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AN ANTHROPOMETRIC AND MORPHOLOGICAL ANALYSIS OF A PREHISTORIC SKELETAL POPULATION FROM SANTA CRUZ ISLAND, CALIFORNIA

Thomas W. McKern

1960

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FIGURES AND TABLES

Introduction

The data on skeletal material from the vicinity of Santa Barbara, California, including the islands of San Miguel, Santa Rosa and Santa Cruz, have appeared periodically in anthropometric studies of the California Indians. Carr (1880, pp. 497-505), Boas (1895, pp. 261-269), Matiegka (1904, pp. 1-123), Hrdlicka (1947, pp. 49-64), Dixon (1923), Oetteking (1925), and Gifford (1926, p. 353), have severally analyzed the skeletal populations of that area. From these works only two, that of Carr and Hrdlicka, have dealt specifically with the island of Santa Cruz. Carr's series consisted of about 100 individuals of mixed sex which were later re-measured by Hooton and appear in Gifford's monograph (Also re-measured by Birdsell but unpublished.). Hrdlicka measured 69 male, adult skulls from Santa Cruz Island.

The following pages are concerned with the description of skeletal material from a prehistoric group of California Indians.* The skeletons which form the subject of this report were the results of two summers' (1927, 1928) archeological work on the island of Santa Cruz in the Santa Barbara Channel off the southern coast of California. They were collected by Dr. R. L. Olson of the Department of Anthropology, University of California. A detailed summary of the archeology and geography of the area may be found in Olson's publication on Chumash Prehistory (1930, pp. 1-21).

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*The manuscript for this study was completed in 1955 at the University of California, Berkeley, California.

The Santa Cruz collection was measured and its general characteristics will be outlined as completely as the material permits. The material as a whole was in only fair condition. Over fifty percent of the specimens were in a highly fragmented condition and reliable restorations were impossible. The antiquity of the burials was difficult to determine due to previous disturbances of most of the sites by eager trophy hunters and the indiscriminate placing of recent burials within ancient cemeteries by the natives (Ibid., p. 4).

Osteometric techniques as outlined by Martin (1928) were employed and the results were recorded on the standard data sheets of cranial measurements, indices and observations which is in present use in the department of Anthropology at Berkeley (A slightly revised edition of the Harvard data cards.).

The Sample of the Present Study

The series numbers 245 and consists of 101 females and 144 males. Age at death was judged from either the occlusal pattern of the cranial sutures and/or the symphysial pattern of the pubic bones depending upon the completeness of each individual case.

The age distribution for both males and females from eighteen years through fifty years was plotted and recorded in Figures I, II and III. Figures I and II reveal the type of mortality distribution one would expect in any random sample. However, in Figure III a slump in the middle age groups appears. Here the male and female curves represent the mortality ages of the population derived from the pattern or rate of sutural occlusion. This is a common ageing criterion and its credibility has been established by Todd (1920, pp. 285-334; 1921, pp. 1-20) and Todd and Lyon (1924, pp. 325-384; 1925, pp. 23-71).

A comparative analysis of the three figures indicates that the cranial ageing of the male skulls deviates but slightly from the curves derived from pelvic and total skeletal observations. The majority of individuals fall into a normal frequency curve. Mistaken judgments in the earlier age groups could account for the resulting bimodality. However, for the female curve, there can be no such rationalization. The crania were obviously aged either too young or too old in relation to their pelvic age. The middle age groups were slighted. Therefore, not only do we have a discrepancy between the rates of sutural occlusion and the remaining skeletal growth pattern, but there is also a specific rate difference between male and female sutural closure. If any single cause can be attributed to this breakdown in the continuity of osteological growth patterns then why should the cranial sutures reveal the only manifestations of such cause? Endocrine balance and calcium-phosphorus metabolism are intimately associated with osteological growth and may be responsible for such a growth fluctuation. As yet, the process is not thoroughly understood.

Determining sex was greatly aided by the ischio-pubis index (Washburn, 1948, p. 200). Complete pelves accompanied approximately half of the specimens so that the remaining individuals' sex was ascertained by the standard methods as outlined by Hrdlicka (1947, pp. 127-134).

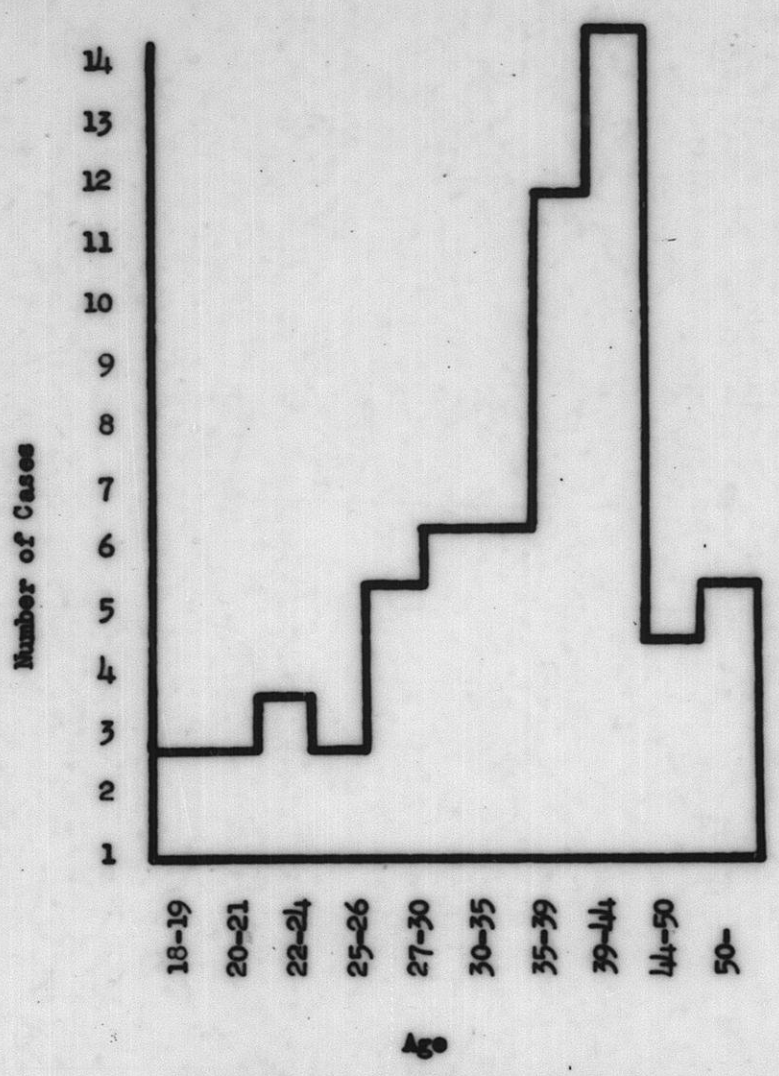
Cranial Morphology

There are a great many features of the skeleton which are desirable to record but which are difficult or impossible to measure. Classifications have been devised but have been largely neglected because of the opinion that a constant standard cannot be maintained due to the variation between individual observers (op. cit., p. 127).

Table I is a summary of the cranial morphological observations of the Santa Cruz skeletal material. The frequency, both actual and percentage, is listed for both males and females.

FIGURE I

Male Skeletal Age at Death*
(62)



* Skeletal age refers to the mean age obtained from the symphyseal pattern of the pubic bone and/or the occlusal pattern of the cranial sutures.

