ARCHAIC POPULATION AFFINITIES AS DETERMINED BY ANALYSIS OF CRANIAL MORPHOLOGY

Susan Pfeiffer

ABSTRACT

Cranial material is analyzed from seven Archaic sites in the Great lakes and maritime regions dating from 5000 to 3400 B.P. Discrete morphological traits are used to arrive at a matrix of mean Measures of Distance. Results are then compared with those of a discriminant function analysis previously performed on the cranial measurements from the same samples. It is concluded that Maritime and Laurentian skeletal materials are clearly distinct from one another, and that there are clearly affinities among at least some of the Laurentian and Old Copper samples.

INTRODUCTION

Skeletal material representing Archaic populations (here dating from ca. 5000 to 3400 B.P.) is not commonly found. Low population density and considerable antiquity combine to make skeletal samples small in size and number, hence, the study of Archaic population affinities is intriguing, but fraught with difficulties. In a previous work the author used continuous variables (cranial measurements) to assess population relationships (Pfeiffer 1977). Conclusions drawn from that discriminant function analysis can be stated mainly in the negative: results show no clear grouping of samples by geographic area or cultural affiliation. The small samples of male crania show no physical "type" to be associated with Old Copper, Glacial Kame or Laurentian Archaic. Two intriguing and problematical features appear in that analysis (1) the pooled Ottawa River samples of Morrison's Island and Allumette Island appear to have a distinct cranial size/shape as compared to all other Archaic samples, and (2) a Maritime Archaic sample, Port au Choix, appears to show some strong similarities to a large Laurentian sample, Frontenac Island.

These observations, plus the generally unsatisfactory results of the population distance analysis, clearly indicate that more work is needed on the problem. Discriminant function analysis requires complete data sets and this in turn causes the Archaic problem to be represented by very small samples and few variables. The work reported here is a new analysis of these same Archaic samples using discontinuous (discrete) variables.

MATERIALS AND METHODS

Six Archaic skeletal samples are used for the tests of population relationship as shown with their radiocarbon dates in Table 1. In terms of age, they may be grouped into samples dating earlier than 4000 **B.P.** (Oconto, Morrison's Island and Allumette Island), those from 3400-4000 B.P. (Cole and Reigh) and those that may cover a long span both before and after 4000 B.P. (Frontenac Island and Port au Choix). Five of the samples were studied by the author in 1973-74. The sixth sample, Port au Choix, has not been directly studied by the author. The discontinuous observations are taken from the published work of J. E. Anderson (Tuck 1976). Hence, there is a possibility of interobserver error in comparisons that include port au Choix, but it is not expected that such error is likely to be common.

The two Ottawa River site samples, Morrison's Island and Allumette Island, have been treated throughout as a single sample. The two sites are located one mile apart, and are

TABLE 1

SAMPLES USED IN THE STUDY

Site	Location	Radiocarbon Date (B.P.)	Suggested Cultural Affiliation	Sources
Port au Choix	Northwestern Newfoundland	4290±110 3690±90	Maritime	Tuck (1976)
Frontenac Island	Cayuga Co. New York	4930±260 3963± 80 3673±250	Laurentian	Ritchie (1961, 1965)
Cole Gravel Pit	Livingston Co. New York	3980±160 3890±120	Laurentian (Lamoka)	Hayes (1969)
Morrison's Island-Allumette Island	Pontiac Co. Quebec	4700±150	Laurentian & Old Copper	Kennedy (1963,1967)
Reigh	Winnebago Co. Wisconsin	3660±250	Old Copper & Glacial Kame	Baerreis et al (1957) Ritzenthaler (1970)
Onconto	Onconto Co. Wisconsin	4540±400	Old Copper	Ritzenthaler and Wittry (1952) Ritzenthaler (1970)

TABLE 2

COMPOSITION OF **SAMPLES**

Sample	Male	Female	Undetermined
Port au Choix	21	16	11
Frontenac Island	23	26	5
Cole	4	4	1
Morrison'Allumette	8	4	3
Reigh	10	12	6
Oconto	6	-9	2

