An Anthropometric Study of the Chinese Clavicle Based on the Hsiao T'un and Hsiu Chiu Shan Specimens

BY T. L. WOO

I. *Introduction.* Among the various bones of the human body, the clavicle, as it connects the upper limb with the trunk, is undoubtedly one of the most interesting for physical anthropology. The available literature concerning it is far less extensive than that concerning the bones of the limbs and the pelvis. Possibly due to the fact that the clavicle is smaller in size and peculiar in form, it has been generally neglected by collectors and investigators.

In the last few decades, studies on a few series of clavicles of different races have been published,[1] but most of these publications are of little value because in them the clavicle is only briefly dealt with in conjunction with other bone and the characters described are few in number. A detailed study of the English clavicle by F. G. Parsons appeared in 1917 in the *Journal of Anatomy*.[2] Besides the direct maximum length and the circumference at the middle, he obtained several linear and angular measurements from drawings of the horizontal and vertical contours for which he constructed types in order to examine the curvature of the bone and other features. As the methods used in orientating the bone and the contour measurements taken on the basis of that orientation are somewhat inadequate, the numerical results arrived at are not of great value for racial comparison. This point is discussed in detail in a later section of the present poper. Metrical data relating to the clavicle of Asiatic races, especially the Chinese, are extremely meagre. The only valuable study of Chinese skeletal remains was made by D. Black.[3] In his paper which appeared in 1925, nine principal bones, including the clavicle, were examined in the case of three series of specimens. Two of these series are of prehistoric date: one is from Sha Kuo

[1] Anthropological writings on the clavicle up to 1925 are given in the references under "Schultergürtel" in *Lehrbuch der Anthropologie* by R. Martin, Dritter Band, pp. 1605–1608.

[2] F. G. Parsons: "On the Proportions and Characteristics of the Modern English Clavicle." *Journal of Anatomy*, Vol. 51, pp. 71–93, (1917).

[3] D. Black: "The Human Skeletal Remains from the Sha Kuo T'un Cave Deposit in Comparison with those from Yang Shao Tsun and with Recent North China Skeletal Material." *Palaeontologia Sinica*, Series D. Volume I, Fascicle 3, pp. 1–120, (1925).

T'un near Liaoning and the other from Yang Shao Tsun in Honan. The third series is of modern date collected from the North China plain. In the case of the clavicle, the author merely took one direct measurement—the maximum length. In addition to this he made detailed observations on different tubercles of the bone. It was concluded that the general character of clavicular modelling is similar in the Aeneolithic and recent North China series, while in certain morphological characters all these Chinese clavicles display group features which evidently distinguish them from those of non-Asiatic origin.

The present study deals with the clavicle only. The data examined relate to two series of specimens, of both sexes, obtained from two different regions of the country. A considerable number of characters, both metrical and morphological, are used. Several of these were newly devised for the purpose in view. The objects of this study are two-fold, namely: (1) to throw new light on the features of the Chinese clavicle by making comparisons bilaterally, sexually and racially between the available series of the same or different races, and (2) to test the validity of some improved techniques used which may be valuable in the future routine description of the bones of other racial series.

II. *Description of the Material.* Two series of Chinese clavicles obtained from different parts of the country are dealt with in the present study. The sources of the material are:

(1) Hsiao T'un Series. More than 30 complete Chinese skeletons, including the crania, were excavated in 1929–1932 by Dr. Li Chi, the head of the Archæological Section of this Institute, and his colleagues from ancient graves at Hsiao T'un, west of the city of Anyang, Honan. Of these skeletons there are 32 clavicles of both sexes available for measurement. According to the archæological evidence they belong definitely to the people of the Sui-T'ang dynasties (A.D. 581–899), probably of the better class. All the skeletal material recovered at Hsiao T'un has most generously been placed at my disposal for study, a privilege for which I must acknowledge my indebtedness to Professors Fu Ssû-nien and Li Chi. Two separate studies on the crania[1] and humeri[2] of the same series will shortly be published. A full account of the discovery of the Hsiao T'un material is given in the first paper mentioned. The present series consists of 18 right and 14 left clavicles, and among these there are only 13 pairs.

(2) Hsiu Chiu Shan Series. 214 modern Chinese clavicles of either sex, together with the corresponding crania and other parts of the skeleton, were collected in the spring session of 1936 by the writer from numerous unclaimed

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[1] T. L. Woo: "A First Study of the Chinese Skull Excavated from Hsiao T'un, Anyang," (ready for publication).

[2] T. L. Woo: "A Study of the Chinese Humerus," (ready for publication).

graves of Hsiu Chiu Shan, north of Hsia Kuan, Nanking. These specimens undoubtedly represent the bones of people of poor class who inhabited the neighbourhood of the city. With the exception of a small number of cases (16.8%) of which the birth places of the occupants of the burials were obtained from the reading of the inscriptions on the tomb-stones, principally representing the natives of provinces of the Yangtze delta, particulars of the origins of the people are unknown. However, the eastern Chinese, the writer believes, are better represented than the people of any other part of the country. Of the total number of specimens, 104 are right bones and the others left. There are only 81 pairs.

In both series, the specimens are nearly all fully adult, as the second centres of ossification for the medial end in a great majority of cases are completely fused. It has generally been recognised by anatomists that the clavicle in males is longer, stouter and more massive than that in females, and that the curvature is also more marked; in males its acromial and sternal ends lie at the same level or the former is the higher, while in females the acromial end is at a lower level than the sternal one. But in actual fact, the variation of characters of the clavicle in both sexes is as large as those for any other part of the skeleton, and the overlapping of the male and female distributions for any character is considerable. An experienced observer will often have great difficulty in sexing the skeleton from the features of the clavicle alone. According to Parsons' experiments[1] on the sexing of the English clavicles of which the sex was previously known, he found that there is an error of 22 per cent., if the sexing of specimens is based on the lengths of the bone only; an error of 16 per cent. on the circumference of the shaft at the middle; an error of 26 per cent. on the size of the inner end calculated from the sum of the height and width of its articular facet. Hence from one-sixth to one-fourth of cases of isolated clavicles will be likely to be incorrectly sexed. Fortunately, the present material mostly consists of complete skeletons. The observer is thus able to examine the characters of the crania, pelves and long bones of the same individuals. As a result of careful sexing, it is found that there are 19♂ and 13♀ bones in the Hsiao T'un series, and 132♂'s and 82♀'s in the Hsiu Chiu Shan series, respectively.

Most of the bones are preserved in a good condition, especially those of the Hsiao T'un series. When considering all the bones together, there are 15 per cent. of cases in which the acromial ends are wholly or in part defective, or worn as a result of exposure. Approximately 5 per cent. are in a similar condition at their sternal ends. These are more frequently found in the Hsiu Chiu Shan specimens. The measurements are taken as far as possible on all the bones.

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[1] **F. G. Parsons:** *loc. cit.*

III. *Measurements Taken.* The metrical characters recorded fall into three classes, according to the techniques used, viz.: 1. direct measurements, 2. those obtained from the horizontal contour section, and 3. those obtained from the vertical contour section. The definitions of these two sections will be given later.

1. Direct measurements. There are only 8 absolute measurements of the clavicle defined in Martin's *Lehrbuch*.[1] Of these 4 measurements were adopted and taken on the Chinese specimens according to the definitions given. The other four have not been used in the present study on account of the fact that measurements of somewhat similar nature can be more accurately obtained from the drawings of the contours. The measurements are:

(1) Maximum length of the clavicle, the greatest distance from the most lateral point of the acromial end to the most medial point of the sternal end, taken with the osteometric board. The specimen is placed in a horizontal plane with the inner surface in contact with the side wall of the board. In nearly all cases the maximum length of the bone is obtained in this way. A line connecting the two points of contact on the posterior border of the bone is termed the base-line of the clavicle, which is almost parallel to the maximum length. The measurement taken in such a way is practically the same as that given by other authors.

(2) Transverse diameter of the shaft at the middle, a maximum horizontal diameter taken from the anterior edge of the middle of the bone to the posterior edge of it. The points used for the mid-section with regard to the maximum length should be previously marked in pencil.

(3) Sagittal diameter of the shaft at the middle, a maximum diameter taken vertically and at right angle to the previous measurement. Both diameters are taken with small calipers.

(4) Circumference of the shaft at the middle, taken at the same mid-section of the bone with a steel tape.

2. Measurements taken from the horizontal section. Before considering the measurements obtained from the contours it is necessary to understand clearly the method of orientation of the bone employed. Parsons[2] was the first to introduce the technique of drawing both horizontal and vertical contours of the clavicle in connection with English material. According to his method, a small tubercle for the sterno-mastoid muscle, directly above the sternal end, is used for orientation. Failing this he supposes that if the anterior and posterior

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[1] See Martin: *Lehrbuch der Anthropologie*, Zweiter Band, pp. 1005–1006.