FIGURE II

Female Skeletal Age at Death
(58)

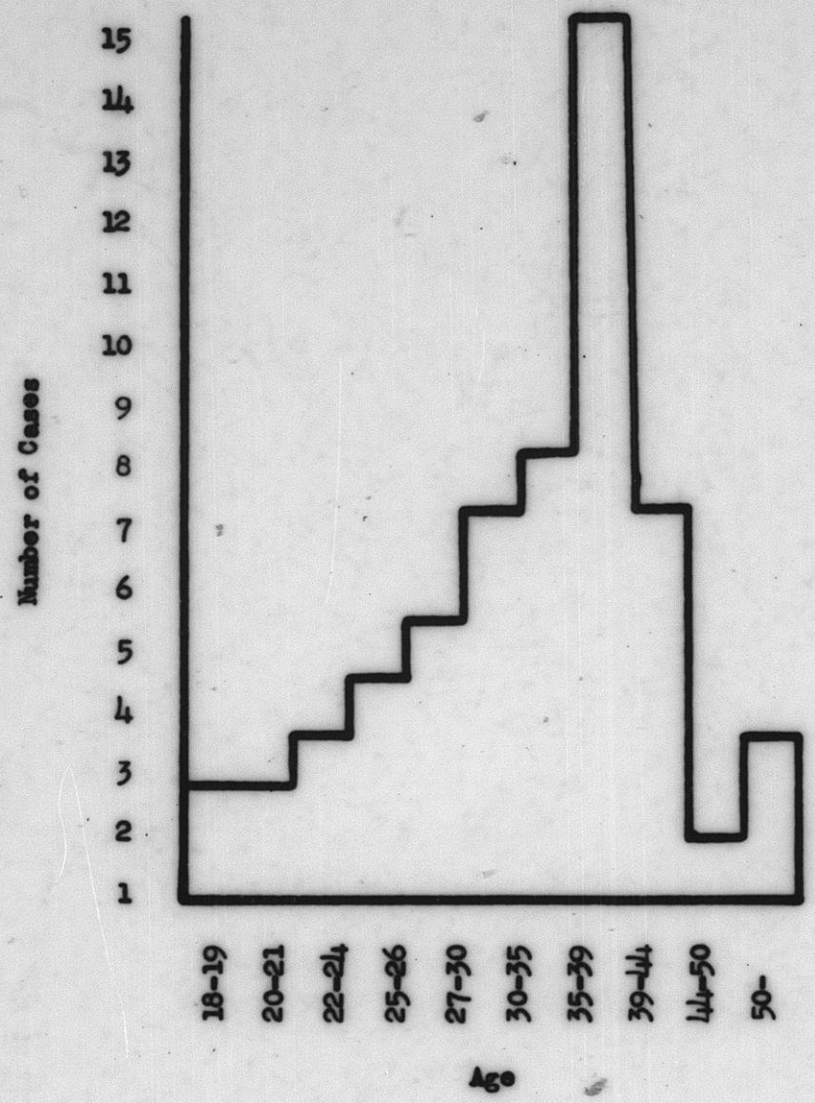
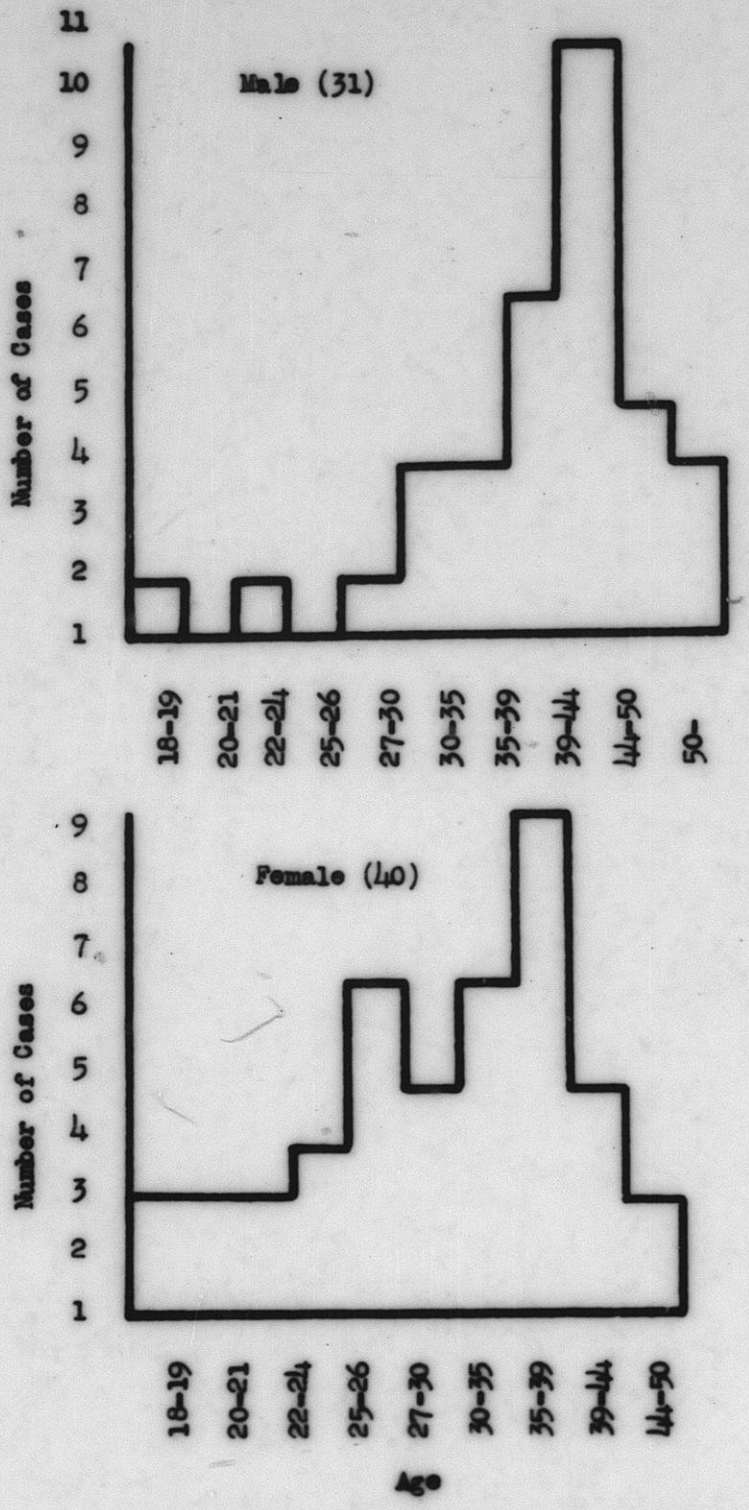


