Larnach, S. L., and L. Freedman, 1964. Sex determination of Aboriginal crania from coastal New South Wales, Australia. *Records of the Australian Museum* 26(11): 295–308, plates 33–34. [30 November 1964].

doi:10.3853/j.0067-1975.26.1964.679

ISSN 0067-1975

Published by the Australian Museum, Sydney

SEX DETERMINATION OF ABORIGINAL CRANIA FROM COASTAL NEW SOUTH WALES, AUSTRALIA

By S. L. LARNACH AND L. FREEDMAN

Department of Anatomy, University of Sydney, Sydney

Plates 33 and 34

Manuscript received May 1, 1963

INTRODUCTION

Professor N. W. G. Macintosh, Department of Anatomy, University of Sydney, initiated and recommended this project and directed us to the relevant material which has been procured and assembled by him over a period of some 15 years. We acknowledge his assistance and his reading of the final manuscript. Through him we express our sincere thanks and appreciation to Dr. J. W. Evans, Director, Mr. F. D. McCarthy, Ethnologist, and the Trustees of the Australian Museum, Sydney, for the continuing loan of 49 crania; also to Dr. Clarence E. Percy, O.B.E., (formerly) and Dr. John Laing (presently) Director of the Division of Forensic Medicine of the Department of Public Health, N.S.W., through whose collaboration 42 crania of the series here described have become the property of this Department. Their continuing interest in, and consultation on, this material are much appreciated. Three relevant crania in the Macleay Museum, Sydney, were kindly made available by the Curator.

Crania from coastal New South Wales are exceptionally rare. Few if any are known to be located in other State or overseas museums, and there is no publication specifically dealing with a coastal New South Wales series. Some are included, but not specifically identified, in Fenner's 188 skulls from total New South Wales (1939). Twenty male and 12 female coastal crania are identified in Hrdlicka's 1928 catalogue, one was described by Krause in 1897, three are mentioned in Macintosh's (1949) catalogue of Macleay Museum crania and one by Klaatsch (1908). It is curious that in one of the earliest settled regions of Australia there should be greater dearth of Aboriginal skeletal material than in most other regions. An attempt to build up a series of 100 coastal New South Wales crania began in this Department in 1946, and a series of 117 is now available for analysis.

One of us (S.L.), working alone in the 1930s, submitted a manuscript on Australian crania to the late Professor A. N. Burkitt, which was subsequently read and recommended for publication by the late Sir Arthur Keith; it was not published because of lack of funds and intervention of war. This author, in company with Macintosh in 1955 and subsequently alone, revised the original manuscript, making experimental selection of sex characters in Australian crania; by 1962 he had elected 11 traits as significant for sex differentiation. One of us (L.F.) extracted seven from those 11 and the present paper is based on these seven.

With very few exceptions the crania used in this series are recoveries from unmarked burials, the vast majority as a result of chance, and a very few as result of deliberate excavation by Macintosh, McCarthy and Mr. V. Megaw, the latter of the Department of Archaeology, University of Sydney. As far as can be assessed, they are all from adult individuals and they appear to be from full-blooded Australian Aborigines. For a few specimens some post-cranial material is available, but, for the majority, the cranium, often quite extensively damaged, is the sole source of information as to sex. A reliable method of sexing the crania is therefore a prerequisite for any adequate study of the material.

Sexual dimorphism in recent human crania is generally of a low order. Smaller overall size, lighter general construction, weaker muscle markings and certain relative size differences, on average, distinguish female from male crania within a particular group. Further, in various groups features such as glabella or brow ridge development, size of the mastoid process, supramastoid crest or malar tuberosity, and similar features, may have different mean values in the two sexes and be utilized for sexing crania. Borovansky (1936) and Keen (1950) made important studies to assess the value of different characters—both metrical and non-metrical—for sexing crania, and Krogman (1962) has reviewed many aspects of the problem of sexing isolated human crania. In virtually all of the studies hitherto conducted by assessing metrical or/and non-metrical features, about 10-20 per cent. of the crania fall into a category which, on the basis of the particular characters and standards used, includes specimens of both males and females.

More sophisticated statistical techniques are currently being applied to the problem of sexing isolated human crania. Hanihara (1959) used discriminant functions of metrical features to sex Japanese skulls of known sex and his reported sexing error was 10-17 per cent. More recently, Giles and Elliot (1963) described multivariate discriminant functions using various metrical features of the cranium and they were able to sex 82-89 per cent. of American white, Negro and Indian crania. All of the discriminant functions calculated by Giles and Elliot utilize the bizygomatic breadth. Unfortunately, the zygomatic arches are damaged or entirely missing in over 50 per cent. of the crania in the present series and, in a number of the remaining crania, other measurements, particularly those involving the prosthion, are not possible because of damage. Nevertheless, it was felt worth-while to try their function No. 3 (which utilizes eight metrical features) on the New South Wales crania.