[2] F. G. Parsons: *loc. cit.*

borders of the acromial third of the bone are placed in the same horizontal plane then the bone is orientated very nearly in the living position. It should be noted that any plane must be geometrically determined by three fixed points. It has been found that the tubercle for the sterno-mastoid muscle is very difficult to locate in many cases, or it may be entirely missing. And tubercles of irregular, variable forms are often found on the anterior and posterior borders of the acromial third. For the sake of accuracy, the horizontal plane of the bone adopted in the present investigation is precisely determined by the following three points: (*a*) the mid-point on the superior medial edge of the sternal end, when the bone is hold in a horizontal position as accurate as possible; (*b*) the most projecting point on the anterior border of the bone at a distance of one-fifth of the maximum length (measurement 1) from the acromial extremity, usually located at the sharp edge laterally to the eminence of the deltoid tubercle if it is present; and (*c*) the most projecting point on the posterior border at the same distance. The latter two points are determined in the same horizontal position as mentioned above. When the bone is properly orientated in the plane determined by the above three points and clamped in position, the horizontal outline of the clavicle is then drawn on the paper by a pen of conical form and a prismatic bar which are both attached to the stereograph by Schwarz.[1] The form of this bar and the operation of the whole instrument are shown in Fig. I (A). The bar[2] was specially designed by the writer for the purpose. The vertical bar which has three edges, is about 2 cms. long. In making the drawing the outer or working edge (see the line ab in Fig. I, A), which corresponds exactly to the central perpendicular axis of the pen, is always kept in contact with the bone. In the middle of the surface diametrically opposite to the working edge is attached a horizontal bar which is in turn fixed to the free perpendicular of the stereograph by means of a bracket and a screw. The working edge can thus be readily moved in any direction with the help of the three movable frames of the stereograph. To draw the vertical contour we only need to turn down the handle of the clamp and bring about a rotation through 90° of the clamp that is holding the bone in the horizontal plane (see Fig. I, C). When drawing these contours, the mid-points[3] on the medial and lateral edges of the superior surface of the two clavicular extremities, as well as the conoid tubercle, are marked as points on the paper, and from these several measurements are later taken.

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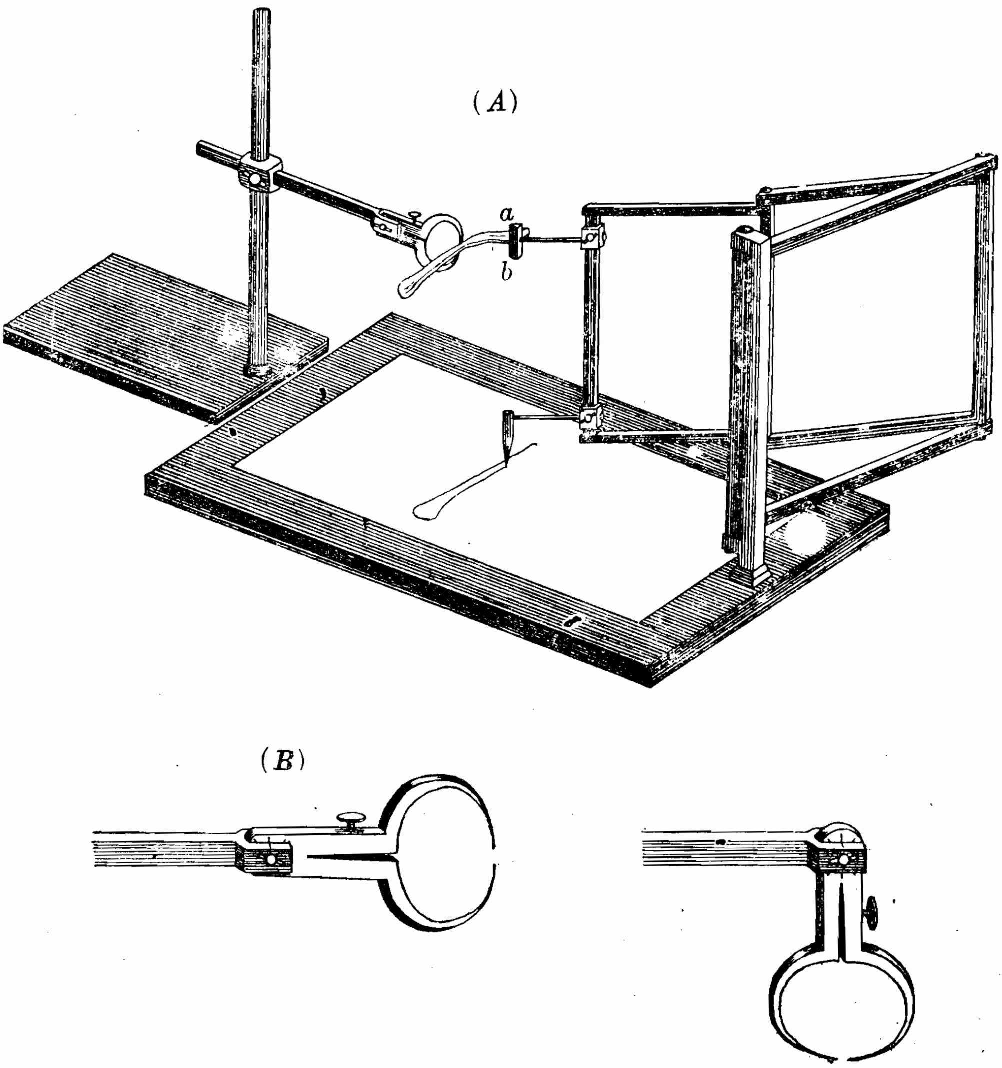
[1] The stereograph used is the one originally designed by Schwarz for drawing the contour of the mandible.

[2] I wish to thank most heartily Dr. G. H. Wang, the Director of the Psychological Institute, Academia Sinica, for help in making this special bar for me in the laboratory of his Institute.

[3] The mid-points on the medial and lateral margins of the bone must be marked on the outline as points on the contour, and the former is practically one of the three points used to determine the horizontal plane.

Fig. I. (A) The Drawing Instrument in Use. (B) The Clamp, Holding the Bone in a Horizontal Position. (C) The Clamp, Holding the Bone in a Vertical Position



It is evident that the drawing of contours with an instrument of this kind is much more convenient than the use of Lucae's or Mollison's dioptograph. The advantages of the revised method are two-fold: (*a*) the plane determined by three definite points can be fixed in any specimen, and (*b*) the two planes are exactly perpendicular to each other.

The form of the clavicle is curved like the letter S: it is convex forwards at its medial part and concave forwards at its lateral part, corresponding to the hollow between the chest and shoulder. The relationship of the chord between the mid-points of the two terminals of the bone to the corresponding arc is important for the purpose of investigating the curvature of the clavicle. If the chord and arc coincide with each other, there is, of course, no curvature. When the arc becomes more convex, both anteriorly and posteriorly, the divergence of the two measurements will be greater. Since the form of the bone presents a double curve, the total chord and its arc must intersect at one point, which divides the whole length into two separate curves, viz. an outer concave and an inner convex curve, viewed anteriorly. The former is bounded by its outer chord and arc, and the latter bounded by its inner chord and arc. The two parts divided in this way indicate the natural state of the curvature of the bone better than any artificial division would.

The following measurements, either linear or angular, are obtained from the horizontal section defined above. Fig. II, (A) shows all the points from which measurements are taken. The definitions are:

(5) Total arc of the clavicle. After the horizontal section has been properly orientated, the mid-points on the medial and lateral edges of the acromial and sternal ends are marked (see *c* and *d* of Fig. II, A). A central broken line from *c* to *d* along the bone is then drawn carefully so that at all points it is midway between the anterior and posterior borders of the bone. The total arc is taken from the point *c*, the terminal of the acromial end, through the central broken line previously marked to the point *d*, the terminal of the sternal end. This can be measured conveniently with a slip of ruled paper.

(6) Outer arc. This arc is measured along the broken line from the point *c* just mentioned to the point of intersection of the entire arc and the chord (*c-d*), i.e. the point *e*.

(7) Inner arc. This is measured along the broken line from the point *e* to the point *d*, the terminal of the sternal end.

(8) Total chord of the clavicle: the distance between the two points *c* and *d*.

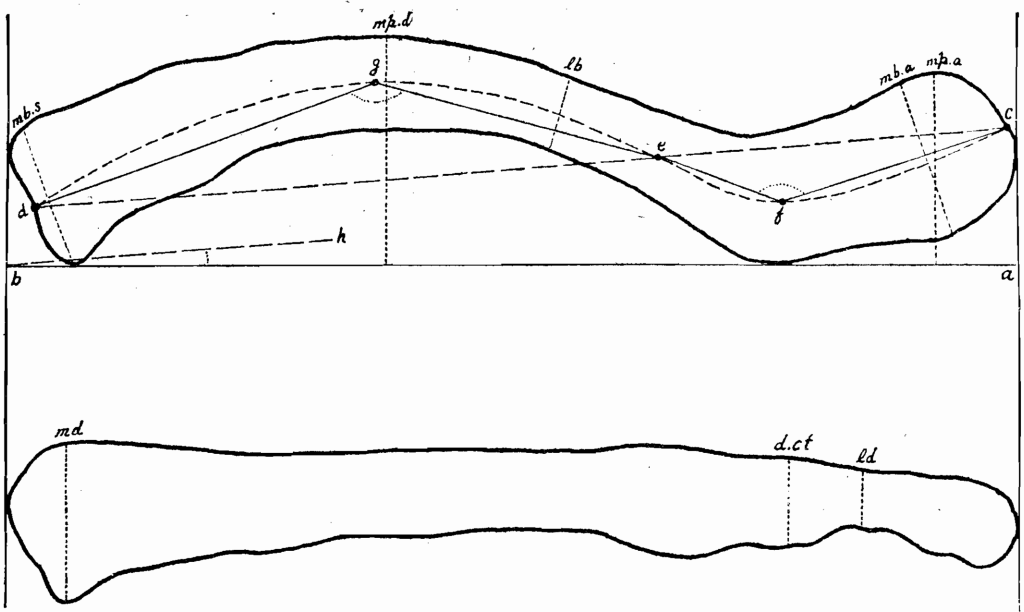
(9) Outer chord: the distance between the points *c* and *e*.

