Preface

This new Bulletin, Series D (Anthropology), is planned to contain original papers prepared by staff members who are associated with the Department of Anthropology within the National Science Museum. It is planned to issue further volumes of this Series on an annual basis.

The Department of Anthropology was established in 1972 as an addition to the National Science Museum, which was founded originally in 1877. The Department's responsibilities include the storage, as well as the research and display of the anthropological specimens housed in the Museum, relating to human evolution, and the variation of man, as well as human palaeoecology. The Department is expected to be a center in Japan for cooperative research in related scientific fields.

July, 1975

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A Case of Microcephaly in an Aeneolithic Yayoi Period Population in Japan

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In 1925, during road improvement work, a new cave site was discovered while cutting a slope on a cliff of sandy tuff at Sano, Awa-gun, Chiba Prefecture, at the southern tip of the Boso Peninsula. As the cave was rapidly being quarried away, Prof. YAWATA, an archaeologist, and the late Prof. KOIKE, an anatomist, investigated it immediately.

From the cultural and human skeletal remains, it seems fairly certain that this cave site was a burial ground from the early Yayoi Period, the aeneolithic age in Japan (YAWATA, 1925; KOGANEI, 1933) (Plate 1, fig. 1). Skeletal remains of nearly 30 individuals were excavated from the site, but except for 3 calvarium, the other pieces are skull fragments, incomplete mandibles and separate extremity bones, which do not identify with each other. Of the three calvarium, skull No. 1 (adult, male) and skull No. 2 (adult female) were normally developed, but skull No. 3 (adult, male) was found to be microcephalic. The normal Sano skulls are characterized by a round head, a broad face with a prominent supraorbital region, a prominent nose, orthodontia, no incisura praeangularis of lower jaws, etc., which give the impression that they are quite different from the protohistoric iron (Kofun) Age populations, but that they are quite similar to the neolithic Jomon ones (Plate 2).

When the Sano and Jomon skulls are compared with each other by means of cranial measurements, there are fairly conspicuous coincidences between them. Because of this, it was concluded that the early Yayoi Period people from the Sano Cave Site had a close physical resemblance to the Jomon Age people (KOIKE and SUZUKI, 1955; SUZUKI, 1969).

The microcephalic Sano No. 3 skull is missing the left half of the maxilla as well as the temporal bone of the right side, and is underdeveloped in both the cranial vault and upper face, although the latter seems to be more developed when compared with the former. The three main cranial sutures do not obliterate at any point. Judging from the broken surface of the parietal bone, the thickness of the skull is assumed to be normal; the tabula externa and interna, as well as the diploë between them are also fully developed. A molar tooth, the only one remaining, is heavily worn (Plate 1, fig. 2).

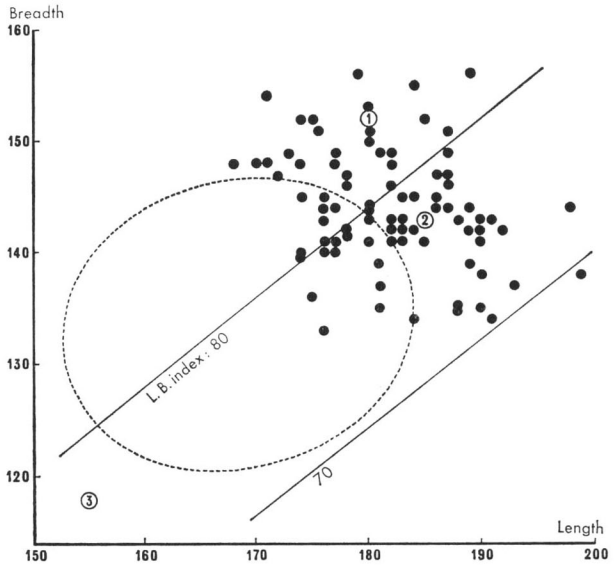

Fig. 1. Distribution of cranial size and form of the skulls from the Sano Cave (1 ~ 3) and those of the prehistoric Jomon people (black dots) in respect to the maximum length and breadth. The broken line indicates the boundary of distribution for modern Japanese (male).