Using the Giles and Elliot function No. 3 and sectioning point to sex a small series of the New South Wales crania, many crania which seem clearly male on subjective non-metrical assessment (in two cases backed by post-cranial characters) were sexed as female. Also, one cranium clearly female on morphological and post-cranial features was indicated as male. For these reasons, and because there were insufficient crania of " known " sex at this stage to make a new sectioning point, it was decided to attempt another approach to the problem of sexing the New South Wales Aboriginal crania. In any case, because of the damage mentioned above, less than 50 per cent. of the crania could be subjected to the test.

A more subjective method to be described below was thus evolved which, for the present purposes, has given what appears to be most satisfactory results. However, subjectively, sexual dimorphism seems to be at least as great in Australian Aboriginal crania as in the groups for which Giles and Elliot devised their technique and, what is more, their functions even gave good results with chimpanzees. The Giles-Elliot discriminant functions are simple, practical and completely objective. Thus, when metrical data for the two sexes were calculated on the basis of the sexing method described below, a new sectioning point for their function No. 3 was computed. The results (described below) were now most encouraging.

METHODS AND MATERIALS

In considering which features to use for sexing, it was decided to concentrate mainly on morphological (descriptive), non-metrical characters at this stage, as the significant sex differences in these features are fairly well established. However, in two cases (palate size and mastoid size) the characters were objectively assessed by metrical means. On the basis of the sexing studies mentioned above, and taking cognizance of the special features noted on the New South Wales Aboriginal crania,

11 characters were chosen for trials in sex determination. For each of these characters three classes were delineated to include the different amounts of development of the feature. Class 1 in each case includes the most characteristic female form of the feature, class 3 the most male form and class 2 the intermediate group. To facilitate classification of the crania, unless metrical or similar standards were used, two crania were selected from the New South Wales group to mark the limits of class 2. Each feature was then studied separately in the complete group of New South Wales crania and the 11 values thus obtained for each cranium were totalled. Table 1 lists the 11 characters used, some relevant remarks and the reference numbers of the two crania (or values of the other standard) utilized for assessing the three classes of the particular character.

Of the 117 New South Wales coastal Aboriginal crania assembled for study, the sex of only one (a dissection room male cadaver) is known from records and only another 18 (nine males and nine females) have sufficient associated post-cranial bones for their " cranial sex " to be confirmed by post-cranial features (mainly of the pelvis and femur). As 19 crania are clearly an inadequate sample for developing a sexing technique, it was decided to examine first all of the crania in which all of the 11 sexing features decided upon were present.

RESULTS

List 1 shows the distribution of 107 Aboriginal crania using the 11 characters listed in Table 1. If one notes the distribution of the crania of known sex, there is a fair suggestion of bimodality for the distribution. The left-hand group (including all of the known females) covers a range of 11-17 and the specimens form a clear, leptokurtic distribution. The right-hand group (including all of the known males) covers a range of 19-32. These latter specimens do not form as smooth and definite a curve as the left-hand group and, in addition, their distribution is probably platykurtic. The differences in shape of the distributions of the two groups may merely reflect peculiarities of the three arbitrary categories chosen for each character, or, on the other hand, they may be evidence of greater variability in the group including the known males. In view of the known male and female crania falling on either side of category 18, it would seem quite likely that this technique separates at least the majority of male and female crania into two distinct groups.

In an effort to improve the technique, it was next decided to attempt to assess which of the 11 characters utilized were the most useful for determining the sex of Aboriginal crania. In order to do this, it was necessary to accept some preliminary assessment of probable male and female crania—the specimens of known sex alone, as pointed out above, being too few in number. The distribution of the cranial values in List 1 suggested that, by removing the crania in the region of possible overlap, the sexes of at least most of the remaining crania would be unequivocal. After further consideration of List 1, it was decided to eliminate categories 17-21. The asymmetry of this selection of categories around the meeting point of the two groups (category 18) was deemed advisable because of the leptokurtic nature of the distribution of the " females " and the apparently platykurtic distribution of the " males ". The 54 " male " and 36 " female " crania so indicated were then carefully studied subjectively and in none was there any strong indication of disagreement with the sex indicated. The mean values for each of the 11 characters were then calculated separately for " males " and " females " of the group and the differences between these values for each character in the two sexes recorded. Table 2 shows the results of this examination. On the standards used for delimiting the classes, the features yielding the greatest differences between the sexes (as separated by the above technique) can be readily seen.

