	1	1	0
paramastoid	x	xx		2	1	0
parietal notch			xx	1	1	0
parietal bone		x	xxx	2	1	1
mastoid foramen		x		1	0	0
tympanic dehiscence	xxx	x		2	1	1
arthritis-occip. cond.	xxx	xxx		2	2	2
chin form	x			1	0	0
mandibular torus			xx	1	1	0
gonial eversion	x	x		2	0	0
accessory mandib. foramen	x			1	0	0
TOTAL (excluding arthritis)						
0.05	8	8	8	24		
0.01	3	2	6		11	
0.001	2	0	2			4

x = significant at 0.05 probability level

xx = significant at 0.01 probability level

xxx = significant at 0.001 probability level

TABLE 5.5

SUM OF CHI-SQUARED VALUES--52 TRAITS

	Carton	Shaver	Ossossané
Carton		112.84	105.09
Shaver	112.84		89.24
Ossossané	105.09	89.24	

SUM OF CHI-SQUARED VALUES--44 SELECTED TRAITS

(Those traits for which the sample size is less than ten are omitted.)

	Carton	Shaver	Ossossané
Carton		102.05	94.98
Shaver	102.05		68.81
Ossossané	94.98	68.81	

TABLE 5.6

MEAN SQUARE DISTANCES: 44 CRANIAL TRAITS

	Carton	Shaver	Ossossané
Carton		177.31	235.40
Shaver	177.31		184.24
Ossossané	235.40	184.24	

TABLE 5.7

ROOT MEAN SQUARE DISTANCES: 44 CRANIAL TRAITS

	Carton	Shaver	Ossossané
Carton		13.29	15.34
Shaver	13.29		13.57
Ossossané	15.34	13.57	

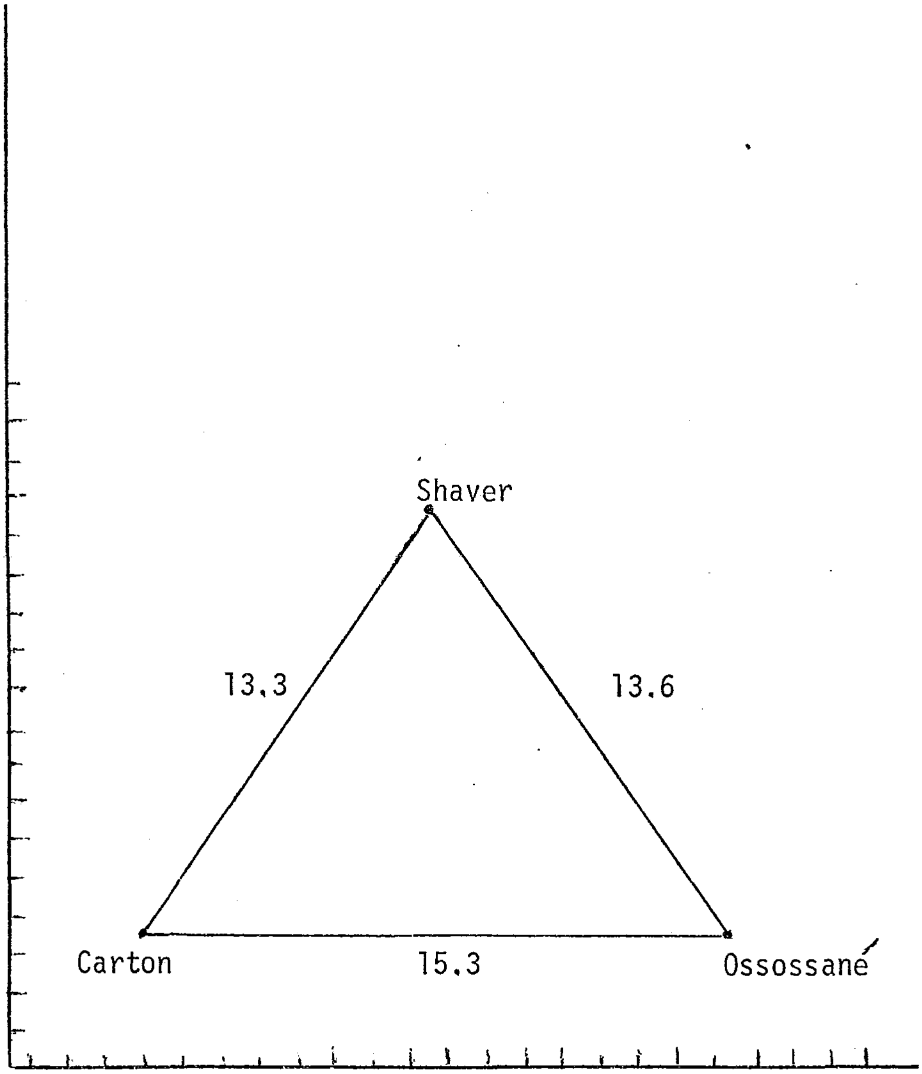
TABLE 5.8

AGE BREAKDOWN

AGE	NUMBER OF FRAGMENTS EXAMINED		
	Carton	Shaver	Ossossané
Indeterminate child	0	35	2
2-6 years	0	9	1
6-12 years	5	12	1
12-18 years	0	20	6
young adult 18-35 years	67	119	54
middle age adult 35-55 years	51	55	30
old adult over 55 years	0	0	0
Indeterminate adult	27	275	61
Sub total	150	525	155
Age Indeterminate	7	158	13
TOTAL	157	683	168

FIGURE 5.1

PLOTTING OF ROOT MEAN SQUARE DISTANCES
TO SHOW AVERAGE DISTANCES
BETWEEN THREE IROQUOIAN POPULATIONS



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