Morphological Observation of the Skull No. 3

The cranial capacity of reconstructed skull as estimated by the millet seed method, is about 730 cc., or nearly half the size of a modern male Japanese from the Kanto District, which is an average of 1551.8 cc., and ranges from 1250 to 1920 cc. (MORITA, 1950). Among a sample of skulls of normal American natives, the two smallest specimens were 910 cc. and 920 cc. in cranial capacity (HRDLIČKA, 1939). The smallest capacities reported in the Andaman and Krumbar populations, who are known as being of low stature, were 950 cc. and 970 cc. respectively (MARTIN, 1928).

Thus, the lower limit of the normal cranial capacity seems to be about 900 cc. Therefore, the capacity of Sano No. 3 is abnormally small for humans and matches the 750 cc. capacity of the largest gorilla (SCHULTZ, 1962). Nevertheless, the capacity surpasses those of the hypermicrocephalic humans of which the lower limit is considered to be 360 cc. for males and 280 cc. for females (WEIDENREICH, 1943).

The three main dimensions, namely the length, breadth and height, of skull No. 3 are extremely reduced (Figs. 1, 2). The height is the most affected and the length the least (Fig. 3 and Appendix). Because the length-breadth index is 76.1, the headform of Sano No. 3 is mesocranic and almost the same as that of the average Jomon Period skull. The length-height index (MARTIN, 17: 1) is 70.3, and the skull is nearly on the border between chamaecranic and orthocranic, whereas the breadth-height index (17: 8) is 92.4, which is on the border between methriocranic and tapeinocranic.

It is noteworthy that the auriculo-bregmatic height is much lower in relation to the basi-bregmatic height. The absolute value of the former is measured as 78.0% of that of the latter in skull No. 3; 84.0% in skull No. 1, 86.5% in No. 2. As a result, the length-auriculo-bregmatic height index of skull No. 3 is 54.8, or chamaecranic, whereas those of the skulls No. 1 and No. 2 are 63.9, or hypsicranic and 61.1, or orthocranic respectively. Recent male skulls of Japanese average 66.1, or hypsicranic.

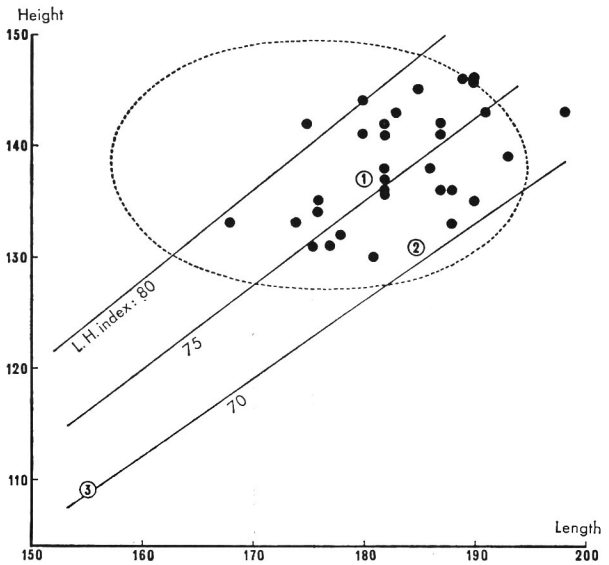

Fig. 2. Distribution of cranial size and form of the skulls from the Sano Cave (1 ~ 3) and those of the prehistoric Jomon people (black dots) in respect to the maximum length and basi-bregmatic height. The broken line indicates the boundary of distribution for modern Japanese (male).

This difference is clearly shown in Fig. 4, which indicates the lateral outlines of Sano No. 1 and No. 3 superimposed so that the porion of each is on the same point of the Frankfort plane. The basi-bregmatic height then becomes divided by the Frankfort plane into two portions, that is, the portions above and below the porion. In respect to the skull No. 3, the height below the porion is quite the same as on skulls No. 1 and 2. As a result, the height above the porion of skull No. 3 becomes much lower than that of the latter two, and this is the reason why the auriculo-bregmatic height is much lower than the basibregmatic height. This means that there is a heavy reduction of the cranial vault in relation to the cranial basis, which is almost completely developed.

In accordance with the reduction of the three main dimensions of the cranial vault, the horizontal circumference, medio-sagittal arc length and the transverse arc length are shortened, with the latter conspicuously affected, probably due to the

lowness of the auriculo-bregmatic height (Appendix).

