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Human Skeletal Remains Excavated at the Hot Springs Village Site, Port Moller, Alaska Peninsula, in 1972

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Four human skeletal remains were recovered by H. OKADA and his crew at the Hot Springs village site, Port Moller, the Alaska Peninsula, in 1972 (OKADA & OKADA, 1973, 1974). The material has been deposited with the Department of Anthropology of the National Science Museum in Tokyo for osteological treatments and analyses.

The archaeological background of the material will be described briefly in the first section by H. O. It will then be followed by the sections of the osteological descriptions and comparative analyses by B. Y.

Archaeological Background of the Material

The Hot Springs Village Site

The site is located at 55°52′N. latitude and 160°30′W. longitude, on one of the headlands extending northward into Port Moller, a bay on the Bering Sea shore of the Alaska Peninsula. It covers an area of approximately 60,000 square meters of low sandy tundra. The midden area is divided by a hot water stream into two parts: the highland sloping down toward the stream and the lowland extending to the west of the stream.

The site was investigated in 1928 by E. M. WEYER and yielded some 1,100 artifacts as well as four human skeletal remains (WEYER, 1930). In 1960, a joint team from the University of Wisconsin and Meiji University carried out excavations for five weeks and disclosed some 1,000 artifacts and seven human skeletal remains (OKA *et al.*, 1961; WORKMAN, 1962, 1966). Charcoal from the bottom layers of two trenches yielded dates of 2680±250 (I–1507) and 2960±320 (I–1508) years B. P.

The 1972 Excavations

The field crew, consisting of H. OKADA, A. OKADA, Y. KOTANI, Keishi HATTORI, Kumi HATTORI, M. MORIHARA, N. KUBO, Y. MIYATSUKA, and M. SUGITA, spent four weeks on the Hot Springs village site from July 10 to August 5, 1972. More than

330 probable semi-subterranean houses were located and mapped. One house from the lowland and another from the highland were selected for intensive excavation. The refuse deposits surrounding the lowland house were also inspected by placing two trenches.

Charred organic material from the lowland house yielded a date of 1390±70 B.P. (TK–124), while charcoal from the highland house yielded a date of 610±90 B.P. (TK–125), at the University of Tokyo Radiocarbon Laboratory.

Descriptions of the house structures as well as of the bone and stone artifacts have been given in the preliminary report (OKADA & OKADA, 1973, 1974).

Burials

In addition to a large number of stone and bone artifacts, remains of four human skeletons were found in and around the lowland house.

Burial 1 was the cranium of a child with associated finds of vertebrae and ribs. It was crushed flat on the house floor and had red ochre on it. Pieces of two broken pins were found beside the cranium.

Burial 2 was also found in the lowland house. An oval pit of 1×0.7 m in diameters and 0.18 m in depth from the level of the house floor contained the cranium and only a small part of the postcranial skeleton of an adult. No artifacts were discovered in association but the remains were overlain by a whale rib.

Burial 3 was found underneath the compact shell lenses in the east-west trench. It was the isolate cranium of an adult, lacking the mandible and the entire postcranial skeleton.

Burial 4 was the skeleton of an adult found in relatively good condition in the north-south trench, extending to the south of the lowland house. The skeleton was buried presumably in a flexed position in the layer of brown soil between two shell layers, and was covered by an alignment of stones of various sizes. Associated with the skeleton were a beautifully carved ornament, a decorated pin, a whale bone adze, a side prong for a fish spear and two stone arrowheads. Among the alignment of stones, a whale vertebra was recognized. Stratigraphically, Burial 4 is significantly younger than the other three burials.

Cultural Affinities

In relation to the findings of human skeletal remains in the house, the Aleut custom of burying the dead in a side compartment of an underground house should be taken into consideration. The burial pit dug into the floor of the lowland house comes closer to the Aleut burial practice, although no compartments as such were found in this case.

More data are needed not only in artifact types but also in house structures, burial customs and many other important cultural characteristics. But, at the present stage of study, the auther (H. O.) shares the opinion of WORKMAN (1966) in seeing the strongest Port Moller cultural affinities in the direction of the Aleutian Islands rather than mainland Alaska.

Osteological Descriptions of the Material

Cranial measurements of the adult individuals (# 2, 3, and 4) will be treated collectively in the end of this chapter. The incidence of minor non-metrical cranial variants will be handled in the last chapter.

Burial 1 (Infant about 5 years old)

The remain consists of the skull with the incomplete facial skeleton and the broken cranial base (Pl. 1, Fig. 1), the cervical and the upper thoracic vertebrae, fragments of the sternum, a fragment of the rib, a fragment of the fibula, and several foot bones. The mandible was found apart from other bones. Red ochre adheres to the cranium, the cervical vertebrae, and the rib.

Neurocranium. The cranial length: 163; the cranial breadth: 137; the cranial index: 84.0 (brachycranial). The glabella, the superciliary arches and the external occipital protuberance indistinct.

Face. The orbital margin oval. The sagittal profile of the nasion region even and smooth. The canine fossa absent; the inferior margin of the piriform aperture blunt. A low palatine torus discernible along the median palatine suture.

