

LIST OF FIGURES

	<u>Page</u>
Figure 1. Age Distribution in 248 S.A. Negro Male Vertebral Columns -----	12
Figure 2. Age Distribution in 157 S.A. Negro Female Vertebral Columns -----	12
Figure 3. Number of Sacral Vertebrae -----	18a
Figure 4. Left Lateral Aspect of Sacrum -----	24
Figure 5. Superior Aspect of Sacrum -----	24
Figure 6. Method of Measurement of Promontory Angle -----	27
Figure 7. Measurement of Length of Pubis and Length of Ischium -----	31
Figure 8. Measurement of Sciatic Notch Width -----	31a
Figure 9. Distribution of Ischium-pubis Index in Present San Series -----	35
Figure 10. Distribution of Sciatic Notch Width in Present San Series -----	35
Figure 11. Five-piece and 6-piece Sacra -----	45
Figure 12. Minor Separation of the Bodies of S1 and S2 ----	169
Figure 13. Major Separation of the Bodies of S1 and S2 ----	170
Figure 14. Major Separation of the Bodies of S1 and S2 (contd.) -----	171
Figure 15. Vertebral Arch Variation: Separation of Laminae and Facets -----	177
Figure 16. Vertebral Arch Variation: Separation of Lateral Parts -----	181
Figure 17. Alar Facets -----	185
Figure 18. Transitional Lumbo-sacral Vertebra -----	187
Figure 19. Categories of Basality -----	195
Figure 20. Measurement of Degree of Basality -----	196
Figure 21. Basality -----	197
Figure 22. Basality: Level of S1 in Relation to the Auricular Area -----	205
Figure 23. Transitional Features in the Last Sacral Piece -	208
Figure 24. Sacrococcygeal Synostosis -----	212
Figure 25. Developmental Model of the Sacrum -----	289
Figure 25. Developmental Model of the Sacrum (contd.) -----	290
Figure 26. Suggested Mechanism of the Production of Basality based on Wells's (1963) Concept and on the Concept of Level and Strength of the Upper End of the Iliac Individuation Field -----	296

CHAPTER 1

INTRODUCTION

This is a study on the sacrum and vertebral column of the South African Negro and of the San (Bushman). In addition, the study includes original observations on the vertebral column of the American Negro.

The sacral study consists of a metrical analysis of the sacrum as well as descriptions and analyses of non-metrical sacral features. The study of the vertebral column is confined to analyses of numerical spinal formulae and their relation to variations in sacral vertebrae.

The sacrum is a complex and interesting bone owing partly to its varied functions and partly to the differing influences brought to bear on it during development. The sacrum, indeed, has proved fascinating to scientists from earliest times and the origin of the word dates back to the time of Galen (131-201 A.D.). The word is the neuter of the Latin adjective sacer meaning sacred or holy (Stedman's Medical Dictionary, 1966). The Greek term for sacrum, hieron is the one used by Galen. It has been suggested that he used this term because the word also meant illustrious, glorious, mighty or great and Galen considered the sacrum as the greatest or most important bone of the spine. The Greek word is used to this day in certain descriptive terms for the sacrum, for example, 'platyhiery' and 'dolichohiery', meaning a relatively broad or narrow sacrum respectively.

The Latin term os sacrum means the sacred bone. One explanation of why it was so called was that it was the last bone to decay and thus would form the basis of resurrection (Field and Harrison 1957). This explanation is dealt with at some length by Cameron (1934). He states that there was a remarkable Hebrew tradition that the sacrum was the only bone in the body which resisted permanently the effects of decay. It was thought to be the seed from which the new body sprang at the 'resurrection'. He refers to the following quaint account from Hudibras by Samuel Butler of how the bone came to be named

"The learned Rabbins of the Jews write
There's a bone which they call Luez
I' the rump of man of such a virtue
No force in Nature can do hurt to,
And therefore at the last great day
All other members shall, they say,

Spring out of this as from a seed
 All sort of vegetales proceed;
 From whence the learned sons of Art
Os sacrum justly style that part."

Cameron goes on to say that his practical experience of prehistoric burial controverts this belief, the sacrum often being the first bone to decay.

Monro (1732, cited by Skinner 1961) suggests that the sacrum was so-named because it was offered in sacrifice or because of its size in relation to other vertebrae. Yet a further explanation offered is that it surrounded the sacred organs of generation (Field and Harrison 1957).

Previous Workers, Scope and Purpose of Study

Sir William Turner was the first scientist to indicate that there might be racial as well as individual differences in the sacra of various races. After his historic voyage in H.M.S. Challenger, during which time he collected skeletons of many races, he wrote a paper on "The sacral index in various races of Mankind" (1885/6b). In this paper he devised and proposed the sacral index as a method to classify the races. He computed the index by multiplying the breadth of the sacrum by 100 and dividing by the length. He divided sacra into two categories, one platyhieric in which the index is greater than 100, the other dolichohieric in which the index is less than 100. He then reviewed the literature and computed the sacral index from the data of other workers (eg. Verneau 1875). He concluded that the sacral index varied in different races of mankind.