TABLE 1

Characters Used for Sexing Australian Aboriginal Crania from Coastal N.S.W.

Character	Remarks	Class 2 limits
Glabella	Prominence was assessed according to Martin's modification of Broca's scale (Martin, 1928).	Grade IV (Martin).
Supercilliary ridges (Plate 33).	These were graded according to their prominence. Their presence is judged independently of the size of the glabella and zygomatic trigone (see Note 1 below).	>B. 171B <5
Zygomatic trigone (Plate 33).	The development of this feature (also known as the trigonum supraorbitale or external angular process) is similarly independent and should be assessed without reference to the above two.	= or >473 <N.P.
Forehead contour ..	The relative degree of recession was noted independently of glabella development. More vertical, class 1; more horizontal, class 3.	>S. 1748 = or <123
Temporal crests	The relative degree of prominence was estimated, mainly as seen on the frontal (crista frontalis lateralis).	>8 <S. 1609
Malar size	Size was judged in terms of external surface area of malar.	>175 = or <76
Malar tuberosity (Plate 34).	Prominence of the tuberosity, which, as noted by Fenner (1939), may take the form of a ridge in the Australian Aboriginal.	>123 = or <S. 744
Supramastoid crest ..	The degree of development was noted because of sex incidence observations by Keen (1950).	>S. 744 = or <N.P.
Mastoid process	Length x width x depth (nrst. mm.) ÷ 100. (See note 2 below).	55-80
Occipital markings (Plate 34).	General ruggedness, depth of fossae for rectus capitis posterior minor and semispinalis capitis mm., ruggedness of inion region, development of occipital crest and torus.	= or >512 = or <123
Size of palate	Maximum alveolar length x breadth (nrst. mm.) = 100.	35-39

Notes :—

1. The supraorbital region has been treated in this study as consisting of three distinct entities (Martin, 1928), glabella, supercilliary ridges and zygomatic trigones. In the Australian Aboriginal these three features show a considerable degree of independent variation. The development of the supraorbital region as a whole contributes strongly to the male or female appearance of the cranium.

2. The following are the definitions of the mastoid process measurements : Length : From the Frankfurt Horizontal Plane, vertically downward to the level of the tip of the mastoid process. Width : Maximum measurement in the sagittal plane and parallel to the Frankfurt Horizontal Plane, from the uppermost point on the anterior margin (in practice, the lowest point at which the tympanic plate abuts against the mastoid process) to the level of the most posterior point on the posterior surface. Depth : Maximum measurement in a coronal plane and parallel to the Frankfurt Horizontal Plane, from the uppermost part of the digastric fossa medially, to the most lateral point on the mastoid process.

3. Plates 33 and 34 illustrate class 2 limits of the morphological features utilized in the final seven character sexing technique. For the glabella, Martin's modification of Broca's scale was used; the palate and mastoid process were assessed by metrical means.

LIST 1

Distribution of 107 Australian Aboriginal Crania from Coastal N.S.W., Using 11 Sexing Characters

Values for sum of 11 Characters																					
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
..	..	B169A†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	512†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	506	..	..	..	..	..	..	..	..	..	496	..	..	..	..	..	..	..	..	..
..	240†	S2256	YB†	..	..	..	..	..	..	..	..	S1614	..	1*	..	..	..	493*	..	..	..
..	510	S2093	S1748	463	..	..	..	..	..	..	S1755	372	..	504*	505*	..	..	S2218	..	..	..
..	S1825	S1734	S1616	509	..	..	..	B171B*	..	..	306	371	..	503*	B160	NP*	274*	S1828	..	..	..
..	352	S2079	S1612	S1615	S1613	..	..	S637	..	B169B*	1210	275	S774	S1749	1204	12	S267	1169	..	..	..
..	A17590	E17551	1181	S1157	B163A	473†	..	S2105	1196	B164*	S1989	179	E12778	177	264	180	S2104	S1611	S1609	..	..
511†	E8664	11	S1921	S1643	B165	B135†	489	507	S595	9	465	123	497	6	30	239	490	S1916	1180	S394	..
381†	175	8	378	173	7	1201	460	1185	450	1238	M62	10	M60	502	5	508	M64	307	340	76	377

† = Known ♀

* = Known ♂

TABLE 2

Examination of 11 Characters in 90 Australian Aboriginal Crania from N.S.W. for their Value in Sexing Determinations