Here it is noteworthy that both the biauricular breadth and maximal occipital width are broad in relation to the size of the cranial vault. This is clearly shown by the high values of the ratio between the biauricular breadth and the transverse arc, as well as the ratio between the maximal occipital breadth and the cranial breadth.

Because of the smallness of the medio-segittal arc length, its three components, i.e. frontal, parietal and occipital arcs, are also extremely reduced, with the parietal arc most affected, followed by the frontal arc and the occipital arc (Fig. 3). The order of these three components in respect to the whole arc length is quite the reverse of the normal individual. Comparing the ratio between the sagittal arc and the chord lengths, the sagittal curvatures of the frontal and parietal bones are weaker than those of the normal Sano skulls, while the curvature of the occipital bone is almost normal. The frontal bone is strongly inclined backwards, and flattened. The inclination angle (∠b-n-Frankfort plane) is 44.0 for skull No. 3, whereas those of the

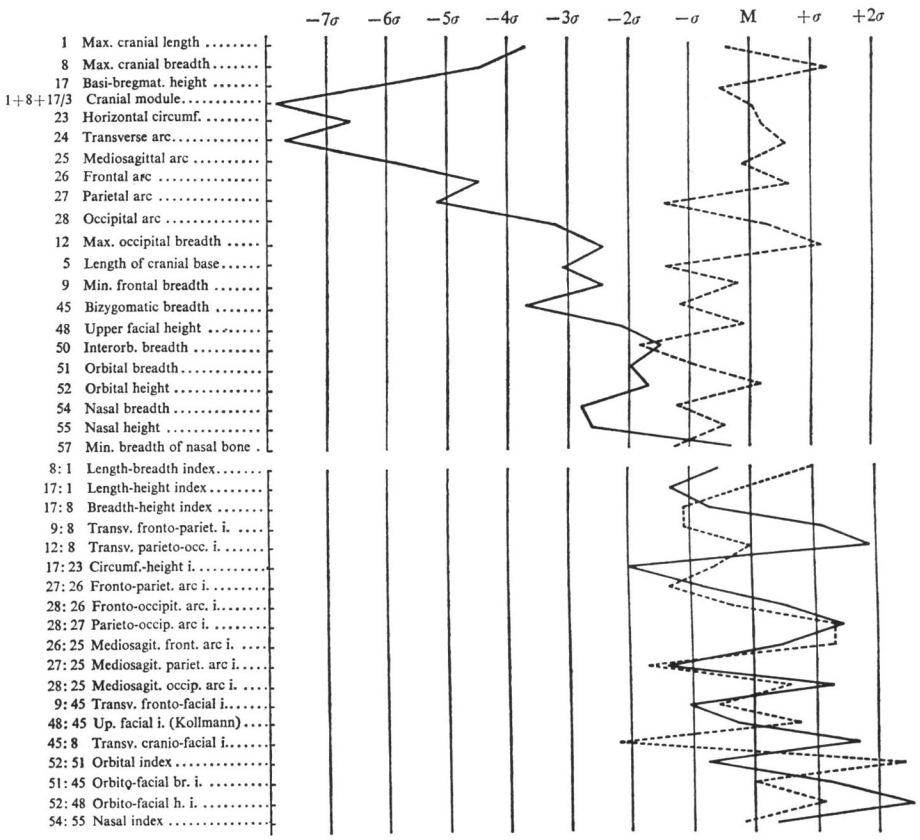

Fig. 3. Comparison of the cranial features of Sano No. 1 (dotted line) and No. 3 (solid line) with those of the prehistoric male Jomon people (M) by means of deviation graph.

skulls No. 1 and 2 are 50.0 respectively. As to the supraorbital region, the glabella appears to be prominent but circumscribed. Radiographically, the frontal sinus is small and has a limited extension into the frontal bone. The supraorbital margin is extremely thin owing to the inclined frontal bone. The minimum frontal breadth is wide in relation to both the maximal cranial breadth and the maximum frontal breadth.

The zygomatic process of the frontal bone is tremendously robust, rectangular in shape and more laterally directed, compared to the normal Sano and Jomon skulls (Plate 2). As a result, the temporal lines of both sides run almost parallel to each other.

The parietal bone is reduced and flattened. The total area of its outer surface is estimated at nearly 60% of skulls No. 1 and 2. The relative length of the temporal margin compared with the sagittal margin is longer than the normal skulls, and the parietal bone as a whole is nearly rectangular in shape. The parietal eminence is indistinct, and the temporal line is located much highter than those of the normal skulls, which shows strong development of the temporal muscle in relation to the size of the skull vault (Table 1).