Paterson (1892) studied a series of 265 adult sacra. His study included an account of the sacral curve, the results of which form the basis of descriptions of sacral curvature in many anatomy textbooks. In his discussion of the sacral index he introduced a category intermediate between platyhiery and dolichohiery which he termed subplatyhiery in which the sacral index lies between 100 and 106%. These three categories of the sacral index, platyhiery, subplatyhiery and dolichohiery, are employed today. Like Turner (1885/6b), Paterson found population differences in the sacral index. Paterson (1892) also made observations on the extent of the sacral auricular surface, the number of sacral pieces and variation in the first piece of the sacrum. He correlated the latter two features with vertebral numerical variations.

Radlauer (1908) carried out an extensive study of the sacrum and reviewed the literature to date. His methods of mensuration of the sacrum are adopted as standard by most workers, notably Martin and

Saller (1957), as are his descriptions of the morphological features of the sacrum. For example, his categories of basality are cited by Martin and Saller (1957) and by such workers as Wells (1963).

Bardeen (1904) provided a particularly valuable contribution on vertebral numerical variation, including that of the sacrum, in adults and embryos. Adolphi (1912) examined a large sample of Caucasoid sacra (292) in which he analysed the numerical composition of the sacrum. Similar data were available from Steinbach (1889, cited by Bardeen 1904) and from Frey (1929) whose studies included presacral vertebrae.

There have since been many papers on the sacrum but the majority of reports have been on small samples or even single sacra. Exceptions are the study of Japanese sacra by Hasebe (1913) and the study of Australian aboriginal sacra by Davivongs (1963).

In more modern vein, the sacrum has a two-fold role; (i) it forms part of the vertebral column and, as such, is especially adapted to perform a weight bearing function, and (ii) together with the two innominate bones it constitutes the pelvis which itself has dual functions, locomotion and child-bearing.

In the first instance, the sacrum, being in series with the cervical, thoracic and lumbar vertebrae, is subject to variation in morphology and in number. Along the length of the vertebral column, the costal elements of the developing vertebrae are modified in response to influences in the region in which they lie. For example, in the neck, the costo-transverse bar of the cervical vertebrae protects the vertebral artery; in the thorax the ribs protect the thoracic contents; whilst, in the lumbar region, the costal elements constitute the transverse processes. In the sacral region of the spine, the costal elements enlarge and, together with the transverse process elements, form the lateral part (mass) of the sacrum. The developmental stimulus for this would appear to be related to the proximity of the developing iliac anlagen. In this regard, the sacrum may be considered to be functionally in two parts; the first, consisting of the first three sacral vertebrae, articulates with the ilium and transmits body weight to the lower limbs; the second, a vestige, consisting of the last 2 (or 3) vertebrae which are free at their lateral borders. Topinard (1890) called the first the sacrum nécessaire and the second the sacrum supplémentaire. He suggested that the coccyx plus the sacrum supplémentaire forms the tail in man. The sacrum nécessaire is indeed essential and provides for three important aspects of sacral function, namely, weight-bearing, child-bearing and locomotion. The sacrum supplémentaire, besides having a tail-bearing function in tailed

animals, has important functions related to the upright stance. The gluteus maximus muscle, one of whose important functions is the maintenance of upright posture, is attached to the postero-lateral aspect of the sacrum below the auricular surface. More anteriorly, at the same level, the sacrum provides attachment for the coccygeus muscle and sacro-spinous ligament which both help to support the pelvic contents in the upright position.

The sacrum, being an integral part of the pelvis, is subject to another set of influences (in addition to those associated with its position in the vertebral column) which are responsible for the sexual differences in the pelvis and, in particular, of the sacrum. These two sets of influences may not always work to their mutual advantage. For example, a 6-piece sacrum causes no manifest disadvantage in the male pelvis, but when present in a female pelvis contributes to the conformation of an "assimilation pelvis", which commonly causes dystocia (Greenhill 1965). The assimilation pelvis is so-called because the last lumbar vertebra seems to be assimilated to the sacrum which has six segments instead of five and is long and narrow.

The most striking and perhaps the most interesting variations in the sacrum are at the lumbo-sacral junction. The more extreme forms of variation in S1 result in an asymmetrical sacrum and this may cause clinical problems such as backache or even scoliosis owing to uneven weight distribution. In the female sacra, asymmetry of S1 usually results in an obliquely contracted pelvis, one of the important causes of dystocia (Greenhill 1965).