TABLE 3

DISCONTINUOUS TRAITS USED IN THE STUDY

Trait	Port au Choix		Frontenac Is.		Cole		Morrison's Is.-Allumette Is.		Reigh		Oconto	
	N	%	N	%	N	%	N	%	N	%	N	%
1. Left Sagittal Sinus Direction	4/39	10.3	14/47	29.8	1/6	16.7	5/10	50	4/22	18.2	3/13	23.1
2. One Parietal Foramen	38/66	57.6	25/73	34.2	3/13	23.1	6/10	60	27/38	71.1	5/17	29.4
3. Lambdoid Wormians	34/35	97.1	6/28	21.4	4/5	80	1/3	33.3	3/14	21.4	3/10	30
2. Asterionic Bone	8/57	14.0	8/59	13.6	3/9	33.3	2/11	18.2	7/30	23.3	1/6	16.7
5. Two Mandibular Foramina	16/78	20.5	4/81	4.9	3/9	33.3	1/16	6.3	1/23	4.3	7/20	35.0
6. Gonial Eversion	20/44	45.4	62/92	67.4	5/11	45.5	10/11	90.9	16/25	64.0	16/24	66.7
7. Mylohyoid Arch	20/83	24.1	17/91	18.7	5/11	45.5	3/14	21.4	6/33	18.2	12/36	33.3

thought to be similar in age (Kennedy 1967). Each sample is quite small. Hence it is difficult to statistically justify their combination. Tests of infracranial dimensions (Student's t-test) show no significant differences that cannot be explained on the basis of disparate sex ratios (Pfieffer 1977). Further, these dimensions, when the two samples are pooled, show no greater coefficients of variability than do the bones of later, relatively homogeneous samples. Therefore, the two samples have been pooled to increase sample size.

Smith's Mean Measure of Distance (MMD) (Berry and Berry 1967) is used, with a correction factor for small samples sizes incorporated into the calculations (Green and Suchey 1976). This statistical test is common to the literature of skeletal distance analysis. The calculations were made using a program supplied by D. K. Patterson of University of Toronto (TI 59 calculator).

Selection of variables to be included in the analysis was based on criteria of availability (sample size), ability to reflect genetic differences (cf. Ossenberg 1976), and likelihood of trait variability. To increase potential sample sizes, left and right sides, male and female sexes were combined (as per Szathmary and Ossenberg 1978). Traits were considered for replicability, and 22 traits were chosen as being relatively unambiguous in interpretation. Seven traits were then selected from the 22 because they demonstrate frequencies which are generally greater than 5% and less than 95%. Traits used for the analysis are: sagittal sinus direction, parietal foramina, lambdoid wormians, asterionic wormians, mandibular foramina, gonial eversion, and presence of the mylohyoid arch. Of these traits, only the degree of gonial eversion requires some degree of subjective interpretation (Tables 2 and 3).

A large number of traits were rejected because of very low frequencies (commonly 0%). When sample sizes are small and one or more states of a morphological trait are rare, the probability of this state occurring is very low. The resulting small battery of traits may obscure the true relationships among groups, and this is regrettable. However, both the number of variables and samples sizes are greater for this discrete trait analysis than they could be for an analysis of cranial measurements.

TABLE **4**

MEAN MEASURES OF DISTANCE USING SEVEN DISCONTINUOUS VARIABLES

	Cole	Frontenac	MI-AI	Reigh	Oconto
Port au Choix	.076	.528**	.423**	445**	.361**
Cole		.261**	.231*	.306**	-.016
Frontenac			-.010	.039*	.036*
Morrison's-Allumette				-.017	.023
Reigh					.098*

* = $p \leq .05$
** = $p \leq .01$

RESULTS

Results are summarized in Table 4 and Figure 1. While there may be some inconsistencies, certain features can be seen clearly. The most obvious observation is that the Port au Choix sample is quite distinct from all other samples. This result is very different from that obtained from the analysis of cranial measurements (Pfeiffer 1977). Of the five comparisons involving Port au Choix , four of the MMD values are statistically significant at the 0.01 level. The fifth MMD value, comparing Port au Choix with Cole, is not statistically significant. This inconsistency is probably best attributed to the small size of the Cole sample. Composed of