The moderate protrusion of the frontal and parietal bones in mediosagittal direction, which gives a scaphocephalic impression to the skull, is doubtless in part at least the effect of the powerful temporal muscles by which they are covered (Plate 2; text Fig. 5).

The temporal bone seems to be normal in length but the height of the squama is clearly low. The temporal line and supramastoid crest of the temporal bone are strongly developed and the mastoid process is nearly the same size as those of normal male skulls. Therefore, it will be considered that the process is large sized in relation to the smallness of the cranial vault of skull No. 3.

The occipital bone is quite small. Its occipital part is rather underdeveloped compared with the nuchal part, which is remarkably swollen, especially in the lateral halves, corresponding to the development of the posterior fossa for the cerebellum. Accordingly, the endoinion on the internal occipital protuberance is located much higher than the inion of the outer surface of the bone (Plate 3). The strongly devel-

Table 1. Development of the temporal muscle in relation to the skull vault.

	A Transverse arc (au-au)	B Smallest surface distance between the sup. temp. lines	B: A* Vertical extent of the temp. muscles
Sano No. 1 (♂)	321	141	43.3
Sano No. 2 (♀)	296	132	44.6
Sano No. 3 (♂)	(238)	86	36.0
Eskimo (av.) (♂)*	296	82	28.3
(Southampton Isl.) (♀)*	294	84	28.5

* after Hrdlička (1910)

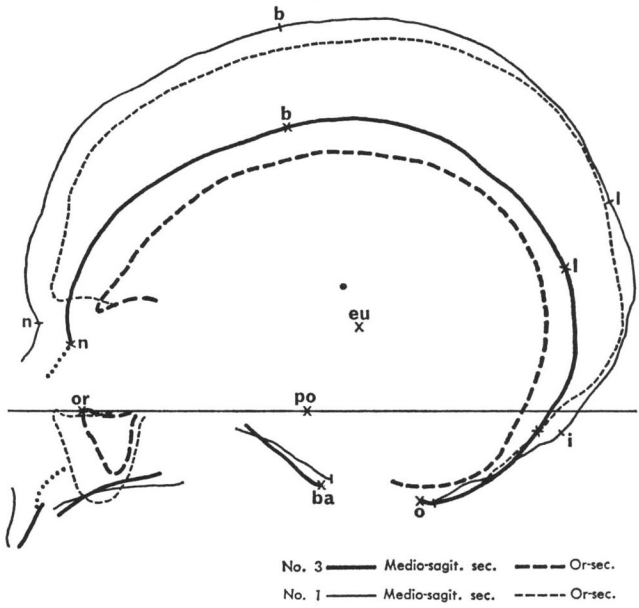

Fig. 4. Superimposed sagittal sections of Sano skulls No. 1 and No. 3. The porion (po) of both the skulls are aligned on the same Frankfort plane.

Table 2. Thickness of the cranial bones.

	Frontal		Parietal		Occipital				Temp.
	Tub. front.	Fac. temp.	Bregma	Tub. par.	Lambda	Squama occ.	Fossa cranii post.	Inion	Squama, Center
Sano No. 1 (♂)	5	2	8	5.5	10	4	2	11	1
Sano No. 2 (♀)	9	1.5	10	8	10	5.5	2	15	3
Sano No. 3 (♂)	8	2	8	6	7	4	1	8	1
Modern man (♂) (Martin, 1928)	5.8 ~ 6.3	1 ~ 2	5.5	2 ~ 5	6 ~ 8	4 ~ 6.5	1 ~ 1.8	15	1.3 ~ 2.5

oped tuberosities for the nuchal muscles are seen on the outer surface of the nuchal part. The foramen magnum is round in shape and of normal size. Therefore, the foramen looks rather wide in relation to the cranial basis.

In spite of the small size of the skull No. 3, the thickness of the skull vault is comparable to those of the skull No. 1 and 2, as well as those of modern man. The results are given in Table 2.