The number of vertebrae which fuse to form the sacrum vary. It is commonly assumed that when there is an increase or reduction in sacral vertebral number, there is a corresponding decrease or increase in presacral vertebral number. This does occur in a proportion of spines, but it is not the usual pattern and there are many variations of spinal formula. In fact, it will be shown that an increase in sacral number is more likely to be accompanied by a modal number of PSV than by a reduction of PSV.

Many studies have been made on numerical variation of vertebrae in man. However, few give results for sacral plus presacral (i.e. total precoccygeal) vertebrae in males and females of various populations. Most such studies have been made on only presacral vertebrae, for example those of Nishi (1928) on Japanese, of Bornstein and Peterson (1966) on three North American population groups namely, Caucasoids, Negroids and Mongoloids and, more recently, my own study (1974) on Southern African

Negroes. As discussed previously, other studies have been made only on sacral vertebrae. A notable exception is the work of Bardeen (1904) which included analyses of both sacral and presacral vertebral numbers in males and females and also includes reports of early workers (eg. Steinbach 1889, Bianchi 1875). It was possible to use these sources for precoccygeal vertebral number in Caucasoids.

The extensive collection of skeletons of South African Negroes present in the Raymond A. Dart Collection of Human Skeletons in the Department of Anatomy, University of the Witwatersrand, Johannesburg forms the basis of the study and the San skeletons are drawn from this and other collections in South Africa; the American Negro skeletons were studied at institutions in the United States of America.

Previous studies on the S.A. Negro sacrum are few and include J. Gillman's description of 32 'Bantu' (and 7 'Bush') sacra (1929); the section on the sacrum in the late Professor O.S. Heyns's Ph.D. thesis on the "Bantu pelvis" (1945); Shore's study of 82 vertebral columns which includes some observations on the sacrum (1930) and my own study on variations of the sacrum (1962). Information on the San (Bushman) sacrum is found in a note by Thomson (1913) on 3 San vertebral columns; Slome's description of 'The Osteology of a Bushman Tribe' (1929); Orford's study of 13 San pelves (1934); the abstract of a symposium on the Bush skeleton by Weiner (1934) and Duparc's (1942) study of the Khoisan vertebral column which included 21 San sacra. There is thus a paucity of information on a large or representative sample of S.A. Negro or San sacra and the related presacral vertebrae.

The present study was begun as a simple analysis of sacral characteristics in the S.A. Negro in order (i) to determine the characteristics and morphology of the S.A. Negro sacrum; (ii) to determine, if possible, whether three of the many sub-groups of the S.A. Negro population, represented in the study by the Natal Nguni, the Cape Nguni and Sotho, could be distinguished on the basis of their sacral characteristics; and (iii) to compare the results of the analysis on the S.A. Negro sacrum with studies on the sacrum of other racial groups. About the time the sacral project was begun, similar analyses on the skulls (de Villiers 1968) and the teeth (Jacobson 1967) from the same collection of S.A. Negro skeletons had been set on foot by Professor P.V. Tobias as part of a large scale human biological investigation of the South African dark-skinned peoples. Other facets of this human biological programme included studies on growth and somatotypes,

pigmentation and tanning, limb-bones, chromosomes, blood-groups and other gene markers, and many additional parameters. A number of anthropological studies had indicated that, whilst some intertribal differences did exist among the sub-groups of the S.A. Negro (Elsdon-Dew 1937, Dart 1937, de Villiers 1968), these were not marked (c.f. Shapiro 1951). There were, however, marked differences between S.A. Negroes and the San (Dart 1937, Drennan 1937, Tobias 1961, 1966). Accordingly, the present study was extended to include the San sacrum.

During analysis of the sacral project, variations in the number of sacral vertebrae and the presence of transitional features in the sacrum indicated that an examination of the related presacral vertebral columns might solve many of the questions raised by the sacral study. Accordingly, the presacral vertebral columns related to the sacra were examined and this investigation, too, forms part of this dissertation.

Comparison of data on the numerical composition of the sacrum and vertebral column of the South African Negro with available data on the American Negro suggested that there was a marked difference between the two Negro groups. Such a difference, if substantiated, would have tended to belie the presumed common Negroid ancestry of the two groups, or, at least, would have been laid at the door of Caucasoid admixture in the American Negro population. Accordingly in an attempt to resolve this poser, I sought and obtained an opportunity to examine a large sample of American Negro skeletal material. The study was amply rewarded. Not only was it possible to obtain results for the total precoccygeal vertebral column for 500 American Negro individuals, where previously data were available for only some 173 American Negro spines, but the presumed differences between the two Negro groups were clarified.