Mandible. The mental foramina multiple on both sides; the mandibular torus absent.

Dentition.

—	—	—	—	i_2	/	i_1	i_2	c	m_1	m_2	(M_1)
(M_1)	m_2	m_1	c	i_2	/	/	/	c	m_1	m_2	(M_1)

(—: tooth present but socket missing; /: tooth missing but socket present; ( ): tooth erupting)

The first permanent molars about to break through. A permanent upper incisor exposed at the broken part of the alveolar process on the right side definitely shovel-shaped.

Postcranial bones. Nothing worthy of special mention.

Burial 2 (Mature male)

The remain consists of the skull (Pl. 1, Fig. 2), a few fragments of the vertebrae and the ribs, the pisiform, fragments of the ilium, the right patella and parts of the foot skeletons. Not a single long limb bone is preserved. The mandible was again found separately.

Neurocranium. The glabellar portion missing. The vault sutures still distinct ectocranially, though largely obliterated endocranially. The superciliary arches and the external occipital protuberance scarcely developed. The forehead rather low and narrow; the frontal bossing indistinct; the supra-orbital nerve grooves present on both sides. No sign of the sagittal keel. The mastoid process medium-sized; the supramastoid crest well marked.

Face. The orbital margin high and narrow. The horizontal section of the nasalia low roof-shaped; the sagittal profile slightly concave. The anterior surface of the frontal process of the maxilla almost even with the frontal plane. The zygomatic

bone medium-sized and not flared; the malar tuberosity absent; the zygomaxillary tuberosity (OSCHINSKY, 1962) weak; the anterior surface of the zygomatic bone not vertical, but inclined downwards and posteriorly. The infrazygomatic crest not incised; the canine fossa absent; the piriform aperture limited inferiorly by a faint ridge; the alveolar process of the maxilla slightly prognathous.

Mandible. Found out of the pit. The mental tubercles well developed; the mental foramen single on both sides; the angle thickened and everted, forming the preangular notch in front; the mandibular torus absent.

Dentition.

		A		A																		A		
/	/	M_1	/	/	/	/	/	|	/	I_2	/	/	/	M_1	/	/
*	M_2	M_1	/	/	/	=	=	|	=	/	/	/	/	M_1	M_2	*

(A: abscess at the root; *: congenital absence; =: tooth and socket missing)

The dentine exposed over the entire occlusal surface in all teeth due to advanced attrition. The wear of the $\underline{|I_2}$ nearly horizontal, whereas those of the molars oblique (*ad palatum*). The wear of the $\underline{M_1}|$ so advanced that the pulp cavity exposed widely and an abscess formed around the apices of the buccal roots. Traces of abscess discernible also in the alveoli of the upper second molars. The lower third molars congenitally absent.

Vertebrae and ribs. Only a piece of a thoracic vertebra, two pieces of the coccygeal bone and four small rib fragments are preserved.

Upper limb bones. Only a pisiform bone is preserved.

Lower limb bones. Fragments of the right and left ilia are preserved. The left sciatic notch presumably narrow, suggesting the sex to be male.

The right patella is complete; 40 mm high, 42 mm wide, and 19 mm thick, falling within the male ranges in all diameters. The vastus notch absent; the articular surface normal.

Of the foot skeletons, the left talus, the left calcaneus, and several other bones are preserved. The left talus is complete; 48 mm long, 39 mm wide and 29 mm high. An incipient lateral squatting facet (a smooth concave surface) observable on the lateral part of the neck. The anterior and the middle articular facets for the talus of the left calcaneus completely separated.

Burial 3 (Mature male)

Only the cranium without the skull base is preserved of this individual (Pl. 2, Fig. 3).

Neurocranium. The frontal and the parietal bossing obscure. The vault sutures almost entirely closed inside the calvaria, whereas still at the first or second stage of obliteration outside. The glabella developed to the grade III of Broca; the superciliary arches well developed, separately from the glabellar eminence, along the medial third part of the supra-orbital margin; the forehead broad, receding, and sagittally ill-curved. The sagittal keel rudimentary; the superior temporal lines relatively high,

the minimum arc between the right and left lines being about 10 cm.

Face. The upper face low, broad, and orthognathous. The orbital margins oblique and oblong. The frontal process of the maxilla even with the nasal bone, forming together a horizontal contour of rectangular roof-shape; the sagittal profile of the nasalia concave. The zygomatic bone large and flared; the marginal tubercle pronounced; the zygomaxillary tuberosity developed strongly, causing the zygomaxillary and the inframaxillary fossae (defined by OSCHINSKY, 1962); the anterior surface of the zygomatic bone not vertical, though. The inferior nasal margin sharply defined; the canine fossa small and deep; the infrazygomatic crest deeply notched; the alveolar process of the maxilla low and orthognathous.

Maxillary dentition.

/	M_2	M_1	P_2	P_1	C	×	×	/	/	/	P_1	P_2	×	/	/

(×: tooth lost ante-mortem)

Tooth attrition generally horizontal and extremely advanced; the canine and the premolars completely divested of the enamel; the pulp cavity of the canine exposed. All the remaining teeth affected by advanced hypercementosis; most of the empty alveoli more or less enlarged by resorption, probably due to hypercementosis.