	Glabella	Super-cilliary ridges	Zygomatic trigone	Forehead contour	Temporal crest	Malar size	Malar tuberosity	Supra-mastoid crest	Mastoid process	Occipital muscle markings	Palate size
Male mean ..	2.26	2.41	2.57	2.22	2.30	2.35	2.35	1.61	2.28	2.55	2.69
Female mean	1.08	1.03	1.31	1.25	1.36	1.61	1.00	1.29	1.03	1.05	1.55
Difference ..	1.18	1.38	1.26	0.97	0.94	0.74	1.35	0.32	1.25	1.50	1.14

Varying numbers of characters were then omitted on the basis of the results shown in Table 2 and the values for each of the 107 crania were plotted on separate diagrams for each new combination. After a number of different trials, it became evident that the elimination of the four characters giving the smallest differences in mean values between males and females (supramastoid crest, malar size, temporal crest and forehead contour) gave the most satisfactory division (List 2). Fewer than seven characters resulted in too few categories and consequently one or more categories included specimens of both sexes. When more than seven characters were used, some crania in the " male " or/and " female " groups, on subjective assessment, strongly suggested that they ought to be grouped with the opposite sex to which the technique had assigned them. With the seven best characters indicated in Table 2, there were no obvious disagreements and the few " subjectively doubtful " crania were clearly assigned to one or other sex.

The shapes of the distributions of the individual crania in the male and female groups, as determined by these seven characters, show some differences to the distributions found using all 11 characters. The female (left-hand) group now appears to form either the right half only of a leptokurtic curve with a mean value at about category 7, or a much less leptokurtic curve, with the mean value at about category 9 and the left half of the left limb of the distribution compressed into category 7. The male (right-hand) group falls into a considerably more regular and less platykurtic shape than when the 11 characters were used. These differences between the male and female distributions (when seven instead of 11 characters are used) may partly be ascribed to the reduced number of categories when fewer characters are included. The apparent compression of part or all of the " left limb " of the female distribution suggests that, in some or all of the characters utilized, class 1 at least should be subdivided into two or more categories. The condensation of all of the female crania into only five of the 15 possible categories could be a chance result of the particular limits chosen for the three classes of some or all of the characters, but may well be due to the smaller range of variation characteristic of the morphological features of human female crania when compared to those of males (e.g., Klaatsch, 1908).

The only real shortcoming of the sexing method using the above combination of seven characters was the fact that there is no cranium of known sex in category 11, although, subjectively assessed, all of these crania appear to be from females. In an attempt to resolve this point, and also to test the method generally, all of the Australian Aboriginal crania of known sex that could be obtained from any part of Australia were processed and plotted, using the same seven characters. The results of this test are shown in List 3. In this group of crania, all of the specimens are correctly sexed and, further, a female cranium falls into category 11, confirming that this category belongs to the female group and that the 11/12 boundary is the sectioning point for crania of the two sexes.

DISCUSSION

Various groupings of characters were tried. In a total of 14 different combinations using 5 to 11 features, no cranium indicated as male by the final technique, or strongly suggesting male characters subjectively, fell into or below a category including a known female. Six crania, which by the final sexing were designated as female, fell into or above a category containing a known male in one or more of the other combinations tried. [This is similar to the findings of Hrdlicka (1928, Pg. 2) who noted that " sexing of the Aboriginal skull is not always easy, some of the females closely resembling males ".] Of these six female crania, cranium

LIST 2

Distribution of 107 Australian Aboriginal Crania from Coastal N.S.W., Using Seven Characters

Values for Sum of Seven Characters														
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
511†	..	..	..	..	..	..	..	..	..	..	..	..	..	..
381†	..	..	..	..	..	..	..	..	..	..	..	..	..	..
240†	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S1612	..	512†	..	..	..	..	..	..	..	..	..	..	..	..
510	..	YB†	..	..	..	..	..	..	B164*	..	..	..	..	..
S1825	..	S1748†	..	..	..	..	..	..	1*	..	..	..	..	..
1181	..	509	..	..	..	..	..	..	496	NP*	..	..	..	..
S2256	B169A†	1185	..	..	..	..	..	..	S1614	274*	S1611	493*	..	..
352	506	S1616	..	..	..	..	..	..	S744	505*	S267	1169	S394	..
S2093	S1613	1201	473†	..	..	..	B169B*	..	372	504*	B160	S1609	12	..
A17590	S1157	B163A	B135†	..	..	..	S1749	..	S2218	503*	E12778	S2104	S1916	..
E8664	463	S1921	S1615	507	B171B*	S637	179	S1755	1210	1204	177	490	1180	..
S2079	S1734	S1643	B165	1238	1196	306	465	371	275	6	239	S1828	340	..
E17551	173	460	7	489	S2105	S595	123	497	M60	5	264	307	76	..
175	11	8	378	450	M62	S1989	9	10	502	508	30	180	M64	377

† = Known ♀.