The metrical analysis of the sacrum showed one significant intertribal difference relating to the size of the sacrum, whereas a comparison of the S.A. Negro and San material indicated many more differences present between these two groups. It was suggested to me by Professor P.V. Tobias, Head of the Department of Anatomy, that it would be worthwhile to apply to the sacral measures one of the statistical methods available for the measurement of generalised distance between populations. Accordingly, Mahalanobis's Generalised Distance Statistic, D^2 , was used following the advice of Professor D.M. Hawkins, Professor of Statistics in the University of the Witwatersrand. Since the sacral data had previously been analysed by me on a Facit hand calculator, it became necessary to transfer the raw data on to computer

cards. The D^2 test was carried out by Mr. P. Tuffin of the Computer Centre of the University of the Witwatersrand.

Layout of the Thesis

The source of the sacra and vertebral columns is detailed in Chapter 2.

The methods used in the presentation of the metrical and non-metrical features are described in Chapter 3. Special attention is paid to the definition of sacra into 4-, 5- and 6-piece categories and, in the spines, to the junctional areas between spinal regions. There is a special section on the methods used for the sexing of the San (Bushman) skeletons. For the purposes of the metrical analysis, I have selected 9 measurements and 7 indices which cover the major dimensions of the sacrum. In the non-metrical analysis, I have selected the features which are of functional significance and which are related to the lumbo-sacral and sacrococcygeal junctional areas.

The next five chapters (4-8) deal with the morphology of the S.A. Negro, American Negro and San sacrum. The bones are first categorised into 4-, 5- and 6-piece sacra and the relative frequencies of these categories compared among various population groups. The metrical analysis is made only on the S.A. Negro and San sacra and occupies Chapters 5, 6 and 7. In Chapter 5, all categories of sacra, 4-, 5- and 6-piece, are lumped together and results are presented for the total combined sample. Results for male and female sacra are always presented separately. Cognisance is taken of the differences between 5-piece and 6-piece sacra and results for 'pure' 5-piece and 6-piece sacra are given and discussed in Chapter 6. These findings are taken into account in the discussion on the total sample. In Chapter 5, in addition to the analysis of the individual sacral characters, an analysis is made of a number of traits simultaneously by means of Mahalanobis's D^2 test.

Chapter 7 deals with the variability of the sacral measures.

In Chapter 8, the non-metrical observations on the sample of S.A. Negro sacra are presented. These include (i) a series of detailed observations of variations at the lumbo-sacral junction, in particular, those which are present in S1 or leave their imprint on S1; and (ii) observations made on variations in the last sacral piece of 6-piece sacra. These sacra are clearly distinguished from sacra which have synostosis of Co 1 and the latter are discussed separately.

In Chapter 9, the number of total precoccygeal vertebrae are

presented for the S.A. Negro, the San and the American Negro. In addition, the regional spinal formulae in the S.A. Negro spines are given and the results are correlated with transitional features in 6-piece sacra.

The morphological findings in Chapters 8 and 9 are discussed from a developmental aspect.

In Chapter 10, the sexual dimorphism of metrical and non-metrical features of the sacrum and of vertebral numerical variation is discussed.

In the final Chapter, the general conclusions about the features of the S.A. Negro sacrum and the San sacrum are presented. Comparisons are made between the two populations. The discussion is extended to include the sacral and precoccygeal vertebrae of the American Negro. The developmental implications of the results are correlated. Finally, there is a summary of the thesis and of the general conclusions reached.

There is repetition of some of the findings and their interpretation in the study. This was necessary to preserve the flow and logic of the discussion.

CHAPTER 2

THE MATERIAL

The materials used in this study will be considered under the following headings:

- A. The Source Populations
- B. The Sacra and Vertebral Columns: Ethnic, Sexual and Age Breakdown of the Series.

A. THE SOURCE POPULATIONS

The material of this study is drawn mainly from two African population groups, and, in addition, from two collections of American Negro skeletons. The African population groups are the Southern African Bantu-speaking Negro and the San or Bushman.

1. The Southern African Bantu-speaking Negroes.

The S.A. Negroes fall into six major groups: Natal and Cape Nguni, Sotho, Tsonga, Venda and Lemba. The Nguni constitute no less than 66% of the whole South African Negro population, the Sotho 28,1% and the remainder together only 5,9% (van Warmelo 1974). In this study, the S.A. Negro material is drawn from the three most numerous of the six major tribal groups. These are (i) the Natal Nguni represented by samples from the Zulu and Swazi tribes, (ii) the Cape Nguni represented by a large sample of Xhosa and smaller samples of Pondo, Fingo, Hlubi and Baca tribes, and (iii) the Sotho group which has representative samples from South, Western and North Sotho.