Burial 4 (Adult male)

The remain is composed of the skull (Pl. 2, Fig. 4) and the incomplete postcranial skeleton. The vertebrae and the bones of the thoracic cage are very fragmentary.

Neurocranium. The vault sutures fully open. The glabellar eminence and the superciliary arches slight; the forehead somewhat receding; the supra-orbital nerve grooves marked on both sides. The sagittal keel slightly indicated. The superior part of the occipital squama well-curved and protruding; the external occipital protuberance slight. The mastoid process medium-sized; the supramastoid crest pronounced; the tympanic plate slightly thickened.

Face. The upper face wide and moderately high, with the flaring zygoma. The orbital margins oblique and oval. The facial surface of the frontal process of the maxilla set almost even with the frontal plane. The nasalia missing, but the so-called "pinched nasal bones" suggested by the morphological pattern of the interorbital region. The piriform aperture narrow; its inferior margins blurred. The zygomatic bone medium-sized, with slight zygomaxillary tuberosity; the anterior surface of the zygoma not vertical. The canine fossa wide and shallow; the infrazygomatic crest not notched; the alveolar process of the maxilla slightly prognathous; a low torus present along the median palatine suture.

Mandible. The mental protuberance and tubercles pronounced; the mental foramen multiple on the left side; the lower margin of the body straight; gonial eversion slight; the ramus broad and low; rudimentary mandibular tori noticeable on both sides.

Dentition.

/	/	M_1	P_2	P_1	C	I_2	I_1	/	/	/	P_1	P_2	M_1	M_2	M_3
M_3	M_2	M_1	P_2	P_1	C	I_2	I_1	/	/	/	/	/	M_1	M_2	*

The dentine exposed partially, due to horizontal attrition, with the exception of the third molars. No caries cavities recognizable. Calculus deposited moderately. Only one M_3 congenitally absent.

Upper limb bones. (In the following description of the postcranial bones, measurements taken after the definitions of MARTIN & SALLER (1957) are shown by affixing MARTIN's number at the head.)

The left clavicle with the acromial end broken is slender.

L. Clavicle:—	6.	Mid-shaft circumference	32 mm

The right humerus with the distal end broken is robust. The posterior ridge of the deltoid tuberosity is so protuberant that the humeral shaft looks as if it were bent at the middle.

R. Humerus:—	5.	Maximum shaft diameter at middle	26 mm
	6.	Minimum shaft diameter at middle	19
	6:5.	Shaft index at middle	73.1
	7.	Minimum shaft circumference	74
	9.	Transverse head diameter	45
	10.	Vertical head diameter	46
	9:10.	Head index	97.8

The right ulna lacks the distal end. The left ulna is almost complete.

L. Ulna:—	1.	Maximum length	256 mm
	2.	Functional length	220
	11.	Maximum shaft diameter	17.5
		Minimum shaft diameter at the same level	12.0
		Shaft index	68.6
	3.	Minimum shaft circumference	39
	3:2.	Robustness index	17.7

Lower limb bones. The right and left innominate bones, with the pubis missing, are preserved. The morphology of the sciatic notch is definitely that of the male.

Both of the right and left femora lack the proximal end. The shaft robust; the third trochanter slightly indicated on both sides; the upper part of the shaft flat antero-posteriorly, showing a lateral convexity; the linea aspera moderately developed. The articular surfaces of the distal end entirely free from pathological degenerations.

L. Femur:—	5.	Length of the shaft	333 mm
	6.	Sagittal shaft diameter at middle	29
	7.	Transverse shaft diameter at middle	26
	6:7.	Shaft index at middle	111.5
	8.	Shaft circumference at middle	87
	8:5.	Robustness index	26.1
		Maximum shaft diameter at subtrochanteric level	34.5
		Minimum shaft diameter at subtrochanteric level	22
		Shaft index at subtrochanteric level	63.8

The left fibula lacks the proximal end. The lateral surface is deeply fluted.

L. Fibula:—	2.	Maximum shaft diameter at middle	16
	3.	Minimum shaft diameter at middle	14.5
	3:2.	Shaft index at middle	90.6

Of the hand and foot skeletons, only two metacarpals, two metatarsals and four phalanges are preserved.

Other Isolate Human Skeletal Remains

In addition to the above described remains from four burials, the mandible of an infant 3 or 4 years old, the shaft fragment of a juvenile left femur, and several pieces of calvarial fragments were found in the trenches placed adjacent to the lowland house.

Craniometry of the Adult Skulls

Cranial measurements and indices of the three adult male skulls are collectively recorded in Table 1. Craniometric numbers of MARTIN & SALLER (1957) are given in the first column.

The calvaria of #3 is exceptionally large, while those of #2 and #4 are rather small. All three calvaria fall into mesocranial range in the length-breadth index. The calvarial height indices (17: 1 of #2; 20: 1 of #2 and #4) are all orthocranic. According to the transverse fronto-parietal index (9: 8), the forehead is relatively narrow (#2 is metriometopic; and #3 and #4 are stenometopic).