The upper facial breadth is 94 mm, nearly 92% same of that of skull No. 1. Therefore, the ratio between the minimal frontal breadth and the upper facial breadth indicates a much higher value than those of the normal skulls. The same

is true in the bizygomatic breadth as well as the middle facial breadth. The upper facial height is estimated at 56 mm. This figure is small, but it falls within the variation of the upper facial height of the normal Jomon skulls. Sano skull No. 3, therefore, had a broader, higher face than the other Sano skulls, with a large face in relation to the cranial vault.

The absolute values of both the orbital breadth and height are small but the figures fall within the range of the normal prehistoric Jomon skulls. Both the breadth and the height of the orbita are wide and high in relation to the bizygomatic breadth as well as the upper facial height, and the orbita's form is classified as low orbita (camaeconchy). The orbital base is nearly horizontal, whereas the orbital roof is ascending more steeply backwards than on normal skulls. As a result, the thickness between the orbital roof and the inclined forehead is much thinner than usual (text Fig. 4).

The absolute value of the nasal height and breadth is estimated at 40 mm and ca. 23 mm respectively; therefore, the nose is small in size and is classified as chamaerrhinal in shape. The nasal root is almost the same size and shape as those of normal Jomon people.

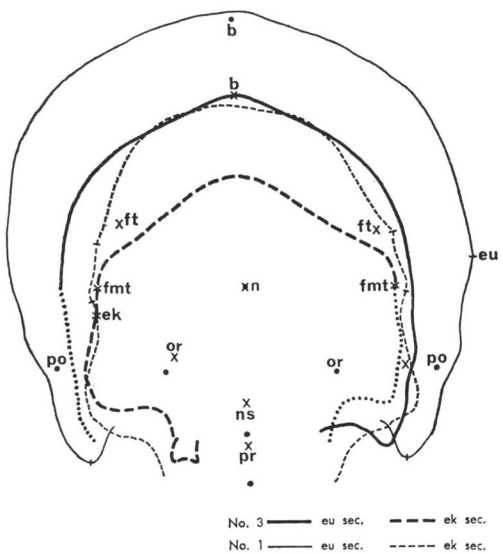

Fig. 5. Superimposed frontal sections of Sano skulls No. 1 and No. 3. The sections are superimposed so that the nasion (n) is in common on both skulls.

Concerning the upper jaw, the height of the alveolar process seems to be low (Fig. 5). The length and width are short and narrow, but both fall within the ranges of those of the normal skulls. The upper jaw is large proportional to the small skull vault.

The teeth of the upper jaw are lost except for the first molar, of which the occulsal surface is strongly worn and cup-shaped, i.e. concave both in the mesiodistal as well as the bucco-lingual directions. The form and degree of the attrition of the molar are quite different from those of molars from protohistoric Kofun Age and later skulls. However, the form and degree of attrition coincide entirely not only with those of the molars of skulls No. 1 and 2, but also with those of molars of the adult Jomon people (Plate 1, fig. 2). This type of attrition shows that the mode of life of the Sano Cave men was quite the same as that of the Jomon people, who are regarded as belonging to a hunter-gatherer culture.

Closing Statement

The cranial features of skull No. 3 from Sano cave in relation to the normal skulls are largely classified into two groups; those which fall far out of the normal ranges, and those which are considered as entirely normal or falling within the normal ranges. The former group is exemplified by the extremely small cranial capacity of 730 cc., and accordingly the reduction of the cranial dimensions especially the cranial height above the Frankfort plane (auriculo-bregmatic height). The latter group is exemplified by the size of the cranial basis, including those of the mastoid process and the foramen magnum, the size of orbita and nose, and the normal development of the chewing apparatus (Fig. 3).

The disharmony in respect to the relative development of the head and face has been regarded by many authors as the most important features of the true microcephaly since the beginning of related studies (GRATIOLET, 1860–1863; VOGT, 1870; VON MIERJEIEVSKY, 1872 etc.).

Now, if we consider the fact that the absolute values of the latter group are fairly small, it will be supposed that Sano No. 3 might have been an individual with small stature, possibly a dwarf. On this supposition, Sano No. 3 would have been affected by the discerebral dwarfism (VLČEK, 1972).

Referring to the microcephaly, it will be supposed that the Sano No. 3 was an idiot. If we take his age of death into consideration, which is about the same age as the other adult Sano people, he must have had normal masticatory, visual and olfactory powers and an adequate motor nervous system. Thus, except for his low intelligence, he must have been capable of productive activities in his hunting-gathering society and it is most interesting that this idiot was apparently accepted by his society in the aeneolithic age.