2. The San or Bushmen

The San (or Bushmen), together with the Khoikhoi (or Hottentots), comprise the Khoisan peoples of Southern Africa. The San are principally hunters and gatherers and speak one or other Bushman language, whilst the Khoikhoi are pastoralists (Tobias 1972). The name 'San' instead of 'Bushman' is adopted in the study following a general agreement reached at a meeting held at the South African Institute of Medical Research (1971). This meeting discussed the terms advocated for Bushmen and

Hottentots by Wilson and Thompson (1969) in the first volume of The Oxford History of South Africa. The San are a distinctive population characterised by yellowish-brown skin colour, short stature and singular features of head and face, and of other body parts.. This distinctiveness is apparent, too, for many gene markers. The relationships between San and S.A. Negroes have been and are still being explored for as many parameters as possible.

3. The American Negroes

It is generally accepted that the modern American Negro population has been formed by the intermixture of a pure Negro and a Caucasoid population. The ancestral Negro population originated mainly (98%) from an extensive area of West and Central Africa (Reed 1969). The degree of Caucasoid admixture in the modern American Negro varies from individual to individual but a critical evaluation of population admixture by Glass and Li (1953) estimates the accumulated amount of Caucasoid admixture in the modern U.S. Negro at 30,565%.

The skeletal Collections of American Negroes examined in this study (Todd and Terry Collections) are derived from cadavers received by Washington University, St. Louis and by Case Western Reserve University, Cleveland. The records are taken from the Bureaus of Vital Statistics in St. Louis and Cleveland, and the Collections thus represent a cross-section of the Negro population of the two cities (Trotter and Lanier 1945).

B. THE SACRA AND VERTEBRAL COLUMNS: ETHNIC, SEXUAL AND AGE BREAKDOWN OF THE SERIES

1. The Southern African Negroes

The Raymond A. Dart Collection of African Skeletons in the Department of Anatomy at the Witwatersrand University has been used for a number of skeletal studies. Most of the skeletons in this Collection have been derived from cadavers, and hence they are of known ethnic group, nationality, chiefdom or tribe, sex and stated age.

The material used in the study comprises 318 sacra and 405 vertebral columns representing the three major tribal divisions of the Southern African Negroes.

For the most part, the cadaver (and hence the skeletal) material

in the Department of Anatomy is derived from hospital sources. From hospital records, information is available pertaining to the ethnic group, chiefdom, sex, cause of death and, in most instances, stated age.

(a) Age: This is not in all cases accurate, since some S.A. Negroes are uncertain of their date of birth. Further, if the patient is unable to give this information on admission to hospital, age is often estimated by hospital staff. In this survey, the range of stated ages falls between 18 and 97 years. Table 1 shows the distribution of given ages. On this analysis the majority of individuals (males and females) comprising 62,7% of the total, fall into the fifth decade (109), the sixth decade (79) or the fourth decade (66). The remaining 151 individuals comprising 37,3% of the total, lie outside these limits. When age distribution is analysed for males and females separately, (Table 1 and Figures 1 and 2), the results for males are similar to those for the total analysis. In females, however, there is a swing to the left and the majority fall into the fifth decade (39), the third decade (35) and the fourth decade (27). All sacra and spines examined were mature, that is to say, all the components of the sacrum were fused and all the epiphyses of all the vertebrae were fused.

TABLE 1

Distribution of Age and Sex in a Series of 405 Vertebral Columns
Derived from South African Negroes

Age in years	Males		Females		Male + Female	
	n	%	n	%	n	%
18-29	25	10,1	35	22,3	60	14,8
30-39	39	15,7	27	17,2	66	16,3
40-49	70	28,2	39	24,8	109	26,9
50-59	55	22,2	24	15,3	79	19,5
60-69	32	12,9	22	14,0	54	13,3
70-79	16	6,5	8	5,1	24	6,0
80-89	9	3,6	2	1,3	11	2,7
90-97	2	0,8	0	-	2	0,5
Total	248	100,0	157	100,0	405	100,0

n = number of individuals.

(b) Sex: Precise information as to sex is available from hospital records and is of value in determining the sexual features of the sacrum. Of the 318 sacra examined, 196 were male and 122 female (Table 2). Of the 405 vertebral columns examined (including the 318 represented by sacra in the main study), there were 248 male and 157 female individuals (Table 3).