(10) Inner chord: the distance between the points *e* and *d*.

(11) First segment. This chord is taken from *c* to *f*. The last is the point of maximum subtense on the mid- (broken) line of the section from the outer chord (*ec*).

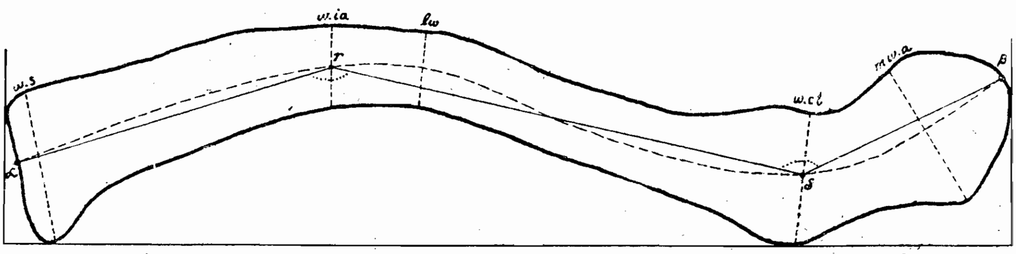
(12) Second segment. This chord is taken from the point *f* to the point of intersection *e*.

Fig. II. The Horizontal (A) and Vertical (B) Sections of the Clavicle, Showing the Positions of Points from Which the Contour Measurements Are Taken



Abbreviations: mp. a, maximum perpendicular of the acromial end; mp. d, maximum subtense of the diaphysis; mb. a, maximum breadth of the acromial end; mb. s, maximum breadth of the sternal end; lb, minimum breadth of the shaft; ld, minimum depth of the acromial end; md, maximum depth of the sternal end; d. ct, depth at the level of the conoid tubercle.

Fig. III. The Horizontal Section of the Clavicle, Showing Contour Measurements Taken by Parsons



Abbreviations: mw. a, maximum width in the acromial third; w. ct, width at the conoid tubercle; lw, least width; w. ia, width at the inner angle, w. s, width at the sternal end; βδ outer segment; δγ, middle segment; γα, inner segment; βδγ∠, outer angle; and δγα∠, inner angle. These measurements are the ones defined by Parsons.

(13) Third segment. This is measured from *e* to the point which is the point of maximum subtense from the inner chord (*ed*).

(14) Fourth segment. This is measured from the point *g* to the point *d*, the terminal of the sternal end.

The above four segments are numbered in order from the acromial to the sternal end. Their axial lines are also used for the purpose of finding the angles given below.

(15) Maximum perpendicular of the acromial end. This is a projective 'height' of the acromial end, measured from the most anterior point of this end in the horizontal plane to the base-line of the bone (mp. a in Fig. II, A). It corresponds to one of Martin's direct measurements.

(16) Maximum perpendicular (or subtense) of the diaphysis. This is a projective 'height' taken from the highest point on the upper edge of the convex curve of the diaphysis to the base-line (*mp. d*).

(17) Maximum breadth of the acromial end. This is the maximum breadth of the section of the acromial end taken perpendicular to the first segment *cf* (*mb. a*). Without this limitation, the points where the maximum breadth may be taken as shown by Parsons are somewhat indefinite.[1]

(18) Maximum breadth of the sternal end. This is the maximum breadth at the sternal end, taken in the same way as the last but perpendicular to the fourth segment *dg* (*mb. s*).

(19) Minimum breadth of the shaft. This minimum breadth is taken at the narrowest part of the shaft regardless of where this is (*lb*).

(20) Distance of the position of the minimum breadth. The distance from the mid-point of the minimum breadth to the vertical tangent to the acromial end is taken, so it is parallel to the base-line.

(21) Outer angle. This is measured between the first and second segments. It is the *cfe* ∠ shown in Fig. II, A.

(22) Inner angle. This is similarly measured between the third and fourth segments, viz. *dge*∠.

The method of measuring the angles described here is quite different from Parsons' method. His outer and inner angles relate to three segments, i.e. the $\beta\delta$, $\delta\gamma$, and $\gamma\alpha$ lines in his figure. The framework of his reconstruction of the

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[1] Parsons took the width at 5 places from the horizontal section: (1) maximum width in the acromial third, (2) width at the conoid tubercle, (3) minimum width, (4) width at the inner angle, and (5) width of the sternal end. In the present study only the minimum breadth is taken in the same way. Our first and last widths are not similar to those used by Parsons. His measurements of the second and fourth widths are entirely omitted owing to the fact that both are somewhat vaguely defined by him.

horizontal type contour, especially showing the angular measurements taken, is reproduced here for comparison in Fig. III. According to his method, it is clear that a change in one angle is necessarily correlated with a change in the other. The advantage of the revised method used for taking these angles is that the two are not necessarily correlated, while the apices of the angles (*f* and *g* in Fig. II, A) are the points of maximum subtenses from the corresponding chords. Two individuals of any given race, or two racial groups, might have the same value of one angle while differing quite significantly from each other in the other angle.

(23) Inclination of the entire chord of the clavicle. This is the angle between the entire chord *cd* and the base-line *ab*, measured with a protractor. It may be of value in indicating the relative positions of the terminals of the two ends with regard to the base-line. It is evident that when the two extremities are more bent upwards and downwards the angle in question will be greater.

3. Measurements taken from the vertical section. When drawing the vertical contour it is not necessary to reset the bone. All that need to be done is to turn the handle of the joint downwards through 90 degrees (see Fig. I, C). The anterior border of the bone is now uppermost. The plane thus fixed is exactly perpendicular to the horizontal one. In this plane we take the following four measurements on either side and these are shown in Fig. II, B.

(24) Minimum depth of the acromial end. This minimum projective depth is taken at the acromial end. It usually lies in the range between the terminal of the acromial extremity and the level of the conoid tubercle. The form of the acromial end in the vertical section, unlike that of the horizontal one, is usually concave both on the anterior and posterior borders. For this reason the measurement of the minimum depth is chosen (*ld*).

(25) Maximum depth of the sternal end. This projective depth is taken wherever it appears at the sternal end (*md*).

(26) Depth at the level of the conoid tubercle. This projective depth is taken from the central point of the conoid tubercle to the opposite edge of the section. The point of the conoid tubercle should be previously marked in pencil (*d. ct*).

(27) The distance of the position of the conoid tubercle. A horizontal distance is measured from the centre of the conoid tubercle to the extremity of the acromial end, taken parallel to the base-line. This measurement may be taken from either standard plane. Since the tubercle appears more marked in

the vertical plane, it is included as one of the characters of this group. It should be borne in mind that the first three depth measurements are all perpendicular to the base-line.[1] Readings of the above characters measured with the osteometric board, or with a tape or slip of ruled paper, are given to the nearest 0.5 mm., while those measured with small callipers are to the nearest 0.1 mm., an instrument with a vernier scale being used.

4. Indices. In order to obtain measures of the shapes of different parts of the bone, the following 10 indices were used. Several of these are new ones derived from measurements of the horizontal and vertical sections. Their definitions are:

(28) Caliber index:

$$\frac{100\text{x Circumference of the shaft at the middle (4)}}{\text{Maximum length of the clavicle (1)}}$$

This index expresses the relative delicacy or robustness of the bone as a whole, the larger the value, the stouter the bone.

(29) Shaft index at the middle:

$$\frac{100\text{x Sagittal diameter of the shaft at the middle (3)}}{\text{Transverse diameter of the shaft at the middle (2)}}$$

A higher value signifies that the cross-section at the middle of the shaft shows a closer approach to the cylindrical form, while a lower value indicates greater flattening of the shaft transversely.

(30) Length-height index of the clavicle:

$$\frac{100\text{x Maximum subtense of the diaphysis (16)}}{\text{Maximum length of the clavicle (1)}}$$

The more curved the specimen is, the larger the index will be.

(31) Claviculo-humeral index:

$$\frac{100\text{x Maximum length of the clavicle (1)}}{\text{Maximum length of the humerus}^{2}}$$

[1] Parsons took the depth at four places, namely: (1) the minimum depth of the acromial end (2) depth at the conoid tubercle, (3) depth at the middle, and (4) depth of the sternal end. The first, third and fourth measurements of depth are taken in a similar (but not the same) way in the present study but they are all perpendicular to the base-line. The depth at the middle is omitted since it was taken directly from the bone.

[2] This represents the first measurement of the humerus in Martin's *Lehrbuch*. Its definition is: the greatest distance from the highest point of the caput to the lowest point of the trachea, measured with the osteometric board. The mean measurements of this character for the two Chinese series are given in the writer's paper on the Chinese humerus, *loc. cit.*

This index has been widely used by different authors, so the comparative data for it are more abundant than those for any of the clavicular indices.

(32) Total curvature index:

$$\frac{100\text{x Total chord of the clavicle (8)}}{\text{Total arc of the clavicle (5)}}$$

This index is designed to give a measure of the total curvature of the bone, the lower the index is the more curved the bone must be.

(33) Index of the two arcs:

$$\frac{100\text{x Outer arc (6)}}{\text{Inner arc (7)}}$$

This indicates the relative extents of the two segments. As the inner arc is usually greater than the outer one, the index will usually be less than 100.

(34) Sterno-acromial breadth index:

$$\frac{100\text{x Maximum breadth of the sternal end (18)}}{\text{Maximum breadth of the acromial end (17)}}$$

This index gives the relative measure of the maximum breadth taken at the two ends of the bone.

(35) Sterno-acromial depth index:

$$\frac{100\text{x Minimum depth of the acromial end (24)}}{\text{Maximum depth of the sternal end (25)}}$$

This is of the same nature as the foregoing index giving a relative measure of depths taken at the two extremities of the bone.