* = Known ♂.

LIST 3

Distribution of 35 Australian Aboriginal Crania of Known Sex, Using Seven Sexing Characters (Females—large italicized numbers)

Values for Sum of Seven Characters														
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
..	..	..	..	..	..	..	..	..	..	505*	..	..	..	..
..	..	*512**	..	..	..	..	..	..	..	504*	..	..	..	..
*511**	*B169A**	*S1748**	..	..	..	..	..	..	..	503*	..	..	..	..
*240**	*SL11*	*YB**	*B135**	..	..	..	B169B*	..	..	NP*	..	..	..	..
*381**	*B170*	*475*	*473**	*B142A*	..	..	B164*	SL15	..	274*	..	75	..	..
499	*SK63*	*333*	*SL14*	*332*	B171B*	320	248	330	1*	334	..	493	SK72	..

* = N.S.W. crania.

1238 is the one which most commonly changes to the male side and 489 only changes when less than seven characters are used. The development of certain features should be noted in these six crania: numbers 1185, 450 and 507 have well developed supramastoid and temporal crests, in numbers 1238 and 489 the supramastoid crest is well developed and in cranium number 7 the forehead contour slopes backwards markedly as in males. It is on these features that the balance is tipped towards the male side in certain of the combinations tried. As these three features were shown in Table 2 to be the least reliable of the characters tested for sexing, it seems likely that the designation of these crania as female is correct.

For most of the characters studied, male and female crania were found which showed development typical, or occasionally even extreme, for the opposite sex. The percentile frequencies for each class of each character in males and females separately are shown in Table 3. Certain crania (e.g., 9, B. 171B, 1185 and 1238) presented particular difficulties for subjective sexing as "base" and "brow" indicated opposite sexes. The relative weight given to these two regions may swing the balance one way or the other in such a case. In the sexing system described above, the "brow region" is considered in three characters (glabella, supercilliary ridges and zygomatic trigone) and the "base" in two (occipital markings and mastoid process). This may well lay too much stress on the brow ridges, particularly in view of the fact that the occipital markings were shown in Table 2 to represent the best single item for discriminating between the sexes.

With regard to the probable degree of accuracy of the technique finally settled on, it is of interest to note that the six specimens discussed above constitute less than 6 per cent. of the total series. Another approach to the accuracy of the test would be to consider the crania in the categories on either side of the sectioning point as doubtful (four in category 11 and four in category 12). This would leave 92·5 per cent. as accurately sexed but, as the sex of one of the crania (B. 171B) is confirmed by the pelvis, the figure would rise to 93·5 per cent. On either hypothesis at least 90-95 per cent. would seem to be the likely degree of accuracy of sexing obtained.

Hrdlicka (1928) sexed 24 of the crania used in this study and 22 (91.7 per cent.) are in agreement. S. 1614, which Hrdlicka called a female, falls into category 16 and, except for slightly small overall size, appears clearly male on morphological characters. S. 1643, which Hrdlicka makes a male, falls into category 9 and seems clearly female, although it is possibly slightly larger than an average female. Stewart (1954) has summarized previous work in which some of Hrdlicka's subjective sexing was called into doubt. He points out that Hrdlicka tended to be biased by overall size and would on occasions change his subjective morphological assessment after completing his measurements.

The difficulties with utilizing the discriminant functions of Giles and Elliot (1963) for sexing the New South Wales crania were outlined above. Using the sexes established in the present study, mean values were calculated for males and females of the series (Freedman, 1964) and, from these, a new sectioning point, 6216.32, was calculated for their No. 3 function. Their No. 3 function is : 6.083 glabella-occipital length — 1.000 maximum width + 9.500 basion-bregma height + 28·250 maximum diameter, bizygomatic + 2·250 basion-prosthion + 9·917 prosthion-nasion height — 19.167 palate, external breadth + 25.417 mastoid length. With the new sectioning point calculated, this function "correctly" assessed 86.7 per cent. of 45 Aboriginal crania (mainly from New South Wales). Of the six crania in which the two techniques (i.e., the one by Giles and Elliot and that by the present authors) disagreed, the Giles-Elliot function made S. 673, S. 1614, 5, M. 62 and B. 169B female, and 473 male. The first four crania all have small bizygomatic breadths and the fourth one, in addition, has a small mastoid process. The fifth, B. 169B, has a particularly short mastoid process. These features receive great weight in the Giles-