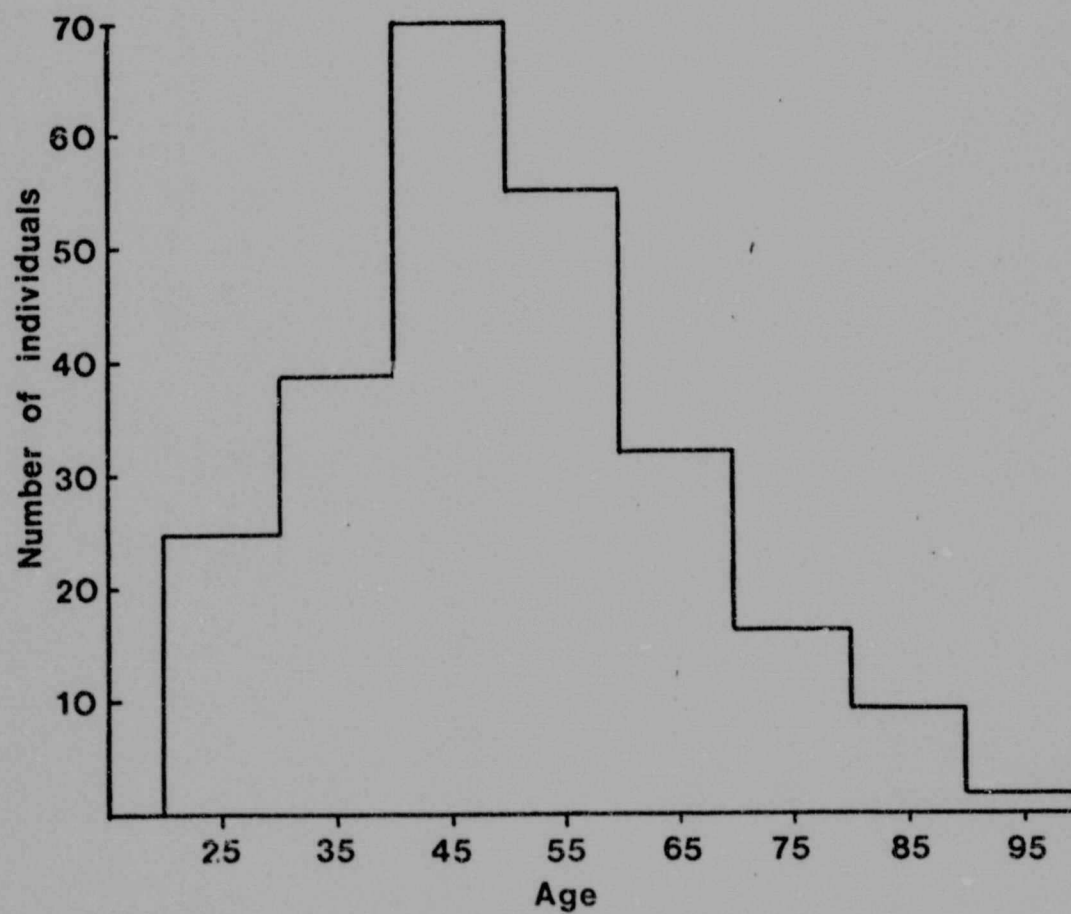


Figure 1 Age Distribution in 248 S.A. Negro Male Vertebral Columns

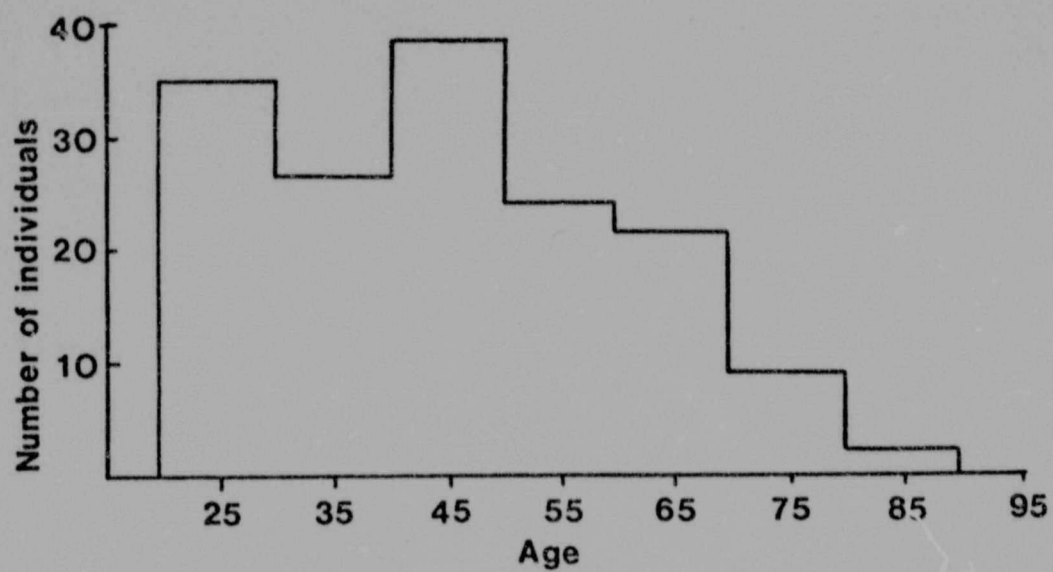


Figure 2 Age Distribution in 157 S.A. Negro Female Vertebral Columns

TABLE 2

The Composition of the South African Negro and San Series of Sacra

Group	Chiefdom or tribal division	Tribe	No. of Sacra		
			Male	Female	Total
S.A. Negro	Natal Nguni	Zulu	65	33	98
		Swazi	13	11	24
		Total	78	44	122
	Cape Nguni	Xhosa	58	28	86
	Southern Sotho Western Sotho	Sotho	60	44	104
		Rolong		6	6
		Total	60	50	110
Total South African Negro		196	122	318	
San	Unknown (of varied origin)		31	21	63*

*This total includes 11 unsexed sacra.