(36) Minimum breadth position index:

$$\frac{100\text{x Horizontal distance of the minimum breadth (20)}}{\text{Maximum length of the clavicle (1)}}$$

This gives a relative measure of the position where the minimum breadth is located. A lower index signifies that the position of the minimum breadth is nearer to the acromial end.

(37) Position index of the conoid tubercle:

$$\frac{100\text{x Horizontal distance from the conoid tubercle (27)}}{\text{Maximum length of the clavicle (1)}}$$

As the distance is measured from the terminal of the acromial end, a lower index denotes a more lateral position of the conoid tubercle.

IV. *Comparisons of Mean Measurements.* The mean measurements of all the clavicular characters for each sex considered separately and for the two Chinese series are provided in the Appendix I. The mean constants given are of the following kinds: (1) mean values of the paired specimens for each side separately, (2) means for all the paired bones, the measurements of those of the right and left sides being pooled, (3) means for all available specimens on each side, and (4) means for all available specimens without regard to side. The probable errors of these constants are only given for the longest, i.e. the Hsiu Chiu Shan, series.

The kinds of means used depend on the nature of comparisons to be made. In the present section there are four comparisons which will be made, viz.: (1) intra-group comparison of all the clavicular characters between the two sides, (2) the same between the two sexes, (3) inter-group comparison between the two series of bones dealt with, and (4) the same between different races for the few characters for which material is available. Excluding the case of the bilateral comparisons, for which means of paired specimens only are used, for sexual and other intra- and inter-racial comparisons the pooled means for all available bones on both sides are adopted in order to make the samples as large as possible. It has been found that differences between means deduced from paired specimens and those deduced from all available cases are all too small to be significant.[1] Hence it is justifiable to use the pooled values for both sides for all except bilateral comparisons.

(1) Bilateral Comparisons. Much have written about the asymmetry of cranial characters but less is known about the asymmetry of other parts of the skeleton. Since our data relate to a considerable number of characters, it seemed desirable to examine the asymmetrical nature of the clavicle. The present comparisons are restricted to the male and female means for the Hsiu Chiu Shan series although the female constants are based on fewer cases. In Table I are provided the mean of the paired specimens for each side, and the side ratios which are formed by expressing the right mean as a percentage of the corresponding left mean.[2] If the right mean is larger than the left the ratio will exceed 100. From the values of these ratios the preponderance of one side over the other can at once be seen. Of 74 comparisons made for both sexes 33 of them show the right side greater and the remaining cases the left side greater. There are 30 characters (80.1%) which show the same side greater for both sexes. Although in the remaining seven cases agreement is not found between the two sexes, yet their deviations of the ratios for these from 100 are all negligible. The average side ratios of absolute characters, and angles and indices for the male series are 99.8 and 101.1, while those for the female series are 99.6

[1] The ratios of differences between pairs of corresponding means to their probable errors are all less than 2.0.

[2] The ratio is 100x right mean/left mean, which may be termed the "side ratio." The inverse form, i.e. 100x left mean/right mean, was previously used by Hrdlička for examining the side difference of humeral characters.

and 99.8, respectively. It is clear that clavicular characters are, on the average approximately symmetrical. Judging from the average ratios no marked distinction can be found between asymmetry in size and that in shape.

The significance of asymmetry of clavicular features can be more accurately determined by comparing the differences between the two sides in terms of their probable errors. The latter constants depend not only on the sizes and variations of the samples but also on the correlations between the homologous measurements.[1] After comparisons have been made in such a way, 13 characters for males are found to be significant and these may be arbitrarily classified into the following two groups.

(1) Characters significantly dominant on the right side. There are only 4 characters belonging to this group, viz.: maximum perpendicular of the acromial end (♂ 7.1, ♀ 3.1), index of the two arcs (♂ 5.9, ♀ 2.5), inclination angle of the entire chord (♂ 4.6, ♀ 2.7), and caliber index (♂ 3.8, ♀ 3.3).

(2) Characters significantly dominant on the left side. 9 characters are included in this group: maximum length of the clavicle (♂ 10.4, ♀ 3.1), inner arc (♂ 6.3, ♀ 3.2), claviculo-humeral index (♂ 5.6, ♀ 5.9), inner chord (♂ 3.9, ♀ 3.2), position index of the conoid tubercle (♂ 3.9, ♀ 3.1), total chord (♂ 3.6, ♀ 3.2), total arc (♂ 3.1, ♀ 3.1), inner angle (♂ 3.1, ♀ 3.0), and outer angle (♂ 3.0, ♀ 2.7).

The characters listed in each group are arranged in order according to the sizes of the ratios for the male series, i.e. the difference between two means of opposite sides ($\triangle_{R-L}$) was divided by the probable error of the difference ($p.e.\triangle$), values being given after each sex in brackets. It is of interest to note that the order of significance for each character is not widely divergent in the two sexes.

Let us discuss at some length the asymmetrical nature of these characters. In the Hsiu Chiu Shan series, the average maximum length of the right clavicle in males is 144.1 and that of the left clavicle is 149.6. Though the difference is merely 5.5, yet it is significant and the same is true for the females. The left dominance of the clavicular length is not only found in the Chinese specimens, but also in those of many other races.[2]

Since the maximum length is greater on the left side, the total chord and its arc are almost bound to be greater on the same side and in fact they are so. It has been noted that the total chord and its arc consist of two components, an outer and an inner. The longer length of the bone may be attributed to its outer or inner component or to both. From the ratios ($\triangle_{R-L}/p.e.\triangle$) shown, it is evident

[1] The formula used for computing the probable error of the mean difference between two sides is $\frac{.67449}{\sqrt{n}}\sqrt{\sigma_r^2+\sigma_L^2-2r\sigma_r\sigma_L}$.

[2] See R. Martin: *Lehrbuch der Anthropologie*, Zweiter Band, p. 1098.

that both the inner chord and arc are significantly larger on the left side, but the outer measurements have small and non-significant differences. This seems to show that the inner component plays an important rôle in making the whole length larger on the left.

Table I. Male and Female Mean Measurements of the Clavicle on Each Side for the Hsiu Chiu Shan Series and Side Ratios

Character	*Means (paired)*[1]				*Side ratios*	
	Male		*Female*			
	Right	*Left*	*Right*	*Left*	*Male*	*Female*
a. Absolute Measurements:						
(1) Maximum length of the clavicle	144.1	149.6	132.7	135.3	96.4	98.1
(2) Transverse diameter of the shaft at the middle	12.9	12.9	11.6	11.4	100.2	101.8
(3) Sagittal diameter of the shaft at the middle	10.6	10.5	9.2	9.1	101.1	100.9
(4) Circumference of the shaft at the middle	37.4	37.3	33.5	33.2	100.4	100.7
(5) Total arc of the clavicle	153.5	155.7	141.4	142.6	98.6	99.1
(6) Outer arc	66.2	64.2	63.1	62.0	103.1	101.8
(7) Inner arc	86.8	92.0	77.5	81.4	94.4	95.2
(8) Total chord of the clavicle	141.7	143.7	129.7	131.9	98.6	98.3
(9) Outer chord	58.2	58.8	54.2	55.3	98.9	98.1
(10) Inner chord	82.6	85.9	74.3	77.7	96.2	95.6
(11) First segment	33.6	33.9	31.8	31.4	99.3	101.3
(12) Second segment	29.4	27.1	25.7	27.8	108.4	92.4
(13) Third segment	40.7	41.4	38.6	37.6	98.2	102.6
(14) Fourth segment	44.5	46.2	39.4	39.6	96.4	99.4
(15) Maximum perpendicular of the acromial end	29.7	28.0	27.0	25.5	106.1	106.2
(16) Maximum subtense of the diaphysis	29.4	29.9	27.9	27.4	98.3	102.0
(17) Maximum breadth of the acromial end	21.9	21.5	19.8	19.9	101.6	99.4
(18) Maximum breadth of the sternal end	19.7	20.1	17.5	17.9	97.9	98.3
(19) Minimum breadth of the shaft	10.5	10.4	9.4	9.2	101.6	102.0
(20) Distance of the position of the minimum breadth	70.1	70.7	64.3	65.6	99.1	98.0
(24) Minimum depth of the acromial end	9.5	9.4	8.6	8.5	101.7	100.9
(25) Maximum depth of the sternal end	23.2	22.8	20.2	20.0	101.8	100.9
(26) Depth at the level of the conoid tubercle	12.5	12.3	11.9	11.7	101.8	101.3
(27) The distance of the position of the conoid tubercle	34.4	35.9	31.6	32.9	95.8	96.1
b. Angles and Indices:						
(21) Outer angle	139°.5	141°.9	139°.6	142°.6	98.3	97.9
(22) Inner angle	151°.1	152°.9	150°.9	152°.3	98.8	99.0
(23) Inclination of the entire clavicular chord	5°.3	4°.7	5°.6	5°.2	111.0	109.1
(28) Caliber index	26.0	25.4	25.4	24.6	102.2	102.9
(29) Shaft index at the middle	82.8	82.1	80.0	80.3	100.9	99.1
(30) Length-height index of the clavicle	20.7	20.5	20.7	20.3	100.9	102.0
(31) Claviculo-humeral index	47.5	48.5	47.0	48.0	98.0	97.9
(32) Total curvature index	92.0	92.6	91.9	92.4	99.4	99.4
(33) Index of the two arcs	79.3	70.4	81.7	78.1	112.6	104.6
(34) Sterno-acromial breadth index	91.3	94.2	87.8	91.7	96.8	95.8
(35) Sterno-acromial depth index	41.7	41.9	43.3	43.8	99.5	98.8
(36) Minimum breadth position index	48.3	47.7	47.1	49.9	101.2	94.5
(37) Position index of the conoid tubercle	23.4	24.5	23.7	24.5	95.5	96.9

[1] See Appendix I.