Of the median sagittal arc, the frontal segment is longer than the parietal in all three calvaria. The sagittal frontoparietal indices are around 90. The occipital arc is also relatively long. As for the median sagittal curvature, that of the frontal bone is slight in all cases. The occipital curvature is pronounced only in #4. According to the frontal profile angles obtained for #2 and #4, the frontal bone is considerably inclined backward.

The face is broad, with the exception of #2, and moderately high in all cases. The upper facial index of #2 falls within the narrow (leptene) range, whereas those of #3 and #4 fall within the medium (mesene) range. Although the total profile angles obtained for #2 and #4 are fairly large (orthognathous and mesognathous), the alveolar profile angles are rather small and fall into the prognathous range.

The orbital margin is relatively high. The orbital index of #2 is hypsiconchic, and those of #3 and #4 are mesoconchic. The piriform aperture is relatively narrow in all cases. All the three nasal indices are leptorrhine. The maxillary alveolar arch is relatively long, particularly so in #3 and #4. The mandible is characterized by the large bigonial diameter and the low and broad ramus.

As for the facial flatness measurements, the Hot Springs skulls are generally close to the averages of the Eskimo reported by DEBETS (1951), with the only exception of the simotic index which is relatively low due to the broadness of the simotic chord.

According to the zygomatic measurements, as defined by WOO (1937), the zygomatic bones of the Hot Springs skulls are much larger than the averages of most populations and very close to those of the Greenland Eskimo. The horizontal curvature is considerable in all three cases, but does not reach the average extent of the Greenland Eskimo.

Summary of the Cranial Morphology

OSCHINSKY (1964) summarized the morphological pattern characteristic of the Eskimo skulls as consisting of the presence of the following craniological features: the

Table 1. Craniometry of the Hot Springs adult male material.

MARTIN's No.	Measurements and Indices	#2	#3	#4
1	Glabello-occipital length	(183)	193	183
5	Basion-nasion length	108	—	—
8	Maximum breadth	138	151	(138)
9	Minimum frontal diameter	92	99	90
10	Maximum frontal diameter	—	120	—
11	Biauricular breadth	129	—	130
12	Maximum occipital breadth	113	—	105
13	Mastoideal breadth	104	—	—
17	Basion-bregma height	133	—	—
18	Maximum vault height	135	—	—
20	Auriculo-bregmatic height	109	—	110
21	Vertical auricular height	111	—	112
23	Horizontal circumference	516	552	(511)
24	Transverse arc	302	—	302
25	Sagittal arc	(356)	—	365
26	Frontal arc	(124)	133	122
27	Parietal arc	114	121	109
28	Occipital arc	118	—	134
29	Frontal chord	112	122	110
30	Parietal chord	104	110	100
31	Occipital chord	103	—	109
32	Frontal profile angle	74°	—	73°
40	Basion-prosthion length	103	—	—
43	Upper facial breadth	104	110	109
45	Maximum bizygomatic diameter	133	(141)	144
46	Mid-facial breadth	99	109	106
48	Upper facial height	80	76	76
50	Anterior interorbital breadth	19	21	21
51	Orbital breadth (mf)	43	42	r 43
51a	Orbital breadth (d)	r 41	40	—
52	Orbital height	39	35	r 36
54	Nasal breadth	24	24	25
55	Nasal height	56	57	55
57	Minimum breadth of nasalia	10	8	9
57–2	Upper breadth of nasalia	13	10	9
60	Length of upper alveolar arch	53	(58)	58
61	Breadth of upper alveolar arch	(65)	(66)	63
66	Bigonial diameter	108	—	107
68	Mandibular length	75	—	88
69–1	Height of mandibular body	32	—	35
69–3	Thickness of mandibular body	12	—	14
70	Height of ramus (direct)	55	—	56
70a	Height of ramus (mandibulometer)	55	—	60
71	Minimum breadth of ramus	—	—	41
72	Total profile angle	87°	—	82°
72–5	Prosthion angle ∠n-pr-ba	72°	—	—
74	Alveolar profile angle	74°	—	73°
77	Nasomalar angle	145°	143°	153°
79	Mandibular angle	119°	—	121°
80	Length of maxillary dental arch	—	—	(56)
80a	Length of mandibular dental arch	—	—	53
80–3	Upper molar length	—	—	30
80–3	Lower molar length	—	—	r 35