TABLE 3

Frequencies of Classes 1-3 for 11 Characters in 107 Australian Aboriginal Crania from N.S.W. (in percentages)

Class	Glabella		Super-cilliary ridges		Zygomatic trigone		Forehead contour		Temporal crest		Malar size		Malar tuberosity		Supra-mastoid crest		Mastoid process		Occipital muscle markings		Palate size	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1	23.0	88.2	15.4	90.4	10.9	71.2	18.5	74.5	13.8	59.6	4.7	33.3	21.9	97.9	32.3	62.0	15.4	92.0	6.1	90.2	1.6	50.0
2	32.3	11.8	40.0	7.7	26.6	25.0	52.3	21.6	53.9	36.5	65.6	54.2	31.2	2.1	41.5	28.0	52.3	8.0	37.9	5.9	34.9	38.5
3	44.7	0.0	44.6	1.9	62.5	3.8	29.2	3.9	32.3	3.9	29.7	12.5	46.9	0.0	26.2	10.0	32.3	0.0	56.0	3.9	63.5	11.5

Elliot functions. The sixth cranium (473) is clearly female on morphological cranial and post-cranial features, but its cranial dimensions generally are rather large for a female. It is of interest that none of these six crania are amongst those discussed above whose sex was " affected " by changes in the number and particular morphological characters used to assess sex.

A final interesting piece of circumstantial evidence about the accuracy of the sexing technique described above, comes from the Aboriginal practice of evulsing one or both of the upper medial incisors in males. Tench (1793) described the method of evulsion of these teeth in men and noted that, although the ceremony was not universal, it was " nearly so ", and mentioned exceptions. The tooth was first loosened by the gum being scarified on both sides with a sharp shell. One end of a stick was then applied to the tooth and the other end struck gently several times with a stone until the tooth became freely movable. The *coup de grace* was then given with a smart stroke. Many of the crania in this study come from a later period than that referred to by Tench and the custom may well have been dying out, but it was nevertheless felt to be of interest to examine the series for this feature. An upper medial incisor has been evulsed in 44.4 per cent. of the male crania and 4.8 per cent. of the female crania. Of the 30 crania where an upper medial incisor had been evulsed, 28 (93.3 per cent.) were diagnosed males. The two female crania were unambiguously female; their incisor loss may have been accidental or a variation in what is more customarily a male prerogative of ritual.

CONCLUSIONS

The sexing technique described in this paper is considered as having been devised as a tool for a specific purpose, namely, the division of a collection of New South Wales coastal Australian Aboriginal crania into two sexes for metrical and non-metrical study. This it would seem to do with at least 90-95 per cent. accuracy. Where one or even two features are not present, as in the 10 crania originally eliminated, substitution of mean values and, when in doubt, maxima of first one and then the other sex, made sexing of most of even such crania feasible. On the limited sample tried, it seems possible that the technique will also work on Aboriginal crania from other parts of Australia. As particular crania or similar rigid standards were used to classify each character, and the characters used for discrimination were chosen objectively on mean differences, it is felt that the technique finally arrived at closely approaches objectivity.

With the calculation of a new sectioning point, the Giles-Elliot No. 3 discriminant function appears to be a most useful technique for sexing Australian Aboriginal crania, provided damage, especially to the zygomatic arches, is not extensive. A discriminant function calculated on the basis of the metrical features of the New South Wales crania themselves, may, however, be the ultimate answer.

ACKNOWLEDGEMENTS

We thank Mr. G. L. Williams and Mrs. W. A. King, both of the Department of Anatomy, University of Sydney, for the photography and manuscript typing respectively.

REFERENCES

Borovansky, L. (1936). Sex differences in the human skull. *Publ. of the Czech. Acad. of Sci. and Art.* Reviewed by Hrdlicka, A. (1936). *Am. J. Phys. Anthropol.*, **22**, 162-163.

Fenner, F. J. (1939). The Australian Aboriginal skull. Its non-metrical morphological characters. *Trans. Roy. Soc. South Aust.*, **63**, 248-306.

Freedman, L. (1964) Metrical features of Aboriginal crania from coastal New South Wales, Australia. *Rec. Aust. Mus.*, **26**, 309-325.

Giles, E. and Elliot, O. (1963). Sex determination by discriminant function analysis of crania. *Am. J. Phys. Anthropol.*, **21**, n.s., 53-68.