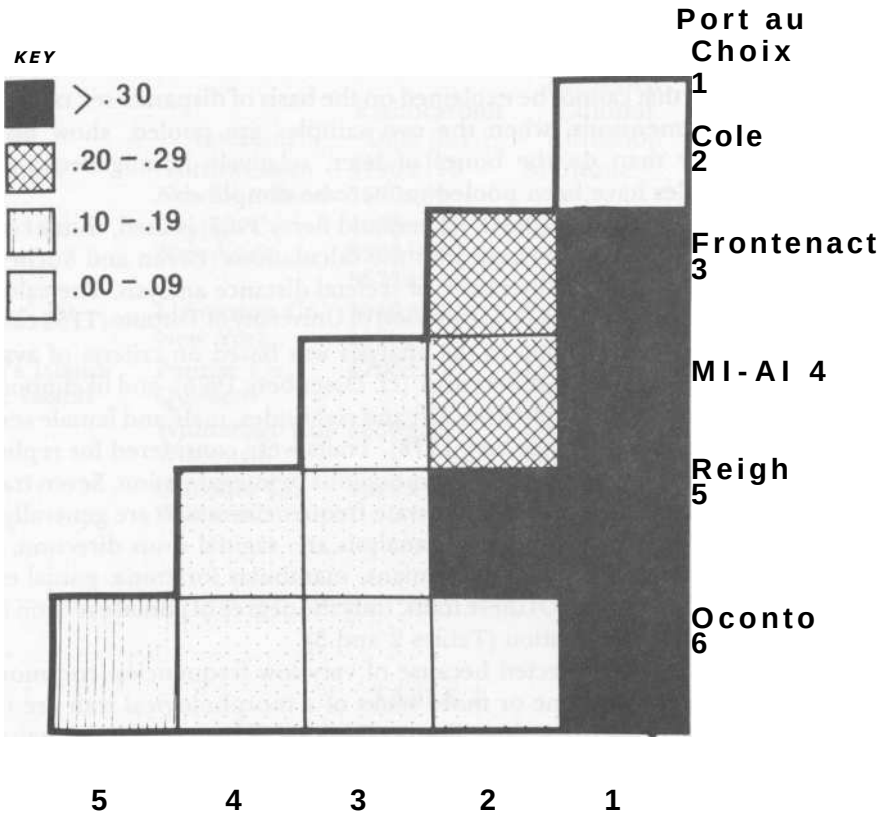

Fig. I. Shaded similarity matrix of Archaic relationships.

only nine crania, the Cole sample is the smallest to be included in this study Surprisingly, it does not even show close affinities to Frontenac Island (MMD=0.26, P<0.01). This too is contrary to what might be expected on the basis of geographic or archaeological evidence. Hence, results of comparisons involving the Cole sample may be abberant.

Among the other samples, results indicate some degree of affinity among the representatives of Laurentian and Old Copper prehistoric cultures. There is not a direct correlation between geographic proximity and cranial affinity. For example, the Reigh and Oconto sites, both from Wisconsin, share an MMD of O.98 (p0.05). There are, however, clearly more similarities among the Great Lakes samples than there are between the Great lakes samples and the Maritime sample.

The sample from Morrison's and Allumette Islands holds a "central" position. Low MMD's were calculated between it and both the Laurentian and Old Copper samples. Like the distinct position of Port au Choix, this too is contrary to the results obtained from the previous analysis of cranial measurements. In the analysis of cranial measurements MI-AI was most distinct from all other samples. This lead to the suggestion that MI-AI was an isolated population, out of breeding contact with other known Archaic populations. The analysis presented here, on the other hand, suggests quite the opposite. Based on cranial morphology, MI-AI assumes a focal position, with no statistically significant differences to either the Laurentian or Old Copper samples.

DISCUSSION AND CONCLUSIONS

The population relationships that appear to exist in this analysis were by no means expected. Although they are reasonable and readily interpretable, their existence could not be presupposed. Based upon archeological and ethnographic reconstruction, arguments can be made for varying degrees of both regional homogeneity and regional heterogeneity.