MARTIN's No.	Measurements and Indices	#2	#3	#4
8:1	Length-breadth index	(75.4)	78.2	(75.4)
17:1	Length-height index	(72.7)	—	—
17:8	Breadth-height index	96.4	—	—
20:1	Auriculovertical index	(59.6)	—	60.1
9:10	Transverse frontal index	—	82.5	—
9:8	Transverse frontoparietal index	66.7	65.6	(65.2)
12:8	Transverse parietooccipital index	81.9	—	(76.1)
27:26	Sagittal frontoparietal index	(91.9)	91.0	89.3
28:27	Sagittal parietooccipital index	103.5	—	122.9
26:25	Frontosagittal index	((34.8))	—	33.4
27:25	Parietosagittal index	(32.0)	—	29.9
28:25	Occipitosagittal index	(33.1)	—	36.7
29:26	Frontal curvature index	(90.3)	91.7	90.2
30:27	Parietal curvature index	91.2	90.9	91.7
31:28	Occipital curvature index	87.3	—	81.3
31:12	Breadth-height index of occipital	91.2	—	103.8
(1+8+17)/3	Cranial module	(151.3)	—	—
48:45	Upper facial index	60.2	(53.9)	52.8
66:45	Jugomandibular index	81.2	—	74.3
52:51	Orbital index (mf)	90.7	83.3	r 83.7
52:51a	Orbital index (d)	95.1	87.5	—
54:55	Nasal index	42.9	42.1	45.5
54:45	Transverse nasofacial index	18.0	(17.0)	17.4
61:60	Upper alveolar index	(122.6)	((113.8))	108.6
40:5	Gnathic index	95.4	—	—
(40+45+48)/3	Upper facial module	105.3	—	—
71:70	Ramus index	—	—	73.2
40:1	Longitudinal craniofacial index	(56.3)	—	—
48:18	Vertical craniofacial index	59.3	—	—
45:8	Transverse craniofacial index	96.4	(93.4)	(104.3)
9:45	Jugofrontal index	69.2	(70.2)	62.5
Facial flatness measurements and indices[1]				
	Frontal chord (IOW)	97.7	101.1	100.4
	Frontal subtense	16.0	16.8	12.0
	Frontal index of flatness	16.4	16.6	12.0
	Simotic chord	9.5	8.4	9.0
	Simotic subtense	3.4	2.6	—
	Simotic index	35.8	31.0	—
	Zygomaxillary chord	—	109.1	102.0
	Zygomaxillary subtense	—	25.3	17.4
	Zygomaxillary index	—	23.2	17.1
Zygomatic measurements and indices[2]				
	Minimum horizontal arc	63	r 71	r 73
	Minimum vertical arc	51	r 56	r 53
	Horizontal chord	56.3	r 62.7	r 64.6
	Maximum subtense	12.8	r 13.7	r 13.6
	Curvature index	22.7	r 21.9	r 21.1

Note: Measurements in parentheses are estimated values. Indices based on one or two estimates are denoted by single or double parentheses.

1) For definitions, see WOO & MORANT (1934) and ALEKSEEV & DEBETS (1964), or YAMAGUCHI (1973). 2) WOO (1937).

sagittal keel, pinched narrow nasal bones, thickened tympanic plates, extreme anterior projection of the zygomaxillary tuberosities, zygomaxillary fossae, inframaxillary fossae, gonial eversion, mandibular torus, and large nasomalar and zygomaxillary angles.

Each of these ten traits can be observed in the Hot Springs cranial material, but the degree of its development is much less than that described by OSCHINSKY who investigated the Eskimo craniology mainly through the material from the Canadian Arctic. It is well known that the Central and Eastern Eskimo of Canada and Greenland are much more specialized morphologically than the Eskimo of the western regions, such as the Alaskan Eskimo, the Aleut, and the Siberian Eskimo (MORANT, 1937; LAUGHLIN & MARSH, 1951; ALEKSEEV, 1964). Therefore, the morphological pattern of the Hot Springs skulls characterized by the complete set of the Eskimo traits expressed in their unexaggerated forms demonstrates the affinity of the Hot Springs series to be closer with the western branches of the Eskimo stock than with the groups in Canada and Greenland.

Comparative Analyses of the Hot Springs Crania

At the time of the first contacts with Europeans, the Port Moller region of the Alaska Peninsula was where the areas occupied by the Anglemiut Eskimo to the northeast, the Aleut to the west, and the Koniag-Eskimo to the southeast were contiguous to each other (WORKMAN, 1966). The analyses of the artifacts and various features of the Hot Springs site have led one of the authors (H. O.) to conjecture some cultural affinities with the Aleut tradition (See the first chapter). The following statistical analyses of the craniological data have been attempted with the intentions of assessing the physical affinities of the Hot Springs cranial series with the Eskimo, the Aleut, and the Koniag, and of learning whether the results of the cultural analyses of the archaeological materials are endorsed by the biological data or not.

Distance Analysis (I) of the Metrical Characters

The most replete craniometric data hitherto published of the Western Eskimo and the Aleut are those reported by DEBETS (1951). In spite of the fact that DEBETS' Eskimo material derived, not from Alaska, but from the Chukchee Peninsula, his data were first compared with those of the Hot Springs material, because a large number of measurements could be utilized for calculating the distances from the present series to the Eskimo and the Aleut averages.

Table 2 gives the sixteen cranial measurements of the Hot Springs skulls side by side with the corresponding male averages of the Asiatic Eskimo and of the Aleut quoted from DEBETS (1951). The standard deviations given in the last column are of the Eskimo series. They were used for standardizing the differences between the Hot Springs measurements and the DEBETS' averages.

PENROSE's shape distances (PENROSE, 1953–1954; CONSTANDSE-WESTERMANN, 1972)

$$C_z^2=\frac{1}{r-1}\left\{\sum^{r} d_i^2-\frac{(\sum^{r} d_i)^2}{r}\right\},$$

Table 2. Craniometric data for the distance analysis (I).