Hanihara, K. (1959). Sex diagnosis of Japanese skulls and scapulae by means of discriminant functions. *J. Anth. Soc. Nippon.*, **67**, 21-27. Quoted in Krogman, W. M. (1962), The human skeleton in forensic medicine. Thomas, Springfield, Ill.

Hrdlicka, A. (1928). Catalogue of the human crania in the United States National Museum collections. *Proc. U.S. Nat. Mus.*, **71**, art. 24, 1-140.

Keen, J. A. (1950). A study of the differences between male and female skulls. *Am. J. Phys. Anthropol.* **8**, n.s., 65-78.

Klaatsch, H. (1908). The skull of the Australian Aboriginal. *Rep. Path. Lab. Lunacy Dept., N.S.W.*, **1**, part 3, 43-167.

Krause, W. (1897). Anthropologische Reise nach Australien. *Zschr. f. Ethnol.*, **29**, 508-558.

Krogman, W. M. (1962). The human skeleton in forensic medicine. Thomas, Springfield, Ill.

Macintosh, N. W. G. (1949). Crania in the Macleay Museum. *Proc. Linn. Soc. N.S.W.*, **74**, 161-191.

Martin, R. (1928). Lehrbuch der Anthropologie. Vols. 1, 2 and 3. 2nd Ed. Gustav Fischer: Jena.

Stewart, T. D. (1954). Sex determination of the skeleton by guess and by measurement. *Am. J. Phys. Anthropol.*, **12**, n.s., 385-392.

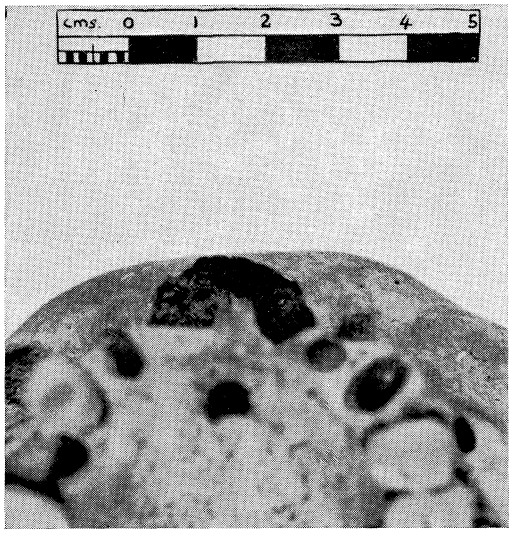
Tench, W. (1793). *A complete account of the settlement at Port Jackson in New South Wales including an accurate description of the situation of the colony; of the natives; and of its natural productions.* Reprinted 1961, by Angus and Robertson : Sydney.

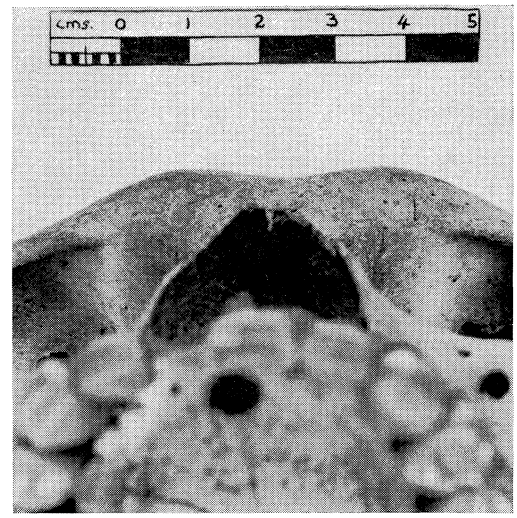
EXPLANATION OF PLATES

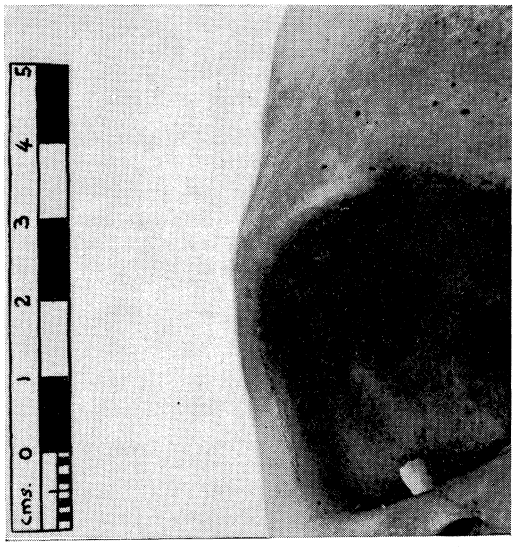
Plate 33.—Crania showing the limits of class 2 of the morphological features used for sexing Australian Aboriginal crania from coastal N.S.W. *Above:* antero-inferior aspect of supercilliary ridges; smallest on left (B. 171B), largest on right (5). *Below:* antero-medial aspect of zygomatic trigone; smallest on left (473), largest on right (N.P.).