FIGURE III

Pelvic Age at Death*

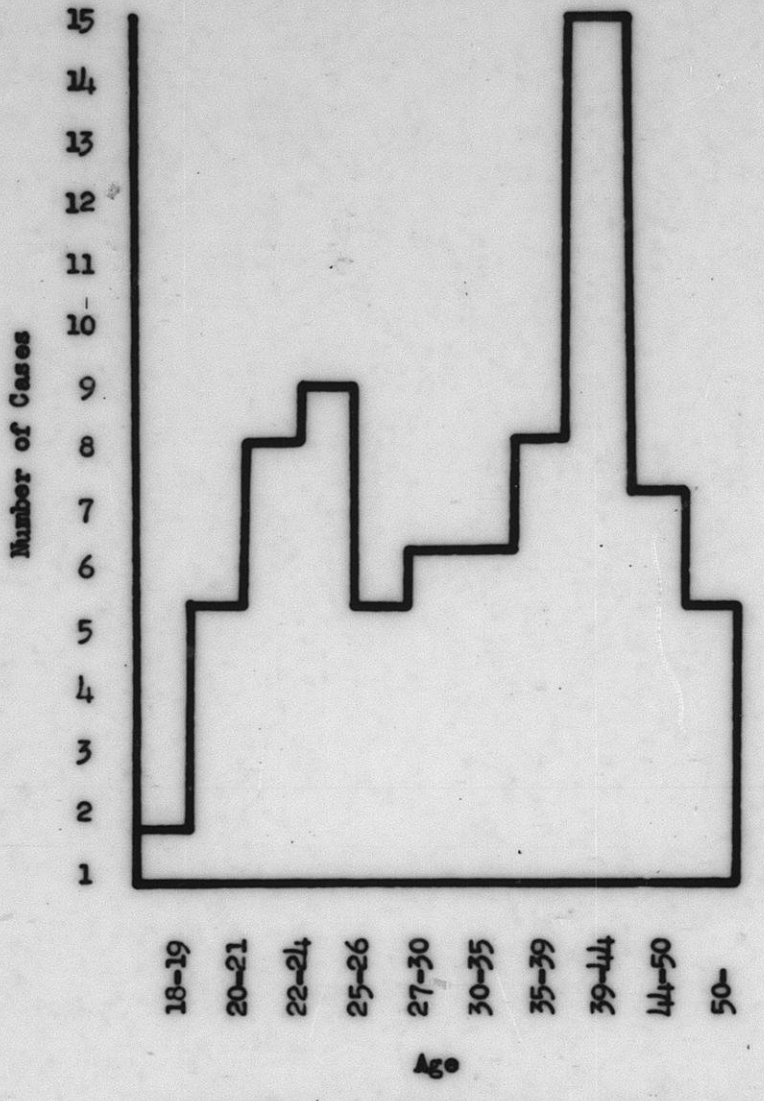


* Pelvic age refers to the mean age obtained from the symphyseal pattern of the pubic bone.

FIGURE IV

Cranial Age At Death*

Male (84)



* Cranial age refers to the mean age obtained from the occlusal pattern of the cranial sutures.

FIGURE V

Cranial Age at Death

Female (67)

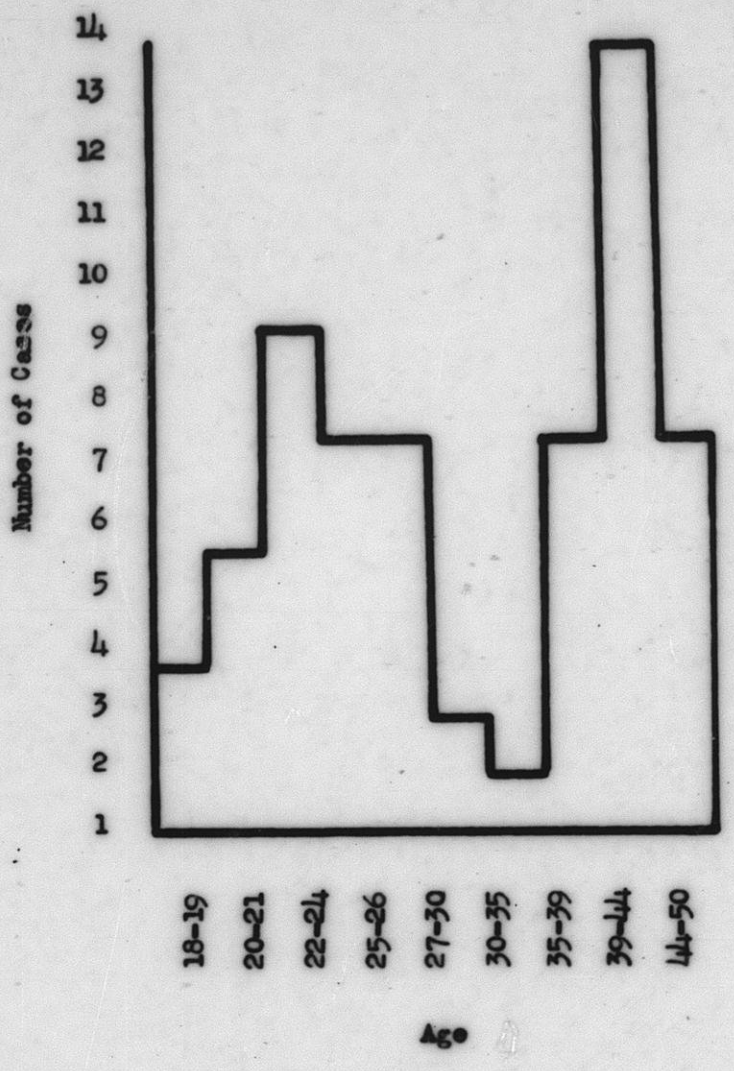


TABLE I

Tabulation of Cranial
Morphological Observations

		Male		Female	
		No.	Percent	No.	Percent
1.	Brow Ridges, Size:				
	Trace	7	8.64	22	36.06
	Small	18	22.22	21	34.43
	Medium	25	30.86	15	24.59
	Large	27	33.33	3	4.92
	Very Large	4	4.94	0	0.00
		81		61	
2.	Glabella:				
	Small	22	27.50	46	74.19
	Medium	30	37.50	15	24.19
	Large	27	33.75	1	1.61
	Very Large	1	1.25	0	0.00
		80		62	
3.	Frontal Slope:				
	None, Bulging	18	22.50	17	27.42
	Slight	27	33.75	33	53.22
	Medium	28	35.00	11	17.74
	Pronounced	7	8.75	1	1.61
		80		62	
4.	Postorbital Constriction:				
	Small	3	3.70	3	4.84
	Medium	40	49.38	30	48.39
	Large	38	46.91	29	46.77
		81		62	
5.	Sphenoid Depression:				
	Medium	28	35.44	27	43.55
	Large	51	64.56	35	56.45
		79		62	
6.	Occipital Curve:				
	None	0	0.00	0	0.00
	Small	6	7.59	7	11.29
	Medium	48	60.76	34	54.84
	Pronounced	25	31.64	21	33.87
		79		62	
7.	Inion:				
	None	3	3.66	6	9.68
	Small	40	48.78	45	72.58
	Medium	20	24.39	8	12.90
	Large	19	23.17	3	4.84
		82		62	

TABLE I, Continued

		Male		Female	
		No.	Percent	No.	Percent
8.	Torus:				
	Absent	0	0.00	0	0.00
	Small	23	28.75	36	59.02
	Medium	45	56.25	21	34.43
	Large	12	15.00	4	4.84
		80		61	
9.	Transverse Suture:				
	Absent	77	95.06	60	96.77
	Present	4	4.93	2	3.22
		81		62	
10.	Glenoid Fossa Depth:				
	Small	15	18.52	16	26.23
	Medium	42	51.85	33	54.10
	Large	24	29.62	12	19.67
		81		61	
11.	Tympanic Plate:				
	Thin	32	39.51	17	27.87
	Medium	32	39.51	23	37.70
	Thick	15	18.52	19	31.15
	Very Thick	2	2.47	2	3.28
		81		61	
12.	Auditory Meatus:				
	Round	9	11.11	6	9.84
	Oval	55	67.90	45	73.77
	Ellipse	15	18.52	11	18.03
	Slit	2	2.47	0	0.00
		81		61	
13.	Orbits Shape:				
	Oblong	18	22.50	15	24.19
	Rhomboid	4	5.00	8	12.90
	Square	55	68.75	34	54.84
	Ellipse	0	0.00	0	0.00
	Round	3	3.75	5	8.06
		80		62	
14.	Orbits Inclination:				
	None	6	7.59	11	17.74
	Small	41	51.90	32	51.61
	Medium	27	34.18	18	29.03
	Pronounced	5	6.33	1	1.61
		79		62	