Measurements	Hot Springs #2	Hot Springs #3	Hot Springs #4	Asiatic Eskimo male means*	Aleut male means*	Asiatic Eskimo male S.D.*
Cranial length	(183)	193	183	181.8	179.9	*6.4*
Cranial breadth	138	151	(138)	140.7	145.4	*4.1*
Auriculo-bregmat. ht.	109	—	110	113.9	110.0	*3.6*
Minimum frontal diam.	92	99	90	94.9	92.2	*3.4*
Orbital breadth (mf)	43	42	r 43	43.4	43.8	*1.6*
Orbital height	39	35	r 36	35.9	36.3	*1.7*
Nasal height (ns)	56	57	55	54.6	51.7	*2.7*
Nasal breadth	24	24	25	24.4	25.3	*1.5*
Simotic chord	9.5	8.4	9.0	6.54	7.66	*1.55*
Simotic subtense	3.4	2.6	—	2.83	2.92	*0.96*
Bizygomatic diameter	133	—	144	137.5	142.2	*4.9*
Upper facial height	80	76	76	77.5	73.8	*4.6*
Frontal chord (IOW)	98	101	100	99.9	99.4	*3.3*
Nasomalar angle	145	143	153	146.2	145.5	*4.2*
Zygomaxillary chord	—	109	102	99.0	101.8	*4.6*
Zygomaxillary angle	—	129	140	135.6	138.1	*5.1*

* Quoted from DEBETS (1951).

Table 3. Results of the distance analysis (I).

	#2	#3	#4
No. of measurements	14	14	15
Distances to Eskimo			
C_H^2	0.8806	1.5308	0.8096
C_Q^2	0.0008	0.1699	0.0431
$\boldsymbol{C_z^2}$	**0.9474**	**1.4655**	**0.8213**
Distances to Aleut			
C_H^2	1.2020	1.6643	0.6800
C_Q^2	0.0030	0.1231	0.0272
$\boldsymbol{C_z^2}$	**1.2912**	**1.6598**	**0.6994**

where d_i is the standardized difference and r is the number of measurements, were calculated between each of the Hot Springs adult male skulls on the one hand and the Eskimo and the Aleut series on the other hand. Results are shown in Table 3.

The Hot Springs skulls #2 and #3 are closer to the Eskimo than to the Aleut, whereas the skull #4 is closer to the Aleut rather than to the Eskimo. In either case, however, the difference between the two distances is slight.

Distance Analysis (II) of the Metrical Characters

The craniometric data of the materials from the more crucial regions, such as southwestern Alaska, the Aleutian Islands, and Kodiak Island, were contributed by HRDLIČKA (1942), though the number of cranial measurements was limited as compared with that of DEBETS.

The male means of eight cranial measurements of the Eskimo of south-western Alaska, the Pre-Aleut, the Aleut, the Pre-Koniag, and the Koniag are given in Table 4 alongside those of the Hot Springs series. PENROSE's shape distances have been calculated between those six cranial series, using the S.D. of the Egyptian E series.

Table 4. Craniometric data for the distance analysis (II).

HRDLIČKA's cranial measurements	Hot Springs averages*	Male averages given by HRDLIČKA**					S.D.***
		S.W. Alaska Eskimo	Pre-Aleut	Aleut	Pre-Koniag	Koniag	
Diam. ant.-post. maxim.	186.3	182.9	185.7	179.7	178.8	173.3	*5.72*
Diam. lateral maxim.	142.3	140.3	141.9	149.8	139.1	149.7	*4.76*
Alveol. Pt.-Nasion height	77.3	77.5	75.6	75.3	77.9	74.7	*4.15*
Diam. bizygomat. maxim.	139.3	140.6	143.7	144.0	139.4	144.8	*4.57*
Orbits-Height, mean	36.7	36.2	36.4	36.2	36.3	35.6	*1.88*
Oribits-Breadth, mean	40.3	41.3	41.6	41.4	41.0	41.1	*1.65*
Nose, Height	55.8	54.1	53.2	52.5	53.9	52.8	*2.92*
Nose, Breadth maxim.	24.3	23.9	25.9	25.5	25.0	25.0	*1.77*

* Remeasured after HRDLIČKA's methods (STEWART, 1947).

** Cited by DEBETS (1951).

*** Of the Egyptian E series (PEARSON & DAVIN, 1924).

Table 5. Results of the distance analysis (II).

$\sqrt{C_z^2}$ \ C_z^2	Hot Springs	Eskimo	Pre-Aleut	Aleut	Pre-Koniag	Koniag
Hot Springs	——	0.1823	0.4632	1.0358	0.3664	1.5882
Eskimo, S.W. Alaska	*0.43*	——	0.2653	0.8168	0.1456	1.2440
Pre-Aleut	*0.68*	*0.52*	——	0.5711	0.3453	1.0855
Aleut	*1.02*	*0.90*	*0.76*	——	0.8415	0.1612
Pre-Koniag	*0.61*	*0.38*	*0.59*	*0.92*	——	1.1481
Koniag	*1.26*	*1.12*	*1.04*	*0.40*	*1.07*	——

Examining the results summarized in a matrix form in Table 5, the interrelationship of the six groups can be delineated as follows: the Eskimo of southwestern Alaska, the Pre-Aleut and the Pre-Koniag form a closely interrelated triangular cluster, whereas the Aleut and the Koniag form another cluster, separated from the former; and the Hot Springs series is adjunctive to the first cluster rather than to the latter. In other words, the older forms of the Aleut as well as of the Koniag were hardly distinguishable from the Eskimo of southwestern Alaska, and the Hot Springs series was also very close to them, whereas the later forms of the Aleut and the Koniag appear to have differentiated and separated from the ancestral cluster. It should be noticed, in this connection, that the two human crania excavated previously from the same site were identified as those of the Paleo-Aleuts by LAUGHLIN (1966).