It is of interest to note that the projective perpendicular of the acromial end is significantly dominant on the right side. The condition is evidently due to the fact that the right bone is shorter in length and its acromial end is bent more inward and projected more forward (see Fig. VII).

Three angular measurements have been used for the purpose of estimating clavicular curvature. It has been found that in both sexes the outer and inner angles are both smaller on the right side, but the inclination angle of the entire chord is larger on the right. These results clearly indicate that the right bone is definitely more curved than the left.[1] It has been shown by Parsons[2] that the curvatures of English clavicle of the right and left sides, as estimated by his index of the curvature or a sum of the outer and inner angles, are identical or only different to a very slight extent. As his method of both measuring and expressing the curvature is quite different from ours, it is not possible to compare the two races in the respect considered. According to our material two indices—the total curvature index and length-height index of the clavicle—show a similar result,[3] viz. that the right bone has a slightly greater degree of curvature, although side differences for these two indices are not quite significant.

In the above two groups there are four indices which are significantly dominant in either direction, the caliber index and the index of the two arcs being dominant on the right side, and the claviculo-humeral index and position index of the conoid tubercle being dominant on the left. However, these cases can all be accounted for by the sizes of their components, some being due to the especially large value of the denominator or the small value of the numerator on the right side, and some due to similar conditions occurring on the left.

Out of the other 24 characters—18 absolute measurements and 6 indices—not shown in the above two groups, 13 are slightly in favour of the right side and the remaining 11 slightly in favour of opposite side, but none of these show a significant lateral difference. In other words, the characters relating to the

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[1] The more curved the bone is, the smaller is the size of the outer and inner angles but the larger will be the inclination angle.

[2] According to Parsons' study, in 83 English left male clavicles the average index of curvature, or a sum of outer and inner angles, is 301°, while in 70 right males it is the same; but when the corresponding bones of opposite sides of fifty males are taken the left index is 300° and the right 301°. In the same way the average index of 64 left female bones is 306° and of 65 right female bones 305°; but when fifty actual pairs of bones are dealt with the left is 305° and the right 304°. In the present material, with the curvature of the bone measured by our method, the male right index of paired specimens is 290°.6 and the male left one 294°.8, while in females the right is 290°.7 and the left 294°.9. In both sexes the side difference is 4°.2.

[3] As the denominator of the total curvature index and the numerator of the length-height index both increase with greater curvature, so a small value of the former index and large value of the latter one on the right side imply a more curved bone of the same side.

size and shape of the middle shaft, to the two extremities, and to the position of some osteometric or arbitrary points, may be considered roughly symmetrical.

It should be noted that the degree of transverse flattening of the Chinese clavicular shaft at the middle is quite pronounced. In the case of the male specimens from Hsiu Chiu Shan the percentage of cases with the transverse diameter greater than the sagittal one is 93.3, while in females the value is 96.0. These are slightly larger than the percentages found in the case of Baiouarii (84%) and Alamanni (94%).[1]

From the above discussion it appears that the asymmetry of the clavicular characters in many cases, especially in the curvature of the bone, may be attributed to the side differences between the lengths. The question whether the asymmetrical traits are inborn or affected by some external factors is one which we cannot attempt to determine at present.

(2) Comparisons between the sexes. Sexual differences of average clavicular characters are considered next. In the second to fifth columns of Table II are provided the male and female means for all available specimens on both sides for the two series considered, and in the last two columns are given the sex ratios of all the characters. The latter constants express the male means as percentages of the corresponding female means.[2] From the values shown the Chinese clavicle exhibits a well marked sexual differentiation, as was found in the case of the humeral characters of the same series. In most cases the ratio for the Hsiao T'un series is sensibly higher than the corresponding one for the Hsiu Chiu Shan series. This is markedly so in the case of absolute characters, and it may be due to the fact that both male and female means of the former and smaller series are subject to large errors of random sampling. If we only take into consideration the larger Hsiu Chiu Shan sample, of 27 linear and angular measurements, with the exception of the inclination angle of the entire chord which is in favour of the females, all the characters show male dominance with the ratios of 100.2–115.1, while in the case of the relative characters 5 indices are in favour of males, and 4 in favour of females. There is only one case of sexual equality. The average ratios of the absolute measurements for the Hsiao T'un and Hsiu Chiu Shan series are 115.2 and 109.5, while those of measurements of shape for the same two series are 100.5 and 99.6 respectively.[3] It is evident

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[1] See Martin: *loc. cit.* p. 1099.

[2] The sex ratio is usually formed by taking 100 times the male mean divided by the corresponding female mean. It was used by Black, *loc. cit.*

[3] The corresponding average sex ratios of the two series derived from means of paired specimens are 112.0 and 99.8; those derived from means of the same series on the right side 111.8 and 100.5; and those on the left 112.2 and 99.1, respectively. The differences between the corresponding pairs of these ratios are practically negligible.

Table II. Male and Female Mean Measurements of the Clavicle for Both Chinese Series and Their Sex Ratios

Character	*Means (all)*[1]				*Sex ratios*	
	Hsiao T'un		*Hsiu Chiu Shan*		*Hsiao T'un*	*Hsiu Chiu Shan*
	Male	*Female*	*Male*	*Female*		
a. Absolute Measurements:						
(1) Maximum length of the clavicle	147.8	138.5	146.8	134.7	106.7	109.0
(2) Transverse diameter of the shaft at the middle	13.9	12.1	12.9	11.6	114.9	111.2
(3) Sagittal diameter of the shaft at the middle	11.0	9.2	10.5	9.2	119.4	114.6
(4) Circumference of the shaft at the middle	39.5	34.1	37.5	33.6	115.9	111.6
(5) Total arc of the clavicle	155.4	142.6	155.1	143.4	108.9	108.1
(6) Outer arc	67.8	66.3	66.1	62.3	102.4	106.0
(7) Inner arc	87.5	75.6	89.0	81.1	115.8	109.8
(8) Total chord of the clavicle	144.4	131.1	143.0	131.7	110.2	108.6
(9) Outer chord	60.8	57.8	59.2	54.6	105.2	108.4
(10) Inner chord	83.6	73.3	83.8	77.1	114.2	108.8
(11) First segment	35.2	30.0	33.9	31.3	117.2	108.2
(12) Second segment	29.1	32.0	28.9	26.3	91.1	107.6
(13) Third segment	39.2	36.9	40.9	38.4	106.1	105.3
(14) Fourth segment	46.3	37.4	45.1	39.7	123.8	113.6
(15) Maximum perpendicular of the acromial end	31.6	28.0	29.0	26.4	112.6	109.9
(16) Maximum subtense of the diaphysis	31.4	26.2	29.7	27.4	119.7	108.3
(17) Maximum breadth of the acromial end	24.5	17.6	21.9	20.1	139.0	108.8
(18) Maximum breadth of the sternal end	22.2	19.3	20.1	17.7	115.0	113.7
(19) Minimum breadth of the shaft	12.2	9.7	10.4	9.3	125.5	111.9
(20) Distance of the position of the minimum breadth	64.4	50.4	69.0	63.8	127.8	108.1
(24) Minimum depth of the acromial end	11.1	9.4	9.4	8.7	118.7	108.1
(25) Maximum depth of the sternal end	26.2	21.3	23.0	20.0	122.7	115.1
(26) Depth at the level of the conoid tubercle	14.3	12.7	12.5	11.9	112.8	105.1
(27) The distance of the position of the conoid tubercle	38.5	32.2	35.2	32.2	119.4	109.1
b. Angles and Indices:						
(21) Outer angle	141°.3	137°.2	140°.8	140°.5	103.0	100.2
(22) Inner angle	153°.5	152°.5	152°.5	151°.5	100.7	100.7
(23) Inclination of the entire clavicular chord	5°.8	6°.7	5°.1	5°.6	86.5	91.1
(28) Caliber index	26.7	24.6	25.7	25.0	108.2	102.6
(29) Shaft index at the middle	80.6	77.9	82.6	79.7	103.5	103.6
(30) Length-height index of the clavicle	21.2	19.5	20.5	20.5	108.6	100.0
(31) Claviculo-humeral index	47.4	48.8	47.7	47.5	97.2	100.5
(32) Total curvature index	93.0	91.9	92.2	91.9	101.1	100.4
(33) Index of the two arcs	80.3	90.4	76.8	78.1	88.8	98.3
(34) Sterno-acromial breadth index	89.9	110.6	92.2	90.2	81.3	102.3
(35) Sterno-acromial depth index	43.3	43.6	41.4	42.8	99.3	96.6
(36) Minimum breadth position index	43.7	37.3	47.0	47.3	117.1	99.3
(37) Position index of the conoid tubercle	26.0	23.4	23.9	24.1	111.4	99.3

that in either series the former average is appreciably higher than the latter. Similar results are also found for other parts of the skeleton. In the following table are given the average sex ratios of two groups of characters for the skulls

[1] See Appendix I.

and humeri of the same series. It will be seen that the average sex ratio of absolute characters is always larger than that of angles and indices. In other words, the sex differentiation in size appears to be more marked than that in shape.