TABLE I, Continued

	Male		Female	
	No.	Percent	No.	Percent
15. Malar Lateral Projection:				
Small	5	6.10	3	4.92
Medium	30	36.58	26	42.62
Large	47	57.32	32	52.46
	82		61	
16. Suborbital Fossa:				
Absent	2	2.50	0	0.00
Slight	22	27.50	26	41.93
Medium	40	50.00	21	33.87
Deep	16	20.00	15	24.19
	80		62	
17. Nasion Depression:				
Absent	1	1.25	2	3.22
Small	15	18.75	22	35.48
Medium	38	47.50	29	46.76
Deep	26	32.50	9	14.52
	80		62	
18. Nasal Root Breadth:				
Very Small	1	1.26	1	1.64
Small	7	8.86	13	21.31
Medium	46	58.23	25	40.98
Large	21	26.58	21	34.43
Very Large	4	5.06	1	1.64
	79		61	
19. Nasal Bridge Height:				
Very Low	0	0.00	6	9.68
Medium	29	35.80	23	37.09
High	41	50.62	31	50.00
Very High	11	13.58	2	3.22
	81		62	
20. Nasal Bridge Breadth:				
Small	6	7.59	7	11.47
Medium	34	43.04	31	50.82
Large	39	49.37	23	37.70
	79		61	
21. Nasal Profile:				
Straight	1	1.25	0	0.00
Concave	40	50.00	36	58.05
Concavo-Convex	39	48.75	26	41.92
Convex	0	0.00	0	0.00
	80		62	

TABLE I, Continued

	Male		Female	
	No.	Percent	No.	Percent
22. Nasal Spine:				
Absent	2	2.47	0	0.00
Small	26	32.10	17	27.42
Medium	33	40.74	26	41.93
Large	20	24.69	19	30.64
	81		62	
23. Mid-Facial Prognathism:				
Absent	21	25.92	13	20.97
Slight	43	53.09	39	62.90
Medium	15	18.52	10	16.13
Pronounced	2	2.47	0	0.00
	81		62	
24. Alveolar Prognathism:				
Absent	0	0.00	0	0.00
Slight	13	16.06	5	8.05
Medium	50	61.73	37	59.68
Pronounced	18	22.22	20	32.26
	81		62	
25. Palate Shape:				
Parabolic	49	60.49	37	59.68
Hyperbolic	25	30.86	16	25.81
Elliptical	7	8.64	9	14.52
Small U	0	0.00	0	0.00
Large U	0	0.00	0	0.00
	81		62	
26. Palate Height:				
Low	5	6.25	15	24.19
Medium	34	42.50	29	46.77
High	38	47.50	18	29.03
Very High	3	3.75	0	0.00
	80		62	
27. Chin Form:				
Median	27	44.26	48	94.12
Bilateral	34	55.74	3	5.88
	61		51	
28. Chin Projection:				
Negative	0	0.00	0	0.00
Neutral	5	8.20	2	3.92
Small	11	18.03	11	18.03
Medium	28	45.90	14	27.45
Large	17	27.87	24	47.06
	61		51	

TABLE I, Continued

	Male		Female	
	No.	Percent	No.	Percent
29. Mandibular Alveolar Prognathism:				
None	11	18.03	10	20.41
Slight	38	62.29	31	63.26
Medium	10	16.39	8	16.33
Pronounced	2	3.28	0	0.00
	61		49	
30. Genial Tubercles:				
Absent	0	0.00	1	2.00
Small	26	42.62	32	64.00
Medium	24	39.34	16	32.00
Large	11	18.03	1	2.00
	61		50	
31. Gonial Angle Eversion:				
None	4	6.56	15	29.41
Small	13	21.31	12	23.53
Medium	21	34.43	12	23.53
Pronounced	23	37.70	12	23.53
	61		51	
32. Mandibular Torus:				
Small	38	62.29	41	80.39
Medium	21	34.43	10	19.61
Large	2	3.28	0	0.00
	61		51	

Cranial Dimensions

Table II presents the measurements and indices of the Santa Cruz skulls, male and female, with statistical constants compiled from individual data. Exact definitions for the measurements which were taken may be found in Martin (op. cit.). For each character there is given the number of cases followed by the range of the limits, the mean and its standard deviation. The coefficient of variation has been added for the purpose of comparing the variability of one measurement with another.

Summary

The Santa Cruz male skulls are moderate in size and ruggedness with medium developed musculature being indicated by the size of the mastoid processes and the occipital tori. Aside from narrow nasal measurements, the skulls are not extreme in any of their proportions, being mesocephalic, mesoprosopic and medium in height.

In profile the brow ridges are medium, the glabella is medium and the frontal slope is slight. There is no definite narrowing of the forehead or postorbital constriction. The highest point of the vault is fairly well posterior and the occipital curve is medium. There is little lambdoid flattening and the torus is generally medium.

From above the modal form is ovoid, the parietal region being slightly broader than the forehead and the parietal bosses do not stand out as marked angles.

The Santa Cruz skulls display considerable variation in facial length and general size. They are typically broad at the zygomatic arches but only medium in alveolar prognathism. The orbits display little inclination and are usually square in shape. The nose is leptorrhine rather than mesorrhine. The nasal bridge is medium in height and concave to concavo-convex while the

TABLE II

Tabulation of Cranial Measurements and Indices

	No.	Range	Mean	S.D.	V.
Glabello Occipital Length:					
Male	81	163-191	179.27	5.71	3.52
Female	61	158-189	173.21	5.53	3.16
Maximum Width:					
Male	80	129-149	138.62	4.65	3.62
Female	60	128-147	136.20	4.52	3.58
Basion-bregma Height:					
Male	65	119-114	132.93	5.22	3.66
Female	56	119-140	128.48	5.17	3.58
Auricular Height:					
Male	80	101-123	112.26	4.43	3.35
Female	62	103-116	108.38	4.23	3.28
Minimum Frontal Diameter:					
Male	80	82-102	91.85	4.11	3.88
Female	60	80-95	89.65	3.98	3.76
Maximum Bizygomatic Diameter:					
Male	76	124-144	134-22	4.88	3.64
Female	61	118-135	126.29	4.76	3.55
Prosthion-nasion Height:					
Male	79	63-80	70.37	4.63	3.77
Female	61	55-73	65.98	4.47	3.69
Nasal Height:					
Male	81	43-58	50.44	3.14	4.97
Female	61	42-53	47.03	3.09	4.82
Nasal Breadth:					
Male	81	20-27	23.23	2.23	5.63
Female	61	20-25	22.86	1.87	6.24
Interorbital Breadth:					
Male	78	20-28	23.44	1.83	4.86
Female	56	18-27	22.16	1.92	5.23
External Palatal Length:					
Male	79	52-63	56.24	3.12	5.21
Female	60	47-61	54.31	2.75	4.94
External Palatal Breadth:					
Male	79	58-72	64.43	3.44	4.56
Female	60	46-70	59.75	3.56	4.36