Likelihood Ratio Analysis of the Non-Metrical Discrete Characters

The incidence data of various discrete morphological traits in the skull have been shown to be considerably useful in the assessment of genetic affinities between different skeletal populations by LAUGHLIN & JØRGENSEN (1956), BERRY & BERRY (1967), YAMAGUCHI (1967), ANDERSON (1968), and many others. In most analyses along this line, the incidences of discrete traits are recorded as percentages. Population distance is calculated between two sets of percentage data or between two sets of angle data obtained from percentages by various angular transformations.

In case of the Hot Springs material, which consists of only four skulls, it is impossible to characterize such a small sample adequately by percentage incidences of various discrete traits. Therefore, the following analysis deals with each individual instead of the sample comprising four skulls. It aims to find out the population from which each individual has most likely been drawn by comparing the incidence pattern of a number of discrete traits in each individual with the sets of percentage data of the same series of traits in various populations.

In this particular case, we are concerned with the question to which population the Hot Springs skulls should be attributed, the Eskimo or the Aleut. Incidence data of a large number of discrete cranial traits in these arctic populations reported by

Table 6. Data for the likelihood ratio analysis of non-metrical discrete cranial characters.

Discrete traits	Incidence in Hot Springs skulls*				Proportions** in Alaskan Eskimo		Proportions** in Aleut	
	#1	#2	#3	#4	present (+)	absent (−)	present (+)	absent (−)
1 Metopism	−	−	−	−	0.029	0.971	0.050	0.950
2 Os japonicum, incl. trace	−	−	−	−	0.219	0.781	0.282	0.718
3 Infraorbital suture	+	+	+	+	0.618	0.382	0.541	0.459
4 Tympanic dehiscence[1]	V	−	V	−	0.274	0.726	0.566	0.434
5 Foramen spinosum, defective	V	−	V	−	0.185	0.815	0.125	0.875
6 Marginal for. of tymp. plate[1]	V	−	V	−	0.080	0.920	0.316	0.684
7 Pterygospinous bridge	V	−	V	V	0.074	0.926	0.042	0.958
8 Mylohyoid bridge[2]	V	−	V	−	0.049	0.951	0.257	0.743
9 Parietal notch bone	+	−	V	−	0.292	0.708	0.198	0.802
10 Epipteric bone	−	V	V	V	0.219	0.781	0.173	0.827
11 Parietal foramen, absent	+	+	−	−	0.473	0.527	0.550	0.450
12 Postcondylar canal, absent	V	−	V	−	0.151	0.849	0.208	0.792
13 Supraorbital foramen	−	+	+	+	0.603	0.397	0.573	0.427
14 Supratrochlear foramen	−	−	−	+	0.234	0.766	0.148	0.852
15 Frontal grooves	+	+	+	+	0.280	0.720	0.326	0.674
16 Multiple mental foramina	+	−	V	+	0.097	0.903	0.103	0.897

* Incidence on the left side was recorded preferentially when both sides were observable.

** Quoted from OSSENBERG (1969); proportions of bilateral traits were calculated by sides.

1) Observation limited to the materials over 8 years old.

2) For the materials over 21 years old only.

OSSENBERG (1969) afford excellent comparative data for the analysis. Presence or absence pattern of sixteen discrete cranial characters is given for the four Hot Springs skulls in Table 6 beside the incidence proportions of those characters in the Alaskan Eskimo and the Aleut quoted from OSSENBERG (1969).

Theoretically, the likelihood of a skull to have been drawn from a population is given as

$$L=\Pi P_i^{x_i}Q_i^{(1-x_i)}$$

where P_i is the incidence proportion of each trait in the population, $Q_i=1-P_i$, x_i is 1 or 0 according as the ith trait is present or absent in the skull (TAKAHASHI, 1969). The calculation can be simplified by using logarithms.

$$\log L=\sum x_i \log P_i+\sum (1-x_i)\log Q_i$$

The actual procedure of calculating the likelihood ratio is shown below by the example of the skull # 1.