Bones	*Series*	*Average Ratios of*	
		Absolute Measurements	*Angles and Indices*
Clavicle	Hsiao T'un & Hsiu Chiu Shan	112.5 (48)*	100.1 (26)
Humerus	Hsiao T'un & Hsiu Chiu Shan	113.7 (22)	106.4 (8)†
Cranium	Hsiao T'un	105.1 (53)	100.7 (41)

* Figures in brackets indicate the number of characters averaged.

† The average ratio of angles and indices for the humerus is slightly higher than that for the clavicle owing, possibly, to the small number of characters dealt with.

The order of significance of the sexual differences can be tested exactly in the usual way by finding the ratio of a difference to its probable error. In doing so, it is found that the sexual differences of 24 size characters are all significant (ratios from 3.1 to 14.2), the male being greater. The most significant sexual differences are for: the maximum length, the total arc and its chord, diameters and circumference of the shaft (ratios all greater than 8.0). In the case of three angles the male is slightly greater in the outer and inner angles, while the reversed position is observed in the inclination angle of the entire chord, as was anticipated. However, none of these sexual differences can be regarded as significant (sexual difference, or $M♂ - M♀$, for the outer angle is $.^\circ 28 \pm 1.01$, for the inner angle $1.^\circ 06 \pm .69$ and for the inclination angle $- .^\circ 45 \pm .18$). It has been usually asserted by previous observers that the male clavicle is more curved than the female. Judging from the present measurements, the sexual difference in clavicular curvature is not so marked as it is generally supposed to be. This is possibly due to the fact that since the whole male specimen is larger and more massive than the female bone, so the curvature of the male one is apt to be overestimated on account of its size.

In the cases of 10 indices the sexual differences in either direction are all insignificant, the ratios being all less than 2.7. We may summarize here by saying that the Chinese clavicle shows marked sex differentiation in the whole length and stoutness of the shaft and in the size of its two extremities, but no marked differences are found in its curvature or other measurements of shape.

(3) Comparisons of the Hsiao T'un and Hsiu Chiu Shan specimens. The significance of the difference of two means for any clavicular character, as in

the case of cranial and mandibular characters, may be accurately tested by the value of a, which gives a measure of their divergence in terms of an estimate of the standard error of the difference.[1] A criterion[2] used by biometricians for grading the value of a is adopted: (a) 0–2.7, the difference compared is definitely insignificant; (b) 2.7–6.1, it is uncertain; and (c) greater than 6.1, the difference is improbable to be due to errors of random sampling.

Table III. Values of a between Two Series of Chinese Clavicles (Males)

Number	*Character*	*Values of a*
(19)	Minimum breadth of the shaft	28.67
(24)	Minimum depth of the acromial end	20.11
(25)	Maximum depth of the sternal end	11.19
(26)	Depth at the level of the conoid tubercle	7.91
(15)	Maximum perpendicular of the acromial end	7.64
(17)	Maximum breadth of the acromial end	6.85
(18)	Maximum breadth of the sternal end	6.19
(37)	Position index of the conoid tubercle	6.12
(27)	The distance of the position of conoid tubercle	5.54
(2)	Transverse diameter of the shaft at the middle	5.26
(4)	Circumference of the shaft at the middle	4.89
(3)	Sagittal diameter of the shaft at the middle	2.80
(32)	Total curvature index	2.29
(28)	Caliber index	2.28
(23)	Inclination of the entire clavicular chord	1.68
(30)	Length-height index of the clavicle	1.05
(35)	Sterno-acromial depth index	.95
(11)	First segment	.93
(36)	Minimum breadth position index	.86
(20)	Distance of the position of the minimum breadth	.73
(13)	Third segment	.56
(9)	Outer chord	.33
(29)	Shaft index at the middle	.30
(6)	Outer arc	.29
(34)	Sterno-acromial breadth index	.29
(14)	Fourth segment	.28
(22)	Inner angle	.27
(8)	Total chord of the clavicle	.26
(33)	Index of the two arcs	.26
(7)	Inner arc	.19
(1)	Maximum length of the clavicle	.14
(31)	Claviculo-humeral index	.14
(16)	Maximum subtense of the diaphysis	.12
(21)	Outer angle	.06
(5)	Total arc of the clavicle	.01
(12)	Second segment	.01
(10)	Inner chord	.004

[1] The formula for calculating the value of a is $(m_1-m_2)^2 / \frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}$, where m_1 and m_2 are the two means of the same character for any two series compared; n_1 and n_2, the sizes of the two samples; and σ_1 and σ_2, the two standard deviations. If the σ_1 and σ_2 are assumed to be approximately equal, the formula becomes $\frac{n_1 n_2}{n_1+n_2} \cdot \frac{(m_1-m_2)^2}{\sigma^2}$. In the present case, the second formula was used and the standard deviations of the Hsiu Chiu Shan series were employed throughout on the assumption that the variation of the two populations represented were approximately equal.

[2] See G. M. Morant: "A First Study of the Tibetan Skull," *Biometrika*, Vol. 14, pp. 193-260, (1923).

The 37 α's between our two series for each sex were worked out,[1] although means of the shorter series are admittedly deduced from so few cases that they are of less value. The male values of α are arranged in order in Table III. From these it can at once be seen in which characters the two series compared differ most essentially, and in which they are most alike. Out of all the characters dealt with 8 values of α are larger than 6.1, while all other differences are either uncertain or insignificant. The significant characters which distinguish the two series are: (*a*) minimum breadth of the shaft, (*b*) minimum depth of the acromial end, (*c*) maximum depth of the sternal end, (*d*) depth at the conoid tubercle, (*e*) maximum height of the acromial end, (*f*) maximum breadth of the acromial end, (*g*) maximum breadth of the sternal end, and (*h*) position index of the conoid tubercle. In these cases, the Hsiao T'un means are all greater than the corresponding means of the Hsiu Chiu Shan series. In other words, both acromial and sternal parts of the Hsiao T'un specimens are, on the average, distinctively broader and higher. As the position of the minimum breadth of the shaft and conoid tubercle are both nearer to their respective ends, so the related measurements are accordingly larger. The larger value of the position index of the conoid tubercle is possibly due to the longer length of its component, i.e. of the distance from the tubercle to the acromial extremity.

It is rather interesting to note that the clearest differences of clavicular features between these two series are not found in the total length, diameters at the middle and measurements relating to the curvature of the bone, but in the characters of the two ends. In the case of females[2] there are only four significant values of α, two for absolute measurements and two for indices. In order to compare all the characters together the average values[3] of α between the two series of Chinese clavicles and for both sexes are set forth in the following table.[4]

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[1] Values of α given above are calculated from means of all the specimens available. It might be suspected that the corresponding values, if calculated from means of paired individuals, or from those of the right or left bones only, would be different. In order to test this point, the male average α based on means of paired specimens, and on those of right bones were computed; the former is 3.1 while the latter 2.3 for 37 characters used. Both are not sensibly divergent from the value of 3.4.

[2] The 8 significant values of α found in the male series are slightly smaller in the female series. The largest value of α found for females is for the inclination angle of the entire clavicular chord which is not markedly significant in males.

[3] Owing to the small number of bones represented in each series, the coefficients of racial likeness have not been computed.

[4] 13.4 (all characters) and 13.2 (indices and angles) are the mean numbers of bones for the 37 characters in the Hsiao T'un series while 109.1 (all characters) and 107.4 (indices and angles) are those in the Hsiu Chiu Shan series.

Characters	Average of α 's	
	Male	Female
All	3.4 (37)*	2.7 (37)
Indices & Angles	1.3 (13)	3.5 (13)

*Figures in brackets indicate the number of characters averaged.

It is seen that when considering all the characters together the male average α is slightly higher than the female, but the reversed position is observed in the case of the indices and angles. However, the highest average value is only 3.5. On the whole the measurements of two series are closely similar. The same result is obtained from a comparison of their humeral characters.[1]

(4) Comparisons of the Chinese and other series for a few characters. The comparative data for the majority of characters dealt with in the present paper are extremely scanty. In the case of the contour measurements, although several of the characters are of the same nature as those employed by Parsons, yet the results of the two different sets of material are still not comparable on account of the fact that the technique of orientating the bone, as well as the definitions of measurements, are not exactly the same.

Among the characters considered, two—viz. the maximum length and the claviculo-humeral index—have more abundant comparative data than any others. So the racial comparisons made in the present section are restricted to these two characters. In the first place, we are concerned with the maximum length of the clavicle. In Table IV are provided the mean measurements of this character in both sexes for different races. The series are arranged in order according to the size of the group means (male mean+female mean/2).

Table IV. Means of the Maximum Length of the Clavicle for Different Races*

Series	♂	♀	*Group Mean*
Andamanese	—	—	119
Senoi & Semang	—	—	121
North Chinese-recent	143	128	135
Japanese	147	131	139
Aino	146	132	139
Chinese (Hsiu Chiu Shan)	147	135	141
Chinese (Yang Shao)	159	126	142.
Chinese (Sha Kuo T'un)	—	—	143
Chinese (Hsiao T'un)	148	139	143
Egyptian (Naqada)	152	137	144
Negro	149	142	145
English	152	138	145
Fuegian	155	139	147

* Comparative data given in Table IV are cited either from Martin's *Lehrbuch* or from Black's paper, *loc. cit.* the means are for right and left bones together.

[1] See T. L. Woo: "A Study of the Chinese Humerus," *loc. cit.*

It will be seen that in either sex the means of the 5 Chinese series are not appreciably different from one another, except that the Yang Shao male mean is particularly high, while its female mean is particularly low. According to the size of the group values, the Hsiu Chiu Shan mean is closest to the recent North China one, while the Hsiao T'un mean is nearer to the Sha Kuo T'un and Yang Shao means. When compared interracially, the Chinese clavicular lengths appear to differ insignificantly from those of other Mongolian races, but they are certainly longer than the Andamanese, Senoi and Semang, and shorter than those of the Egyptian, negro, Fuegian and English races.