TABLE II, Continued

	No.	Range	Mean	S.D.	V.
Maximum Circumference:					
Male	78	474-525	503.27	12.42	3.11
Female	59	472-519	490.76	13.28	3.21
Height-length Index:					
Male	65	65.2-80.9	74.16	3.04	4.21
Female	55	68.4-81.0	73.94	2.89	3.87
Height-breadth Index:					
Male	64	86.0-107.5	96.21	3.57	3.48
Female	55	84.7-105.5	94.03	3.52	3.54
Cranial Index:					
Male	80	71.6-85.1	77.31	3.46	3.59
Female	60	73.0-86.7	78.85	3.44	3.51
Fronto-parietal Index:					
Male	80	57.3-73.6	66.22	3.12	3.24
Female	59	56.7-72.2	65.49	3.26	3.34
Auricular Height-length Index:					
Male	80	57.0-68.7	62.48	2.63	3.46
Female	61	58.9-68.3	62.50	2.55	3.41
Cranial Module:					
Male	63	137.0-158.3	150.06	4.36	3.58
Female	54	139.4-153.3	146.12	4.28	3.61
Upper Facial Index:					
Male	76	45.5-58.4	52.52	3.27	4.53
Female	60	44.7-58.1	52.06	2.97	4.89
Nasal Index:					
Male	81	37.7-56.5	45.92	3.72	5.49
Female	61	41.6-56.5	48.67	3.67	5.32
External Palatal Index:					
Male	79	101.6-130.2	114.65	5.26	4.47
Female	59	88.5-130.0	110.22	4.94	4.37
Zygo-gonial Index:					
Male	53	63.5-87.3	75.05	3.61	4.64
Female	46	59.8-85.7	74.30	3.68	4.59
Fronto-gonial Index:					
Male	53	90.8-123.1	109.30	5.72	5.38
Female	45	83.5-121.2	104.15	5.43	5.11

TABLE II, Continued

	No.	Range	Mean	S.D.	V.
Condylo-Symphysial Length:					
Male	54	82-115	92.46	4.63	4.84
Female	47	78-110	85.13	4.59	4.69
Bicondylar Width:					
Male	53	109-131	119.98	5.47	5.26
Female	47	106-128	114.65	5.36	5.18
Bigonial Width:					
Male	54	80-117	100.31	5.53	5.48
Female	47	76-108	93.85	5.47	5.44

spine is small to medium. The palate is well formed, parabolic to hyperbolic and relatively high. The teeth are in good condition generally with absent to slight crowding and a slight overbite seems to be normal. Eversion of the gonial angles is pronounced and chin form tends to be bilateral.

The female skulls deviate from the male only in diminished gross dimensions. No exceptional deviations are exhibited other than what one would expect between male and female.

The average cephalofacial dimensions of the skulls as defined by Krogman (1949, p. 36), are rather short and narrow. The forehead is narrow, the skull base is moderately short and the vault is rather low. The face is large when compared to the vault size yet is relatively narrow.

On the basis of the cranial proportions the Santa Cruz skulls are: (As described by Martin)

Index	Males	Females
Length-breadth	Mesocranic	Mesocranic
Breadth-height	Metriocranic	Metriocranic
Length-height	Orthocranic	Orthocranic
Fronto-parietal	Metriometopic	Metriometopic
Upper Facial	Mesenic	Mesenic
Nasal	Leptorrhine	Leptorrhine
Palatal	Mesuranic	Mesuranic

These classifications indicate that the Santa Cruz skulls of both sexes are medium in all proportions with the one exception of narrow nasal dimensions.

The Postcranial Skeleton

Table III presents the morphological features of the postcranial skeleton for both males and females. With the exception of the usual sex differences in the pelvis, nothing of significance is revealed.

The dimensional observations have been listed in Table IV. I will deal with each bone separately, confining my comments to the few significant deviations observed.

TABLE III

Tabulation of Postcranial Morphological Observations

	Male		Female	
	No.	Percent	No.	Percent
FEMUR:				
1. Third Trochanter:				
Absent	0	0.00	0	0.00
Submedium	21	29.17	12	22.22
Medium	32	44.44	31	57.40
Pronounced	14	19.44	9	16.67
Very Pronounced	5	6.94	2	3.70
	72		54	
2. Linea Aspera:				
Absent	0	0.00	0	0.00
Submedium	3	3.17	2	3.70
Medium	13	18.05	11	20.39
Slight Pilaster	19	26.39	17	31.48
Medium Pilaster	24	33.33	21	38.89
Pronounced Pilaster	13	18.05	3	5.55
	72		54	
TIBIA:				
3. Squatting Facets:				
Present	38	52.78	26	48.15
Absent	34	47.22	28	51.85
	72		54	
FIBULA:				
4. Fluting of Shaft:				
Absent	0	0.00	0	0.00
Submedium	16	25.00	16	36.36
Medium	39	60.94	20	45.45
Pronounced	9	14.06	8	18.18
	64		44	
HUMERUS:				
5. Supracondyloid Process:				
Absent	64	88.89	54	94.74
Traces	8	11.12	3	5.26
Present	0	0.00	0	0.00
	72		57	

TABLE III, Continued

	Male		Female	
	No.	Percent	No.	Percent
PELVIS:				
6. Depth of Ischiatic Notch:				
Small	2	2.90	17	32.07
Medium	30	43.49	25	47.17
Deep	37	53.62	11	20.75
	69		53	
7. Width of Ischiatic Notch:				
Small	38	55.89	17	32.07
Medium	19	27.94	25	47.17
Wide	11	16.18	11	20.75
	68		53	
8. Depth of Preauricular Sulcus:				
Small	34	50.00	16	32.65
Medium	19	27.94	15	30.61
Deep	15	22.06	18	36.73
	68		49	
9. Width of Preauricular Sulcus:				
Small	43	63.23	7	14.00
Medium	14	20.59	13	26.00
Wide	11	16.18	30	60.00
	68		50	
SACRUM:				
10. Sacral Curve:				
Slight	9	19.16	4	12.12
Medium	33	70.21	19	57.57
Pronounced	5	10.60	10	30.30
	47		33	

TABLE IV

Tabulation of Postcranial Measurements and Indices

	No.	Range	Mean	S.D.	V.
Right Femur, Bicondylar Length:					
Male	59	378-458	417.25	16.48	4.45
Female	45	359-455	396.93	16.12	4.32
Left Femur, Bicondylar Length:					
Male	55	377-462	418.23	16.32	4.21
Female	40	357-452	395.55	15.87	4.13
Right Femur, Mid-shaft Circumference:					
Male	61	64-96	82.95	5.37	5.43
Female	48	68-89	79.18	5.23	5.22
Left Femur, Mid-shaft Circumference:					
Male	58	65-96	83.86	5.48	5.57
Female	42	68-89	78.45	5.22	5.25
Right Femur, Sub-trochanteric Diameter, Antero-posterior:					
Male	61	18-28	24.03	2.68	6.37
Female	48	19-30	22.50	2.53	6.26
Left Femur, Sub-trochanteric Diameter, Antero-posterior:					
Male	58	20-29	24.76	2.64	6.34
Female	44	18-26	22.06	2.48	6.24
Right Femur, Sub-trochanteric Diameter, Lateral:					
Male	61	26-36	30.90	2.36	6.54
Female	46	25-34	29.08	2.27	6.51
Left Femur, Sub-trochanteric Diameter, Lateral:					
Male	58	24-34	29.84	2.23	6.42
Female	44	26-34	29.56	2.29	6.53
Right Femur, Mid-shaft Diameter, Antero-posterior:					
Male	61	22-33	28.31	2.15	6.68
Female	46	22-31	26.80	2.11	6.58
Left Femur, Mid-shaft Diameter, Antero-posterior:					
Male	58	21-33	27.60	2.23	6.64
Female	44	23-31	26.65	2.13	6.56
Right Femur, Mid-shaft Diameter, Lateral:					
Male	60	20-29	24.16	2.08	5.94
Female	46	19-28	22.62	1.73	5.84