Acknowledgement

I wish to express my sincerely thanks to Prof. Toshio HAYASHI of Tokyo Medical and Dental University for having taken the X-ray photographs of the Sano skulls.

Appendix. Measurements of the Sano skulls.

Martin, No.	Measurements	No. 1 (♂)	No. 2 (♀)	No. 3 (♂)
2	Glabello-inion l.	169	165	146
22a	Calotte height (g-i. l.)	113	103	80
	22a: 2	66.9	62.4	54.8
1	Max. cranial length	180	185	155
8	Max. cr. breadth	152	144	118
	8: 1	84.4	77.8	76.1
17	Basi-bregmat. h.	137	131	109
20	Auriculo-bregmat. h.	115	113	85
21	Vert. auric. h.	117	115	87
	17: 1	76.1	70.8	70.3
	17: 8	90.1	91.6	92.4
	20: 1	63.9	61.1	54.8
	20: 8	75.7	79.0	72.0
9	Min. front. breadth	98	98	87
10	Max front. br.	127	115	96
	9: 10	77.2	86.1	90.6
	9: 8	64.5	69.2	73.7
5	Cranial base length	98	100	88
11	Biauricul. breadth	131	120	(110)
12	Max. occip. br.	117	111	(98)
	12: 8	77.0	77.6	83.1
13	Mastoid. br.	101	97	(90)
7	L. for. magnum	30	34	33
16	Br. for. magnum	28	—	28
	16: 7	93.3	—	84.9
	Cranial capacity	1550	1340	730
1+8+17/3	Cranial module	156.3	153.0	127.3
23	Horiz. circumf.	531	525	440
24	Transv. arc	327	307	(242)
	11: 24	40.1	39.1	45.5
25	Medio-sagitt. arc	375	377	302
26	Frontal arc	130	127	102
27	Parietal arc	123	126	100
28	Occipital arc	122	122	100
	27: 26	94.6	99.2	98.0
	28: 26	93.9	96.1	98.0
	28: 27	99.2	96.8	100.0
	26: 25	34.7	33.7	33.8
	27: 25	32.8	33.4	33.1
	28: 25	32.5	32.4	33.1
29	Frontal chord	113	112	92
30	Parietal chord	109	114	91
31	Occipital chord	103	98	84
40	Facial length	95	95	82
43	Up. facial breadth	102	103	94
44	Biorbital br.	98	105	(95)
45	Bizygomatic br.	138	130	(125)
48	Up. facial height	66	63	56
	48: 45	47.8	48.5	44.8
	9: 45	71.0	76.2	69.6
	10: 45	92.0	88.5	76.8
	45: 8	90.8	90.9	105.9
50	Interorbit. breadth	17	21	(18)

51	Orbital breadth (r)	42	46	40
52	Orbital height (r)	34	33	30
	52: 51	81.0	71.7	75.0
54	Nasal breadth	26	25	(23)
55	Nasal height	48	45	40
	54: 55	54.2	55.6	57.5
57	Min. br. nasal bone	8	13	(10)
60	Maxillo-alveol. length	52	51	(46)
61	Maxillo-alveol. breadth	61	60	(56)
	61: 60	117.3	117.7	121.7

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Explanation of Plates 1–3

Plate 1

Fig. 1. Cultural remains excavated from the Sano Cave (after YAWATA, 1925).

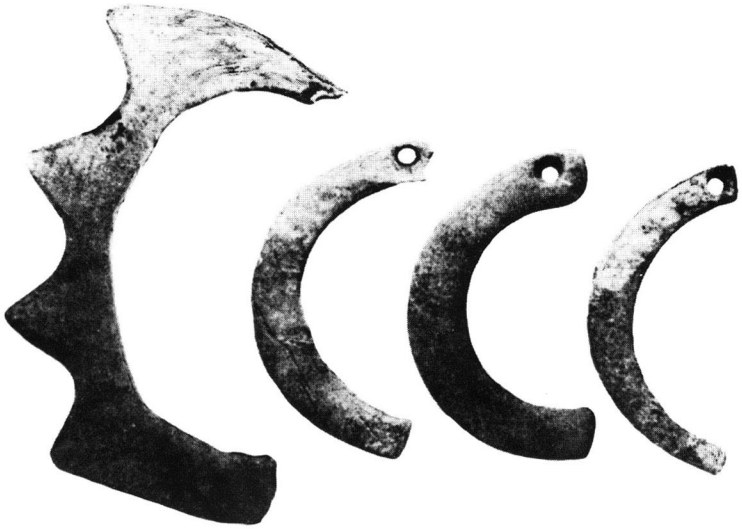
Fig. 2. Occlusal surfaces of the right upper molars of the Sano No. 1 (top) and No. 3 (bottom).