The next character to be considered is the claviculo-humeral index. This index, as indicated previously, is designed to give a relative measure of the lengths of the two bones considered. If any individual, or a given race, has narrower shoulder but a longer upper arm, a lesser value of the index will be given. The mean measurements of this index for the present two, as well as for other racial, series are given in Table V. The series compared are arranged in order according to the size of the group mean.

Table V. Means of the Claviculo-humeral Index* for Different Races

Series	♂	♀	*Group Mean*
Andamanese	42.7	40.8	41.7
European	44.3	45.0	44.6
Chinese (Yang Shao)	45.7	45.1	45.3
Neolithic (Chamblandes)	46.5	44.6	45.5
North Chinese, recent	46.0	45.1	45.5
Egyptian (Naqada)	46.7	46.5	46.6
Negro	45.9	47.4	46.6
Santa Rosa Indian	46.3	47.3	46.8
Chinese (Hsiu Chiu Shan)	47.9	47.5	47.6
Chinese (Hsiao T'un)	47.4	48.8	48.1
Japanese	49.6	47.9	48.7
Aino	49.4	48.5	48.8
Chinese (Sha Kuo T'un)	49.8	—	—
Botokudos	51.5	46.6	49.0

* The mean indices for other races are cited from the same sources as those referred to above.

With the exception of the Sha Kuo T'un series, for which only the male mean is available, the mean indices of the other four Chinese series are by no means the same. The Hsiao T'un and Hsiu Chiu Shan groups means are very close, on the one hand, and those of the Yang Shao and recent North China series are practically the same, on the other. The range of this index for the Chinese series varies from 45.3 to 48.1, and they are not clearly differentiated from the values for American Indians, Negroes and Naqada Egyptians. However, the position of the Chinese as a whole in this respect lies approximately midway between the extremes. It is clear that the index is capable of distinguishing series quite effectively, but it fails to arrange different races in a suggestive order. It may be tentatively concluded that, with the exception of one or two particular cases, the principal characters of the Chinese clavicle for different series are generally very close, and they show some marked divergences from the corresponding characters of other races.

V. *Comparisons of Variabilities.* Both absolute and relative variabilities, viz. standard deviations and coefficients of variation, of all characters,[1] with their probable errors, have been worked out for the sample from Hsiu Chiu Shan in both sexes. The values calculated are given in appendix II. This includes: (*a*) variabilities of all the characters taken on the right side, (*b*) those taken on the left, (*c*) variabilities based on the paired specimens of both sides and (*d*) those based on all available specimens. As the series dealt with is not a large one, the values obtained have rather large sampling errors. It is, perhaps,

Table VI. Comparison of Grades of Variabilities of Clavicles with Those of Crania*

Bones	*Sources*	*Characters*	*No. of Characters*	*Mean Cases*	*Grades of Variation*		
					% of Low Grade (0–4.9)	*%of Med. Grade* (5–9.9)	*% of High Grade* (*over* 10)
Clavicle	Hsiu Chiu Shan	Size	24	108.3	——	20.8(5)	79.2(19)
		Indices and angles	13	104.8	46.2(6)	23.0(3)	30.8(4)
Cranium†	Kansu & Honan (pooled prehistoric)	Size	36	36.3	50.0(18)	47.2(17)	2.8(1)
		Indices and angles	46	32.6	78.3(36)	21.7(10)	——
Cranium‡	Hou Chia Chuang (Yin Dynasty)	Size	27	26.6	51.9(14)	48.1(13)	——
		Indices and angles	17	25.1	76.5(13)	23.5(4)	——
Cranium†	North China (modern)	Size	36	79.8	47.2(17)	47.2(17)	5.6(2)
		Indices and angles	46	80.3	71.7(33)	28.3(13)	——

* As suggested by K. Pearson, the variabilities of linear measurements are compared by coefficients of variation and those of indices and angles by standard deviations.

† Values of variabilities for the pooled prehistoric and North China series of crania are cited from D. Black's paper, *loc. cit.*

‡ Values of variabilities for the Hou Chia Chuang cranial series are quoted from a paper by the present writer on "A First Study of the Chinese Skull Excavated from Hsiao T'un, Anyang, Honan." *loc. cit.*

[1] The coefficients of variation for angles and indices are, as usual, not provided in the appendix as they depend on purely arbitrary factors, such as the base-line chosen and the direction in which the measurement is taken.

more desirable in the present case to compare variabilities for groups of characters instead of those for measurements considered singly. For convenience of comparison the variabilities may be arbitrarily divided into three grades: low variation, values under 5; medium, 5.0–10; high variation over 10. In table VI are provided percentages of the three grades for male variabilities and for the clavicular characters in comparison with those of the cranial characters of different Chinese series.

It will be seen that the variabilities of the clavicular characters for either group are exceptionally high. For the clavicular characters, 79 per cent. of linear measurements and 31 per cent. of indices and angles are listed in the high grade of variation, while for the cranial characters, only a few characters, or even none of them, are found in the high grade, yet the majority are classified in the medium or low grade. It is difficult to suggest an explanation of the high variation of clavicular features. It might be supposed that the present material is not very homogeneous, causing peculiarly large variation. We can test this point by comparing the values of variabilities of the claviculo-humeral index, which are available for several races.

The standard deviation of the index for the present male series is 2.6, while the values[1] for the Yang Shao and recent North China series are 2.2 and 2.8, respectively. It is clear that the variability of the present series judged from this single index is not particularly high. The large average variability for the clavicular characters is possibly due to the nature of the particular characters dealt with. It is probable that characters such as the outer and inner arcs and chords, the measurements of the four segments, and the maximum and minimum breadths and depths, are all listed in the high grade of variation simply because these measurements are mostly taken from the arbitrary points for finding the curvature of the bone. Characters of this kind will be expected to have large variabilities.

The next point we will consider concerns bilateral and sexual differences in variability. The significance of differences in variability can as usual be tested by taking the ratio of the difference between constants for the two sides, or for the two sexes, to its probable error. The latter constants are computed by formulas given in a paper[2] by the present writer.

Considering the bilateral differences in variability first, out of all comparisons there are four cases[3] (or 10.8%) of differences of which can be considered to be

[1] Values in variability for other Chinese series are cited from Black's paper, *loc. cit.* p. 83.

[2] See T. L. Woo: "On the Asymmetry of the Human Skull," *loc. cit.* p. 337. The probable error of the difference between two standard deviations $= \frac{.67449}{\sqrt{2N}} \sqrt{\sigma_r^2 + \sigma_L^2 - 2r^2 \sigma_r . \sigma_L}$ and the probable error of the difference between 2 coefficients of variation

$$= \frac{.67449}{\sqrt{2N}} \left\{ v_r^2 + v_L^2 - 2r^2 v_r \cdot v_L + \frac{2}{(100)^2}(v_r^4 + v_L^4 - 2rv_r^2 \cdot v_L^2) \right\}^{\frac{1}{2}}.$$

[3] The three significant differences on the right side are: length-height index ♂, σ; claviculo-humeral index, ♂, σ; and sternal-acromial breadth index, ♂, σ. The one significant difference on the left is: sternal-acromial breadth index, ♂, σ.

statistically significant, 3 cases being dominant on the right side and the remaining one dominant on the left. These are all found in the male group. A similar comparison may be made with regard to sexual differences in variability. In the following table are summarized percentages of the male and female preponderance in variability for measurements of size as well as for indices and angles.

Measurements of size (based on differences of V)		*Indices and Angles (based on differences of σ)*	
♂ > ♀	♂ < ♀	♂ > ♀	♂ < ♀
70.8%(17)	29.2%(7)	69.2%(9)	30.8%(4)

It will be seen that the percentage for male preponderance is considerably higher than the female, roughly in the ratio of 7:3, in the case of characters of both groups. Among 37 comparisons of variabilities[1] between the two sexes there are 9 cases, or 24.3%, found to be significant. Of these 8 are in favour of males and the remaining one in favour of females; 3 cases are found for absolute variabilities, while 6 are for relative ones.

From the analysis given above it may be concluded: (1) that on the average male variability tends to be greater than female, and that for the same sex variability on the right side tends to be larger than that on the left, (2) that lateral differences in variability are sensibly less than sexual differences.

It may be asked whether there is any correspondence between dominance in size and that in variability. This question can be examined by comparing individually the significant cases of dominant characters in size and in variability. It is found that for the lateral comparisons there is no single case dominant in both ways, while for the sexual comparisons there are only 8 cases which show the same direction of dominance: in the majority of cases dominance either in size or in variability is shown. This clearly indicates that so far as the present material is concerned no relation of any importance is discovered between dominance in size and dominance in variability. The same is true in the case of the cranial characters of single bones.[2]

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[1] Significant sexual differences in variability are: maximum length of the clavicle, inner chord, outer arc, maximum breadth of the sternal end, maximum depth of the sternal end, shaft index at the middle, index of the two arcs, sterno-acromial depth index and maximum subtense of the diaphysis. The first 8 characters are in favour of the males and the last one in favour of the females. In all comparisons the ratios of differences to their probable errors greater than three are considered to be significant.

[2] See T. L. Woo: "On the Asymmetry of the Human Skull," *loc. cit.* pp. 337–340.