TABLE IV, Continued

	No.	Range	Mean	S.D.	V.
Left Femur, Mid-shaft Diameter, Lateral:					
Male	58	21-28	24.86	1.84	5.82
Female	44	20-27	22.91	1.68	5.81
Right Tibia, Maximum Length:					
Male	53	318-384	354.22	15.42	5.37
Female	44	301-368	330.47	16.62	5.45
Left Tibia, Maximum Length:					
Male	55	322-399	353.63	17.31	5.32
Female	37	302-366	333.48	16.55	5.40
Right Tibia, Mid-diameter, Antero-posterior:					
Male	59	23-37	31.05	1.31	5.68
Female	45	24-32	27.55	1.69	5.53
Left Tibia, Mid-diameter, Antero-posterior:					
Male	56	22-36	31.19	1.42	5.71
Female	39	23-31	27.41	1.63	5.47
Right Tibia, Mid-diameter, Lateral:					
Male	57	16-29	19.17	1.74	6.43
Female	45	14-23	17.91	1.76	5.53
Left Tibia, Mid-diameter, Lateral:					
Male	56	16-29	19.32	1.67	6.36
Female	39	14-22	18.10	1.72	5.68
Right Tibia, Nutrient Foramen Diameter, Antero-posterior:					
Male	58	24-39	34.03	2.52	6.48
Female	39	26-36	30.30	2.33	6.39
Left Tibia, Nutrient Foramen Diameter, Antero-posterior:					
Male	59	24-41	34.15	2.57	6.55
Female	45	25-35	30.17	2.36	6.42
Right Tibia, Nutrient Foramen Diameter, Lateral:					
Male	59	18-23	20.16	2.34	5.46
Female	45	14-22	18.86	2.31	5.37
Left Tibia, Nutrient Foramen Diameter, Lateral:					
Male	58	18-24	20.52	2.32	5.43
Female	39	15-22	18.74	2.33	5.33
Right Tibia, Least Circumference:					
Male	57	62-85	75.75	3.44	4.64
Female	45	59-76	68.24	3.34	4.58

TABLE IV, Continued

	No.	Range	Mean	S.D.	V.
Left Tibia, Least Circumference:					
Male	56	61-89	75.94	3.48	4.66
Female	39	59-79	69.23	3.30	4.51
Right Fibula, Maximum Length:					
Male	42	301-368	340.35	14.83	4.66
Female	25	294-348	319.52	14.62	4.50
Left Fibula, Maximum Length:					
Male	34	317-364	336.14	14.34	4.52
Female	21	289-347	322.04	14.26	4.44
Right Humerus, Maximum Length:					
Male	54	273-325	304.38	14.62	4.49
Female	43	267-326	289.20	14.48	4.41
Left Humerus, Maximum Length:					
Male	51	277-324	303.78	14.59	4.47
Female	41	261-322	285.58	14.44	4.39
Right Humerus, Minimum Shaft Circumference:					
Male	56	51-70	60.53	3.45	5.26
Female	45	47-65	53.71	3.33	5.22
Left Humerus, Minimum Shaft Circumference:					
Male	52	49-69	59.05	3.45	5.24
Female	44	47-59	52.13	3.23	5.20
Right Radius, Maximum Length:					
Male	44	213-260	240.65	11.36	4.49
Female	34	198-250	221.09	11.27	4.41
Left Radius, Maximum Length:					
Male	45	213-263	240.35	11.37	4.50
Female	38	200-243	221.50	11.29	4.42
Right Ulna, Maximum Length:					
Male	37	243-286	259.56	11.42	4.33
Female	33	218-265	238.90	11.58	4.46
Left Ulna, Maximum Length:					
Male	44	240-287	259.95	11.32	4.72
Female	29	224-261	241.55	11.67	4.52
Right Innominate, Height:					
Male	40	188-220	201.80	8.46	3.78
Female	36	168-208	188.36	8.39	3.66

TABLE IV, Continued

	No.	Range	Mean	S.D.	V.
Left Innominate, Height:					
Male	36	188-223	202.77	8.57	3.63
Female	33	170-204	187.75	8.41	3.74
Right Innominate, Breadth:					
Male	33	134-161	146.21	4.25	3.82
Female	35	124-159	141.14	7.34	3.69
Left Innominate, Breadth:					
Male	29	133-161	147.72	4.61	3.67
Female	30	122-151	141.43	7.33	3.62
Sagittal Diameter of Pelvic Inlet:					
Male	17	81-126	97.29	5.75	5.35
Female	10	84-118	97.40	5.86	5.56
Transverse Diameter of Pelvic Inlet:					
Male	17	99-132	117.56	5.67	5.42
Female	10	108-138	123.20	5.72	5.57
Right Innominate, Breadth of Ischiatic Notch:					
Male	51	29-52	36.58	5.24	5.71
Female	41	33-58	44.70	5.44	5.64
Left Innominate, Breadth of Ischiatic Notch:					
Male	50	30-54	37.61	5.17	5.58
Female	39	31-57	44.82	5.26	5.74
Sacrum, Anterior-Length:					
Male	38	80-139	103.26	5.76	5.33
Female	28	86-129	103.32	5.24	5.30
Sacrum, Breadth:					
Male	41	93-125	112.26	5.64	5.29
Female	29	104-132	116.58	5.33	5.19
Right Femur, Index of Platymeria:					
Male	60	63.9-93.1	77.93	8.76	8.82
Female	46	65.7-89.3	76.19	8.63	8.68
Left Femur, Index of Platymeria:					
Male	58	66.7-99.99	77.77	8.33	8.57
Female	44	62.1-89.3	75.29	8.59	8.61
Right Femur, Middle Index:					
Male	60	69.7-96.3	84.30	6.47	6.38
Female	46	72.4-96.3	86.67	6.30	6.22

TABLE IV, Continued

	No.	Range	Mean	S.D.	V.
Left Femur, Middle Index:					
Male	59	71.1-96.0	84.01	6.43	6.31
Female	45	73.3-96.4	85.53	6.27	6.11
Right Femur, Pilastric Index:					
Male	60	104.8-143.5	118.98	6.54	5.49
Female	46	103.8-138.1	115.78	5.89	5.42
Left Femur, Pilastric Index:					
Male	59	104.2-140.9	119.91	6.33	5.45
Female	44	103.7-131.8	116.95	5.64	5.39
Right Femur, Index of Robusticity:					
Male	59	104.9-135.4	123.74	5.58	5.48
Female	44	114.1-142.5	125.90	5.46	5.33
Left Femur, Index of Robusticity:					
Male	56	108.7-140.0	124.71	5.49	5.48
Female	41	115.7-139.5	125.09	5.36	5.35
Right Tibia, Middle Index:					
Male	57	48.6-93.5	62.01	6.48	7.43
Female	46	48.3-82.1	65.19	6.33	7.32
Left Tibia, Middle Index:					
Male	56	44.4-81.8	62.03	6.41	7.44
Female	38	53.8-79.2	66.13	6.39	7.28
Right Tibia, Index of Platycnemia:					
Male	59	48.6-79.1	59.28	4.62	5.37
Female	46	46.7-77.8	62.56	4.53	5.28
Left Tibia, Index of Platycnemia:					
Male	58	45.9-75.0	59.34	4.60	5.33
Female	38	50.0-80.8	62.05	4.42	5.20
Right Tibia, Length-thickness Index:					
Male	53	192.8-240.0	213.79	9.38	5.57
Female	45	187.0-240.2	204.17	9.33	5.37
Left Tibia, Length-thickness Index:					
Male	54	189.4-236.6	213.94	9.22	5.32
Female	37	186.7-240.2	206.86	9.30	5.35
Right Tibia, Tibio-femoral Index:					
Male	47	816.-87.3	84.27	2.47	2.37
Female	37	78.5-91.0	83.67	2.33	2.31