TABLE 3

The Composition of the South African Negro and San Series of Vertebral Columns

Group	Chiefdom or tribal division	Tribe	No. of spines		
			Male	Female	Total
S.A. Negro	Natal Nguni	Zulu	64	44	108
		Swazi	21	10	31
	Total Natal Nguni		85	54	139
	Cape Nguni	Xhosa	46	26	72
		Pondo	14	1	15
		Fingo	10	8	18
		Hlubi	5	2	7
		Baca	10	-	10
	Total Cape Nguni		85	37	122
	Southern Sotho Western Sotho	Sotho	58	47	105
		Tswana	8	17	25
	North Sotho	Rolong	3	1	4
		Pedi	9	1	10
	Total Sotho		78	66	144
	Grand Total S.A. Negro		248	157	405
San	Unknown (of varied origin)		16	12	28

(c) Chiefdom: The sacra (Table 2) are drawn from (i) the Natal Nguni represented by 122 individuals of the Zulu and Swazi tribes, and (ii) the Cape Nguni represented by 86 members of the Xhosa tribe; (iii) the Sotho represented mainly by 104 members of the South Sotho linguistic division. The series of vertebral columns totals 405 (Table 3). The composition of this sample is much the same as that for the sacra, save that the Cape Nguni sample is augmented by series from the Pondo (15), Fingo (18), Hlubi (7) and Baca (10) tribes. In addition, the Sotho sample is augmented by 25 Tswana and 10 Pedi individuals of the West and North Sotho divisions respectively.

Information on the chiefdom of the subjects represented in the present study is, as stated, obtained from hospital records. The individuals are drawn largely from the local Witwatersrand urban Negro population. This population is at present undergoing detribalisation but this process has not yet affected the majority of the adult population to the extent that they themselves are products of inter-tribal marriages (de Villiers 1957). For this reason the information on the chiefdoms of origin of the skeletons in the Anatomy Department may be accepted as probably reliable, except perhaps for some of the most recently acquired skeletons. Individuals who, on admission to hospital, are unable to specify their chiefdom, are recorded as "Bantu" or "mixed" in the records. These individuals are excluded from this survey.

2. The San (Bushmen)

The San series comprises 63 sacra and 28 vertebral columns. The series of spines is smaller than the sacral series owing to some of the skeletons being incomplete.

The San material is derived from three sources, the R.A. Dart Collection (32), the McGregor Memorial Museum, Kimberley (14) and the South African Museum, Cape Town (17).

Of the 32 skeletons in the R.A. Dart Collection, 13 are on permanent loan from the Port Elizabeth Museum. Care was taken to ensure, as far as possible, that the skeletons from all the Collections were indeed of San individuals. Three skeletons in the Dart Collection were derived from cadavers of known Bushmen. The San series is, for the most part, however, composed of material derived from archaeological excavations and, in many instances, the geographical locations at which the skeletal remains were found (eg. Easterling, Cape Province,

and Jacobsdal and Klipriver, Orange Free State) provided supporting evidence. In the case of A 379, the skeleton was from a known Bushman grave at Florisbad, Orange Free State. In addition, all the material in the Dart Collection has been independently identified as San on craniological grounds by Professor R.A. Dart, Professor P.V. Tobias and Professor H. de Villiers.

The Collection in the McGregor Memorial Museum included skeletons of a San male who died in gaol, and a San male and female, both of whom were known in life to the late Dr. R. Broom. The records and crania of the remaining skeletons examined indicated them to be San.

The South African Museum in Cape Town had available 33 skeletons which had been identified as San. On the advice of Dr. A.W. Crompton, the then Director, I selected 17 specimens. These included skeletons of San identified during their lifetime. The remaining skeletons were from archaeological excavations at sites historically associated with San, mainly in South West Africa. For some of the skeletons, the tribe was recorded (eg. 'Naron Bushman').

(a) Age: Since the majority of skeletons are from archaeological excavations, no information on age is available for most of them. All skeletons included in the survey are, however, of mature or fully adult individuals, as judged by epiphyseal fusion.