The Archaic hunter-gathers appear to have followed a pattern of seasonal migration which allowed the exploitation of a wide range of food resources. Seasonal movements can be hypothesized for a few of the better-known Archaic sites, but the relationships between local groups remain unclear. Traditions such as Laurentian, Maritime and Old Copper have been proposed. They may have considerable functional utility in terms of artifact assemblage comparisons, but the characteristic assemblages display large areas of overlap.

Archaic skeletal samples are characteristically derived from "burial stations." Each station was probably located along the preferred migratory route and deceased individuals were deposited there when the group was in the region. Some of the groups practiced cremation in up to 50% of the interments. It has been argued elsewhere that since the cremated individuals are not unique by virtue of their age or sex, they may have died while far away from the burial station and been cremated so that they could be interred later in the group's preferred plot (Pfeiffer 1974). If such were the case, a burial station could represent the remains of virtually all members of a lineage or band. Ethnographic analogy can be used to argue that hunting territories were probably associated with the subsistence pattern, and indeed there is evidence of warfare that may have been based upon conflict for preferred resources (e.g. Frontenac Island, see Pfeiffer 1977 for discussion). Both of these conditions would make the possibility of lineage or band burial plots more probable. Hence, it can be argued that each sample represents the members of a distinct genepool. One might then expect the skeletal material to form distinct units: internally homogeneous, but sharing very little genetic material between groups.

Such an argument for internally homogeneous regional isolates must be countered, however, with an argument for internal heterogeneity and contact between the samples. A major problem is that of time depth. We do not know the duration for which one burial station was used. They vary greatly in sample size. The present study includes cranial samples varying from N=9 to N=54. The bulk of the samples appear to be very small, yet occasional sites have included upwards of one hundred individuals. Does the increased number represent increased population density, increased span of site use, or both? Either possibility will probably increase internal heterogeneity. Given the lack of stratigraphy and/or distinguishable artifact assemblages, such questions cannot be answered at present.

A second problem is one of population structure. We do not know to what degree the genes of neighbours were shared. On the one hand, population density appears to have been low and therefore local gene pools may have existed in relative isolation. On the other hand, artifactual assemblages show broad regions of overlap. There do not seem to be isolated (and therefore unique) artifactual assemblages from this time period. Rather, there are many sites that display mixtures of two traditions. Kennedy (1963, 1967) sees elements of Laurentian and Old Copper at Morrision's and Allumette Islands: Baerreis et al (1957) describe both Old Copper and Glacial kame elements from the Reigh site. Such broad regions of geographic overlap may suggest patterns of distant travel and considerable exogamy. Indeed, one is reminded of Wright's (1972) hypothesized explanation for Algonkian ceramic heterogeneity which uses ethnographic analogy to suggest exchange of wives throughout a very broad geographic region.

The results obtained from this analysis of cranial morphology indicate that within the Great

Lakes region there may have been considerable gene exchange. While Frontenac Island (New York State) does not show close affinities to the Wisconsin samples, it does share a low MMD with Morrison's and Allumette Islands. The MI-AI sample, in turn, shares low MMD's with the Wisconsin sites. Such results reinforce Kennedy's observation of mixed Laurentian and Old Copper artifactual elements at the two sites.

The results of this study cannot be used to argue for the existence of any form of Archaic physical "type." If there were a Laurentian "type," then Frontenac Island and Cole should have shown strong similarities. If there were an Old Copper "type," then Reigh an Oconto might have shared a lower MMD. Certainly such types might still exist, but their existence cannot be argued from this data.

Rather, the above results may be used to tentatively suggest local populations involved in broad networks of trade and mate exchange, maintaining artifactual assemblages suitable to the local biome.

The Maritime Archaic sample, Port au Choix, is distinct from the Great Lakes samples. This complements Tuck's recent interpretation of Maritime-Laurentian relationships (cf. Tuck 1976), in which each is portrayed as a distinct tradition. As might be expected given their geographic separation, there is no clear evidence for genetic affinity between them.