TABLE IV, Continued

	No.	Range	Mean	S.D.	V.
Left Tibia, Tibio-femoral Index:					
Male	44	81.0-87.3	84.25	2.47	2.45
Female	31	80.9-90.3	84.32	2.34	2.29
Right Humerus, Index of Robusticity:					
Male	56	166.9-217.2	191.12	9.42	5.63
Female	44	161.8-211.0	185.80	9.33	5.58
Left Humerus, Index of Robusticity:					
Male	50	158.6-210.9	192.60	9.33	5.58
Female	38	164.6-207.1	187.80	9.21	5.62
Right Humerus, Humero-femoral Index:					
Male	45	69.8-78.7	72.84	2.47	2.26
Female	33	67.2-76.0	73.03	2.42	2.21
Left Humerus, Humero-femoral Index:					
Male	39	69.5-77.8	72.64	2.45	2.25
Female	28	68.0-78.0	72.50	2.45	2.23
Right Radius, Humero-radial Index:					
Male	37	71.3-84.2	78.35	2.65	2.66
Female	30	67.0-85.1	75.63	2.78	2.82
Left Radius, Humero-radial Index:					
Male	35	74.0-83.0	78.80	2.44	2.52
Female	30	63.7-80.7	75.93	2.59	2.71
Right Innominate, Breadth-height Index:					
Male	32	130.3-150.7	137.68	4.49	3.53
Female	34	112.6-145.8	133.29	4.42	3.51
Left Innominate, Breadth-height Index:					
Male	27	129.9-149.3	138.11	4.47	3.53
Female	26	125.3-148.1	133.57	4.37	3.39
Index of Pelvic Inlet:					
Male	17	67.5-95.4	81.23	5.48	5.72
Female	10	68.3-85.5	78.90	5.34	5.48
Sacral Index:					
Male	37	89.9-141.5	112.59	6.58	6.52
Female	26	96.5-136.0	113.69	6.32	6.22

Femur

The shaft of the femur for both sexes exhibits on the average a fair degree of bowing. Platymeria is substantial but not pronounced. The female shaft shows a slightly higher degree of flattening but not enough to be significant. The nature of the functional influence responsible for this antero-posterior flattening is still a matter of debate since the areas of origin or insertion of several muscles might affect its development. It is interesting to note that the left male femora are longer and larger than the right whereas the reverse is true among the females. This is usually interpreted as a functional difference but in no way explains the diversity between sexes.

Tibia

Squatting facets, an extension of the astragalar surface beyond the forward rim of the joint surface which normally forms the edge, are regarded as due to an habitual squatting posture, in which this area impinges on the neck of the astragalus. Its presence in about one-half of the Santa Cruz skeletons is not unusual. The index of platycnemia gives the relation of the shaft diameters at the level of the nutrient foramen, or the degree of lateral flattening. Both male and female shafts are platycnemic, the females again reveal a slightly higher degree of flattening.

Fibula

The only observable feature exhibited by the measurement and index values is the difference in length between right and left male tibulae. The right side is substantially longer than the left. This may be a sampling problem since a similar differential cannot be demonstrated for the tibiae.

Humerus

Again, the length and size of the left humerus exceeds that of the right plus the expected sexual distinction in gross proportion. The supracondyloid process, which sometimes forms a complete bridge over the radial nerve, is rare in most groups, appearing only as a trace here.

Radius

No significant differences in side are revealed by the metric values. The humero-radial relationship indicates longer arms for the males.

Ulna

Again, as in the radial measurements, there are no significant differences between the sides or the sexes.

Pelvis

Beyond the expected sex differences between the male and female pelves, no outstanding features are revealed. The innominates of both sexes are much alike with the rights being slightly higher and narrower than the lefts.

Sacrum

The sacral anterior lengths are about equal but the female sacrum is relatively broader than the male. The sacral curve is slightly more pronounced in the female sacrum.

The reader will notice the omission of certain measurements and observations from the present series. Also, bones such as the clavicle, scapula, sternum, ribs and lumbar vertebrae have not been included. These omissions are the direct result of the deficiencies of the sample. The fragmentary condition of a majority of the specimens made the recording of certain measurements impossible and the number of measureable clavicles, scapulae, etc., associated with individual skeletons was not sufficient for statistical analysis.

Morphological Types

Morphological typology has never been completely satisfactory except as a very general classificatory procedure. Within a single population, the variations are minor and the resulting categories are merely vague, subjective groupings. An attempt was made to include typological impressions based on the skull vault as viewed from the front. The extreme variation which was exhibited gave no morphological evidence of group or type differentiation. Therefore, the Santa Cruz crania were segregated into four general classes primarily on the basis of facial characteristics. Males and females were dealt with separately.

I. Long Narrow-Faced Type:

This type is characterized by a long and relatively narrow face. The length is exaggerated by a mandible that is exceptionally deep at the symphysis. The nasal aperture is long and narrow and the lateral extension of the molars give the impression of being subnormal in relation to the total length of the face. The chin is usually pointed.

II. Long Broad-Faced Type:

This type deviates from Type I only in the greater breadth of all facial measurements and highly everted gonial angles.

III. Short Broad-Faced Type:

Type III represents a smaller variety of Type II. The frontal aspect is more square than rectangular.

IV. Short Narrow-Faced Type:

Type IV does not give the impression of a diminutive Type I. There is virtually no gonial eversion, a characteristic which easily distinguishes this group from the other three. There is also a lack of general ruggedness and it compares favorably with Type III only in facial length. The narrow gonial dimensions produce an illusion of an emphasized lateral projection of the zygomatica. Many of the male crania within this class exhibit feminine characteristics.

FIGURE VI

Male Morphological Types For
Santa Cruz Island.

Type I

Type II

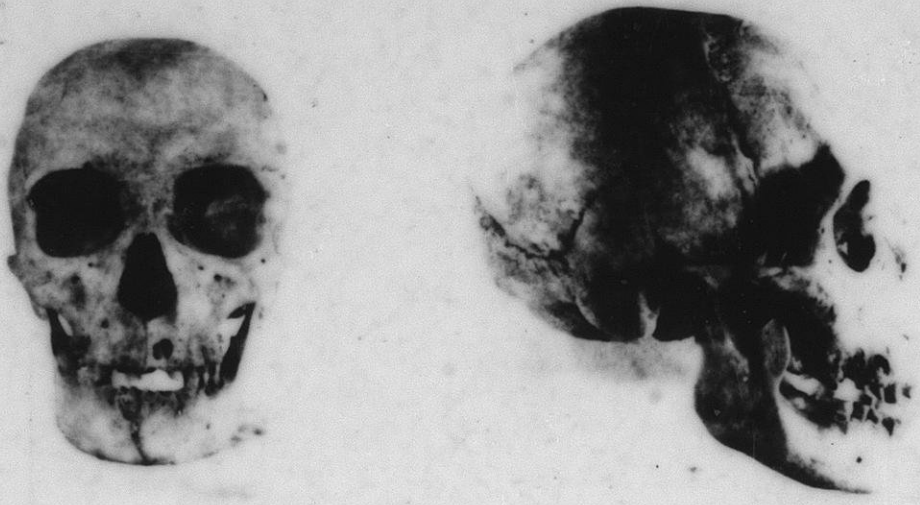
FIGURE VI - continued.