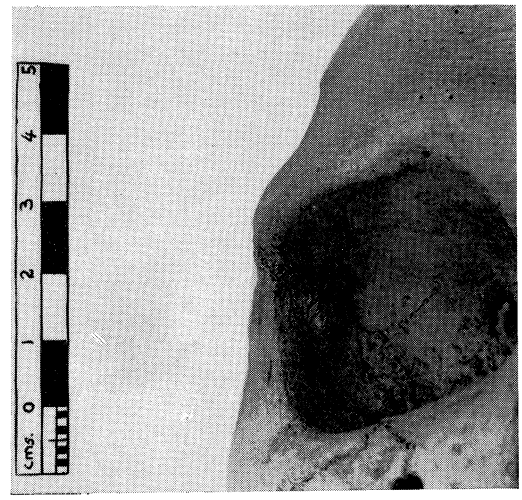
Plate 34.—Crania showing the limits of class 2 of the morphological features used for sexing Australian Aboriginal crania from coastal N.S.W. *Above:* postero-lateral view of malar tuberosities; smallest on left (123), largest on right (S. 744). *Below:* basal view of occipital muscle markings; least marked on left (512), most marked on right (123).

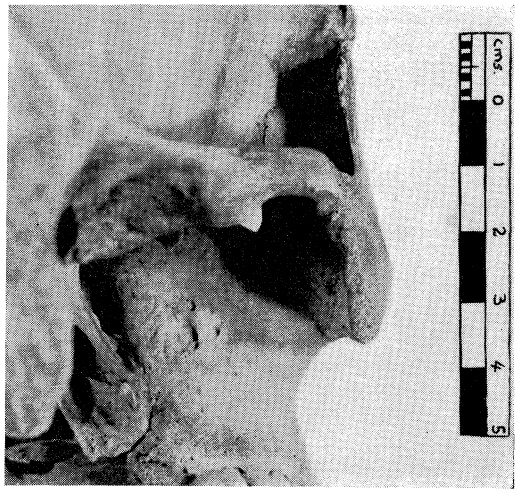
Sydney: V. C. N. Blight, Government Printer—1964

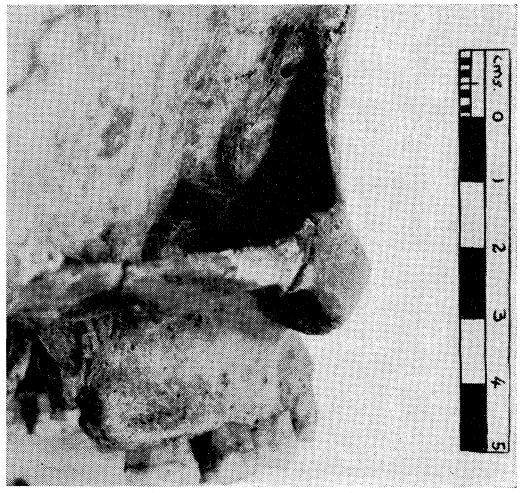

cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5

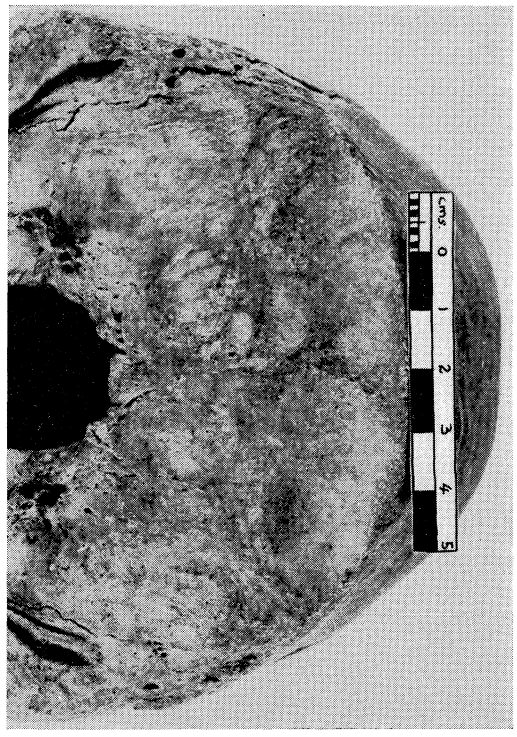

cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5


cms. 0 1 2 3 4 5