It is my opinion that this analysis of cranial morphology should be preferred to the previous analysis of cranial size/shape. Of course, the results of this analysis are more appealing because they are easier to interpret. They fit better with what we know of Archaic archaeology. Methodologically, too, I believe this analysis to be more sound. Sample sizes are larger, both sexes are included, and the variables used are more likely to be of genetic significance (cf. Gruneberg 1963). That is, when doing a discriminant function analysis of fragmentary material one chooses whatever measurements one may have for inclusion. In the case of the Archaic crania, these measurements were few in number and not necessarily those most likely to reflect genetic differences. Given the assumption that the combination of males and females, left and right sides, does no statistical harm, the morphological approach is clearly preferable.

One may hope that future excavations will add further large samples to the body of Archaic skeletal material now available. The conclusions of this study would then certainly be open to revision. At present, the following tentative conclusions can be made: Maritime and Laurentian skeletal material is clearly differentiable; there are affinities among certain Laurentian and Old Copper samples, suggesting the existence of wide ranging trade networks which also facilitated gene exchange around the Great Lakes region 4000 years ago.

ACKNOWLEDGEMENTS

I would like to thank David Patterson, Erindale College, University of Toronto, for allowing me to benefit from his statistical programming skills. The co-operation of the following institutions during the data collection period is thankfully acknowledged: National Museum of Man, Ottawa; Rochester Museum & Science Center; Milwaukee Pulic Museum; University of Wisconsin, Madison.

REFERENCES CITED

Baerreis, D.A, Daifuku, H., and Lundsted J.E.
1957 The Burial Complex of the Reigh Site. Winnebago county, Wisconsin. *Wisconsin Archaeologist,* 33:4:244-78.

Berry, A.C. and Berry, R.J.
1967 Epigenetic Variation in the Human Cranium. Journal of Anatomy, 101(2):361-79.

Green, R. and Suchey, J.
1976 The Use of the Inverse Sine Transformation in the Analysis of Non-metrical Cranial Data. *American Journal of Physical Anthropology,* 45:61-68.

Gruneberg, H.
1963 *The Pathology of Development: a Study of Inherited Skeletal Disorders in Animals.* Wiley Publication, New York.

Hayes, C. F. III
1969 A Progress Report on an Archaic Site on the Farrell Farm: the Cole Gravel Pit 1966-68. *Bulletin of the New York State Archaeological Association,* 47:1-12.

Kennedy, C. C.
1963 The Allumette Island-1 (ALI) site: Field Report to the National Museum of Canada. Manuscript on file at the Museum, Ottawa.
1967 A preliminary Report on the Morrison's Island-6 Site. *National Museum of Canada, Bulletin* 206:100-125.

Ossenberg N. S.
1976 Within and Between Race Distances in Population Studies Based on Discrete Traits of the Human Skull. *American Journal of Physical Anthropology,* 45:3:701-716.

Pfeiffer, S.
1974 Analysis of Cremations from Two Late Archaic Burial Sites: Riverside and Hind. *The Wisconsin Archaeologist,* 55:4:302-308.
1977 The Skeletal Biology of Archaic Populations of the Great Lakes Region. *National Museum of Man Mercury Series No. 64.*

Ritchie, W.A.
1961 A Typology and Nomenclature for New York Projectile Points. *New York State Museum and Science Service, Bulletin Number 384* (revised 1971).
1965 *The Archaeology of New York State.* Natural History Press. New York.

Ritzenthaler, R. E.
1970 Another Radiocarbon Date for the Oconto Site. *Wisconsin Archaeologist,* 51:2:77.

Ritzenthaler, R. E. and Wittry, W. L.
1952 The Oconto Site: an Old Copper Manifestation. *Wisconsin Archaeologist,* 33:4:199-223.

Szathmary, E. J. E. and Ossenbery, N. S.
1978 Are the Biological Differences Between Indians and Eskimos Truly Profound? *Current Anthropology,* 19:4:673-702.

Tuck, J. A.
1976 Ancient People of Port au Choix, the Excavation of an Archaic Indian Cemetery in Newfoundland. *Newfoundland Social and Economic Studies No. 17.* Institute of Social and Economic Research. Memorial University of Newfoundland.

Wright, J. V. *Ontario Prehistory, and Eleven- Thousand- Year Archaeologic Outline.* National Museum of Man, Ottawa.

School of Human Biology
University of Guelph
Guelph, Ontario N1G 2W1