Plate 2

Sano skulls No. 1, 2 and 3.
top: vertical view, middle: frontal view, bottom: lateral view

Plate 3

X-ray cephalogram of Sano No. 1 (right) and No. 3 (left). ei: endoinion, i: inion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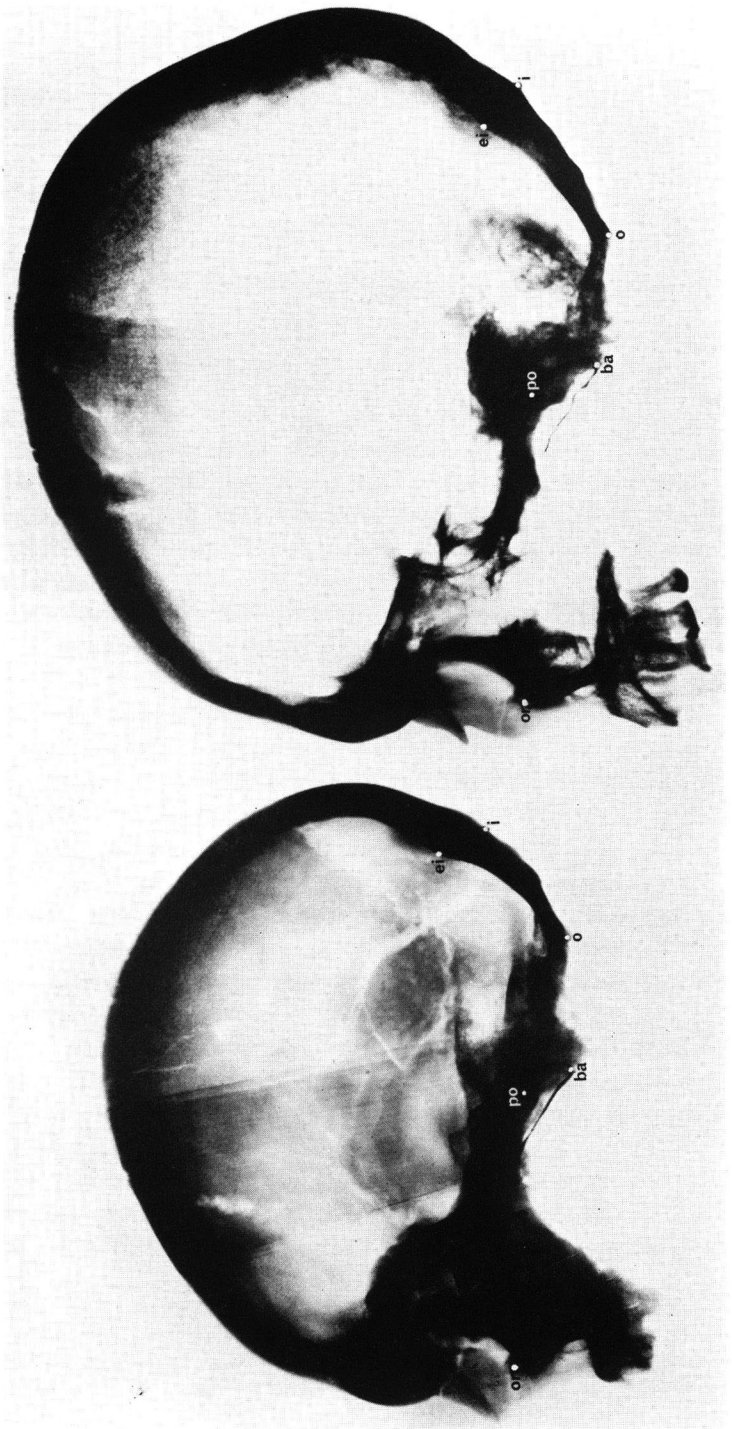
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