(b) Sex: Some of the skeletons have been accurately sexed, for example, those belonging to individuals known during life and those derived from cadaver material. Many of the skeletons had previously been sexed on anatomical grounds; a few bore no record or assessment of sex. It was desirable to sex the skeletons as accurately as possible, for purposes of determining the sexually dimorphic features of the Bush sacrum and the skeletons were sexed by methods to be described in Chapter 3. The total San sacral series (63) was found to comprise 31 males, 21 females and 11 sacra in which the sex was not definitely ascertained. The series of San vertebral columns is, however, smaller: it consists of 16 male and 12 female spines.

3. The American Negroes

The sample of American Negro vertebral columns consists of 500, 250 male and 250 female, and is drawn from two collections: (i) the Robert J. Terry Collection housed in the Smithsonian Institution, Washington, D.C., and (ii) the Hamann-Todd Collection housed in the

Cleveland Museum of Natural History. Reliable information on age, sex and cause of death was available from the comprehensive and meticulous records for these skeletons. As with the African material, all skeletons examined from the Collections were of fully adult individuals as judged by epiphyseal fusion as well as by the record of age.

4. Comparative Series

Comparisons are made with all available published data on these and other population groups. Many studies, both of sacral metrical characters and numbers of sacral and presacral vertebrae give only combined-sex data for example, Allbrook (1955) on the East African Negro spinal column and Paterson (1892) on the Caucasoid spinal column. These and other like studies were not included in the comparative series which are as follows:

(a) Comparative Sacral Metrical Series

One of the most comprehensive studies on the sacrum was made by Radlauer (1908) who provided metrical and non-metrical data from all studies in the literature available to him. Hasebe (1913), too, presented the results of other workers to date, besides reporting the results for 11 sacral metrical characters on a sample of 40 Japanese sacra. Hasebe's study is of especial value in that he presented the results for males and females separately, whereas Radlauer (1908) seldom did this. Koganei (1906, cited by Hasebe) provided results for sacral length, breadth and the sacral index in a sample of 37 Japanese male sacra.

It was particularly difficult to obtain sacral metrical studies on Caucasoid sacra and thus, the very early studies of Verneau (1875, cited by Turner 1885/6b) and Turner (op.cit.) are used as well as the results of Radlauer (1908) for 106 sacra. All three studies give data for sacral length, breadth and the sacral index. Fawcett (1938) reported on the corporo-basal index in a series of 134 male and 79 female American Caucasoids as well as 108 male and 88 female American Negroes.

Three further metrical studies on the sacrum are by Trotter (1926) on 58 ancient Egyptian sacra, Davivongs (1963) on 100 Australian aborigine sacra and Glanville (1967) on 52 Tellem sacra representing a medieval Negro population. All three workers, however, measured only five sacral vertebrae (either by excluding 6-piece sacra or by measuring only as far as the fifth sacral piece). Since the present study had separate data available for both 5-piece sacra and 6-piece

sacra, it was possible to compare the '5-piece' studies with the 5-piece S.A. Negro and San sacra.

(b) Comparative Vertebral Column Series: Number of Sacral Vertebrae

The only studies used were those in which the definition of a 4-, 5- and 6-piece sacrum corresponded with that in the present study.

Data on the number of sacral vertebrae in Caucasoids are available from Adolphi (1912) on 234 male and 58 female sacra, from Steinbach (1889, cited by Bardeen 1904) on 48 male and 35 female sacra and from Frey (1929) on 92 male and 58 female sacra.

A Japanese series consists of 122 male and 59 female sacra reported by Hasebe (1913). Stewart (1932) provided data for 95 male and 84 female Eskimo sacra. A series of Australian aborigine sacra consists of 63 male and 48 female sacra reported by Tulsi (1972).

An additional sample of San sacra (16 male, 12 female) was available from Duparc (1942) who reported on the collection of San skeletons at the Anthropological Laboratory at the University of Geneva¹.

(c) Comparative Vertebral Column Series: Number of Precoccygeal Vertebrae

The source and composition of the comparative vertebral column samples of Japanese, Eskimos and the Caucasoid samples of Steinbach (1889) and Frey (1929) are identical with that for the sacral series. The Caucasoid series is augmented by 59 male and 71 female spines from Bianchi (1875, cited by Bardeen 1904). It was not possible to obtain data for a comparative series of Australian aborigine precoccygeal vertebrae, nor for a further series of San spines.

¹There is, however, some overlap of Duparc's sample with the present sample. Duparc's series of 28 sacra was on loan from the S.A. Museum and the present sample includes 17 of 33 sacra from that source (see p.15). This overlap is only in regard to the results on the number of vertebrae in the sacrum (Chapter 4) and not to the number of precoccygeal vertebrae nor to the sacral metrical features.

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