Type III

Type IV

FIGURE VII

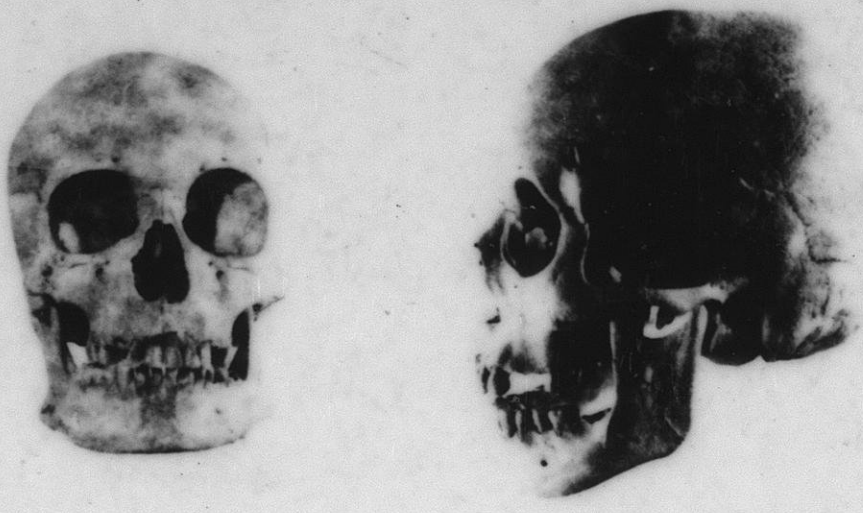
Female Morphological Types For
Santa Cruz Island.



Type I

Type II

FIGURE VII - continued.



Type III

Type IV

TABLE V

The Distribution of Morphological Types

	No.	Percent
Male:		
Long Narrow-Faced Type	11	23.91
Long Broad-Faced Type	16	34.78
Short Broad-Faced Type	11	23.91
Short Narrow-Faced Type	8	17.39
Female:		
Long Narrow-Faced Type	8	22.22
Long Broad-Faced Type	12	33.33
Short Broad-Faced Type	10	27.77
Short Narrow-Faced Type	6	16.66

Table V represents the distribution of the morphological types in the Santa Cruz series. Of particular interest is the similarity between the male and female frequencies. Not only is the Long Broad-Faced Type dominant in both sexes, but the percentages for each type are consistently alike. However, the values suggest a fairly homogeneous population with no single outstanding morphological deviation.

Variability

The standard deviations and the coefficients of variation for the Santa Cruz series have been included for each recorded metric value. According to Howells (1941, p. 144), the standard deviation is more useful than the coefficient of variation as an indicator of the general variability of a series. The coefficient measures not only the variability of the group in question but also, the inherent variability of the particular character. These two variabilities should be kept separate. The standard deviation is a constant

which describes the dispersion of the individual cases about the mean in normal frequency distribution. It furnishes a check upon the process of sampling, and it also gives a rough clue to the relative homogeneity of the series.

To determine the variability of the Santa Cruz series, the standard deviations were employed in a method suggested by Howells (1936, pp. 592-600). They are compared with the average of a number of standard deviations for the same character taken from the literature and pertaining to adult male series of crania numbering forty or more. In Table VI these averages are given in the column headed "Sigma Ratios," or the Santa Cruz standard deviations expressed as a percentage of the mean sigmas.

The sigma ratio is arrived at by dividing any standard deviation by the mean sigma for that character, giving a ratio, or percentage of the mean sigma. Ideally, this figure will approximate 100 which is taken as a norm. Therefore, for any given sample the mean sigma ratio for all available measurements and indices will constitute an index of the variability of that group relative to the general average, represented as 100.

The standard deviations of the Santa Cruz skulls are fairly close to the mean sigmas throughout. The mean sigma ratio for all of the indices is 90.1 and for the measurements, 100.0. Both ratios indicate what would be expected in the case of a normal homogeneous series. Neither ratio deviates far enough from the average (100) to indicate a perceptible inclusion of foreign elements.

We can conclude then, that since the Santa Cruz sample reveals relatively low statistical variability, they demonstrate a uniformity which is indicative of genetic homogeneity. Thus, comparative analyses with other skeletal samples will not be distorted by variability within the series or by possible

TABLE VI

Measures of Variability

	Santa Cruz No.	V.	S.D.	Mean Sigma*	Sigma Ratio
Glabello-Occipital Length	81	3.52	5.71	6.09(26)	93.7
Maximum Width	80	3.62	4.65	5.03(26)	92.4
Basion-bregma Height	65	3.66	5.22	5.12(20)	100.1
Auricular Height	80	3.35	4.43	4.24(15)	104.4
Minimum Frontal Diam.	80	3.88	4.11	4.32(24)	95.1
Bizygomatic Diameter	76	3.64	4.88	5.10(22)	95.6
Nasion-prosthion Height	79	3.77	4.63	4.28(23)	108.1
Nasal Height	81	4.97	3.14	3.03(16)	103.5
Nasal Breadth	81	5.63	2.23	1.81(25)	125.2
Palate Length	79	5.21	3.12	2.93(8)	106.5
Palate Breadth	79	4.56	3.44	3.19(7)	107.8
Bicondylar Width	53	5.26	5.47	5.58(9)	96.2
Bigonial Width	54	5.48	5.53	6.62(10)	83.5
Condylo-symphysial Length	54	4.84	4.63	5.17(9)	89.5
Cranial Index	80	3.59	3.46	3.22(23)	107.1
Height-length Index	65	4.21	3.04	3.05(19)	99.6
Height-breadth Index	64	3.48	3.57	4.61(7)	77.4
Fronto-parietal Index	80	3.24	3.12	3.23(4)	96.5
Upper Facial Index	76	4.53	3.27	3.30(8)	99.0
Nasal Index	81	5.49	3.72	4.49(15)	82.8
Palatal Index	79	4.47	5.26	6.61(7)	79.5

*Howells, W. W., 1941, p. 146.

temporal morphological changes. Even though the Santa Cruz series represents a population in both time and space, the amount of physical differentiation over a period of, say 3000 years, has been slight and adequate statistical results may be expected when the Santa Cruz skeletons are used to represent the prehistoric island populations. This could not be done with samples that exhibited significant temporal differences as well as a high degree of internal variability.

Pathology

The Santa Cruz Island skeletal series was relatively free from outstanding pathological ailments. There were no significant differences in the distribution or incidence of bone pathologies between the sexes. Arthritis was the most common affliction among these people (32%). Arthritic lipping was most commonly noted at the articular surfaces of the long bones and lumbar vertebral borders. The incidence of osteological diseases such as inflammatory lesions and osteoporosis were slightly higher among the male skeletons (6%) than the female (3%).

Dental abscesses were observed in 26% of the male crania and 21% of the female. Dental caries was exhibited by 16% of the male population and 11% of the female. Malocclusion was rare and when present was only slight.

Summary

A series of skeletons from Santa Cruz Island, California has been described in the foregoing sections. The various measurements and observations indicate a people who were rather short, small and gracile. The average age of the adults at death was about 43 years for the males and approximately 47 years for the females. These people were characterized by mesocephaly with a slight tendency towards dolichocephaly, and had faces of medium proportions with the one exception of the nasal aperture which was narrow. They had good teeth generally but at least one-third of the population was afflicted with arthritis. Statistical tests of the variation within this group indicate an inbreeding, homogeneous population which probably lived in isolation for a relatively long period of time.

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