Trait No.	Incidence in HS #1	Proportion in Eskimo	⟶ log	Proportion in Aleut	⟶ log
1	−	0.971	$\bar{1}$.9872	0.950	$\bar{1}$.9777
2	−	0.781	$\bar{1}$.8927	0.718	$\bar{1}$.8561
3	+	0.618	$\bar{1}$.7910	0.541	$\bar{1}$.7332
9	+	0.292	$\bar{1}$.4654	0.198	$\bar{1}$.2967
10	−	0.781	$\bar{1}$.8927	0.827	$\bar{1}$.9175
11	+	0.473	$\bar{1}$.6749	0.550	$\bar{1}$.7404
13	−	0.397	$\bar{1}$.5988	0.427	$\bar{1}$.6304
14	−	0.766	$\bar{1}$.8842	0.852	$\bar{1}$.9304
15	+	0.280	$\bar{1}$.4472	0.326	$\bar{1}$.5132
16	+	0.097	$\bar{2}$.9868	0.103	$\bar{1}$.0128
Sum of logrithms			$\bar{4}$.6209		$\bar{4}$.6084
Likelihood		4.177×10^{-4}		4.059×10^{-4}	
Likelihood ratio (Eskimo/Aleut)			**1.03**		

Likelihood ratios (Eskimo/Aleut) of the four Hot Springs skulls have been obtained as follows:

#1.....1.03
#2.....2.19
#3.....1.21
#4.....5.08

Though generally low, these ratios show that all of the four Hot Springs skulls are more likely to have been drawn from the Eskimo population rather than from the Aleut.

It may be generalized from the above-mentioned results of the distance and likelihood analyses that the Hot Springs cranial series as a whole is slightly closer, metrically as well as morphologically, to the Alaskan Eskimo than to the Aleut.

Summary and Conclusion

The archaeological background of the four human skeletal remains, excavated at the Hot Springs village site, Port Moller, Alaska Peninsula in 1972, was briefly described by H. O. It was followed by osteological descriptions and statistical analyses by B. Y. The material is composed of one infant and three adult male skeletons more or less incomplete.

Total morphological pattern of the adult skulls is coincident with that of the Eskimo defined by OSCHINSKY, though the expression of each morphological character is incomplete or even rudimentary when compared with that in the specialized Eskimo in Canada and Greenland. It is apparent that the Hot Springs series is definitely akin to the western branches of the Eskimo who are morphologically more generalized than their eastern relatives.

Although the archaeological features of the site suggested some cultural affinities to the Aleut tradition, the analyses of the metrical and non-metrical characters of the Hot Springs cranial series showed its closer physical affinity to the Alaskan Eskimo rather than to the Aleut. This inconsistency between the cultural and physical affinities presumably suggests a time lag between the preceding cultural differentiation and the ensuing microevolutionary differentiation of the Aleut population from the original Eskimo stock.

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Explanation of Plates 1–2

Plate 1

Fig. 1. The skull of Burial 1 (infant).
Fig. 2. The skull of Burial 2 (mature male).

Plate 2

Fig. 3. The cranium of Burial 3 (mature male).
Fig. 4. The skull of Burial 4 (adult male).


1

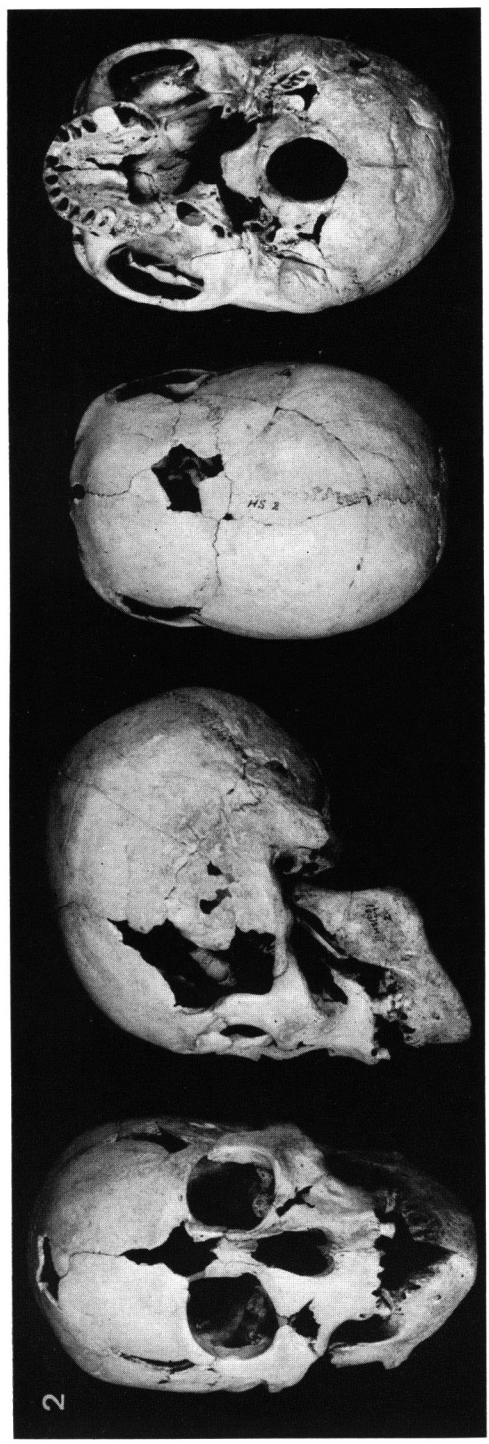
2
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Plate 2 OKADA and YAMAGUCHI: Human Skeletal Remains from Port Moller, Alaska