Fig. IV. Horizontal and Vertical Type Contours Based on 36 ♂ Chinese Clavicles from Hsiu Chiu Shan (Right Side)

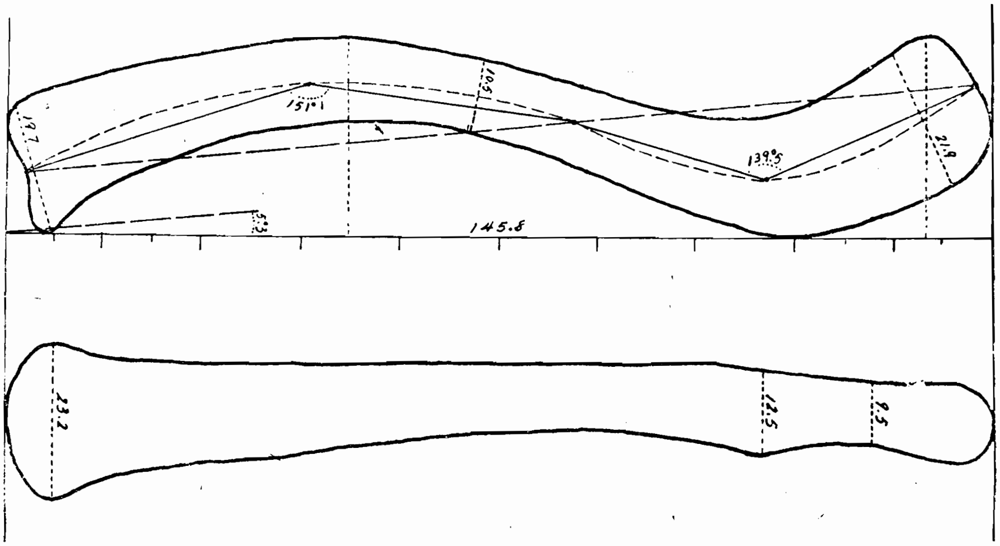


Fig. V. Horizontal and Vertical Type Contours Based on 36 ♂ Chinese Clavicles from Hsiu Chiu Shan (Left Side)

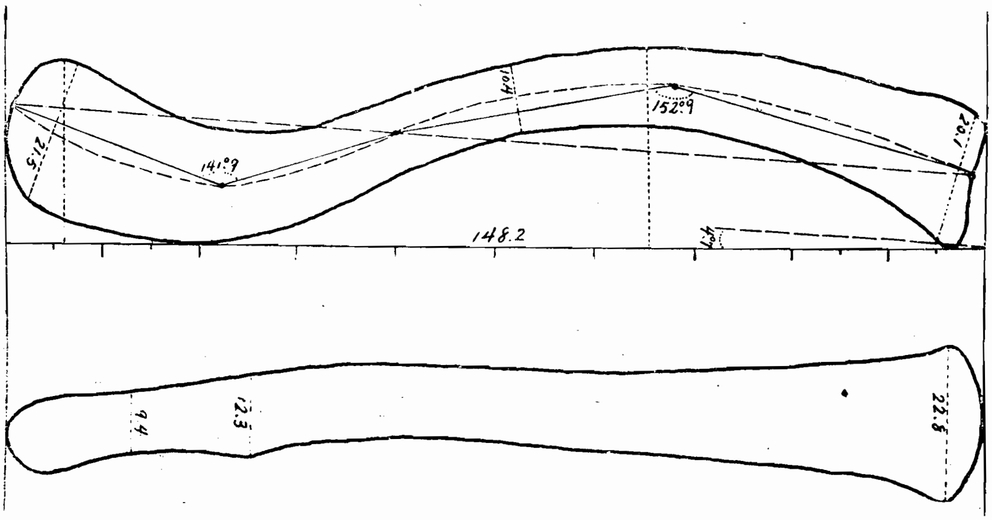


Fig. VI. Horizontal and Vertical Type Contours Based on 18 ♀ Chinese Clavicles from Hsiu Chiu Shan (Right Side)

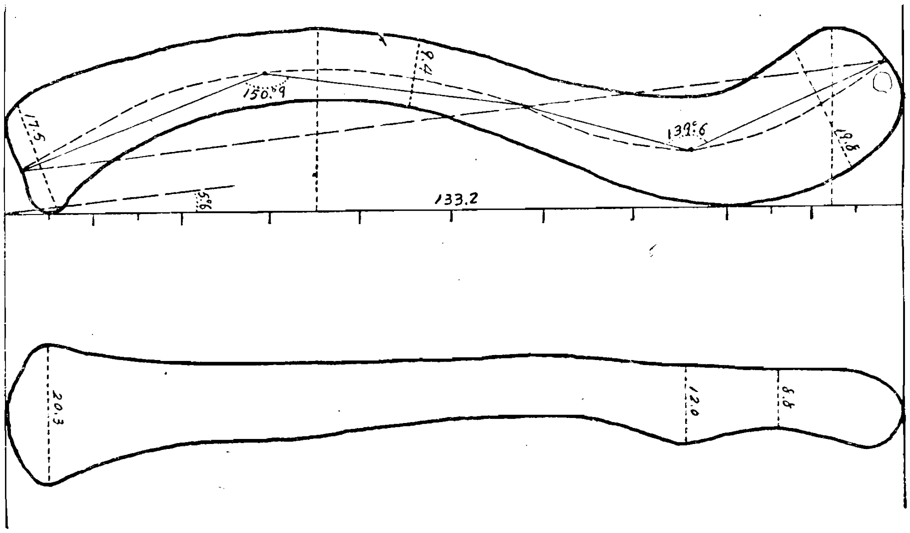


Fig. VII. Horizontal and Vertical Type Contours Based on 18 ♀ Chinese Clavicles from Hsiu Chiu Shan (Left Side)

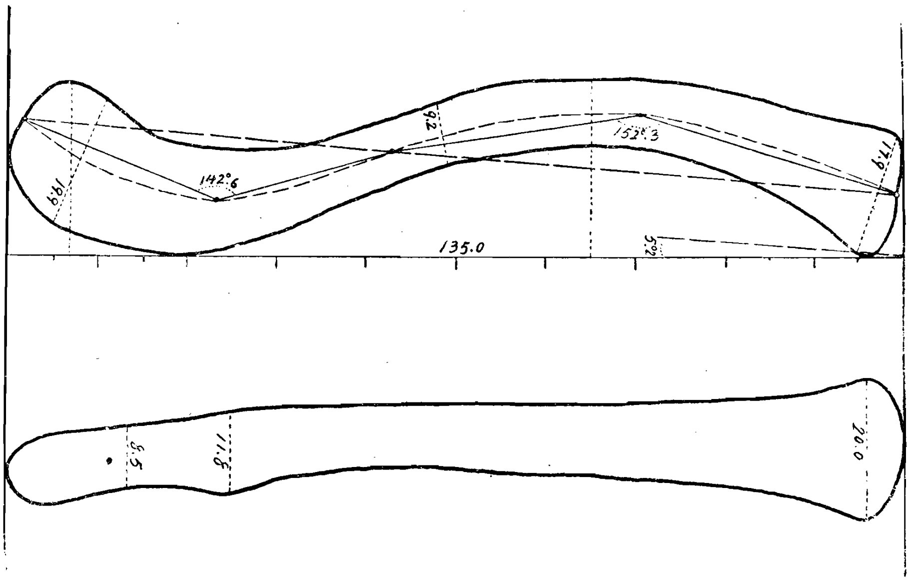


Fig. VIII. Horizontal and Vertical Type Contours Based on 12 ♂ Chinese Clavicles from Hsiao T'un (R+L)

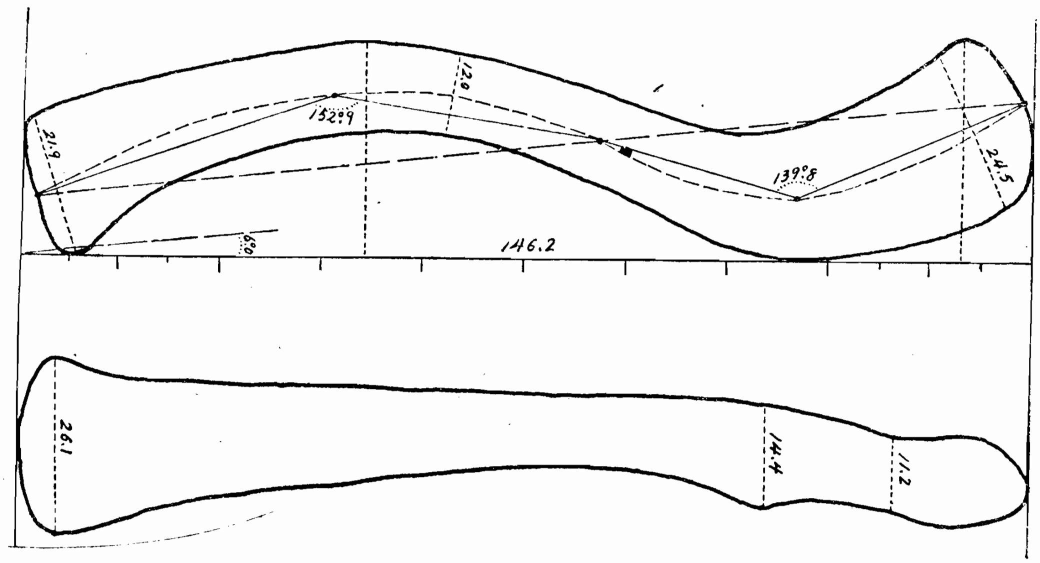


Fig. IX. Horizontal and Vertical Type Contours Based on 8 ♀ Chinese Clavicles from Hsiao T'un (R+L)

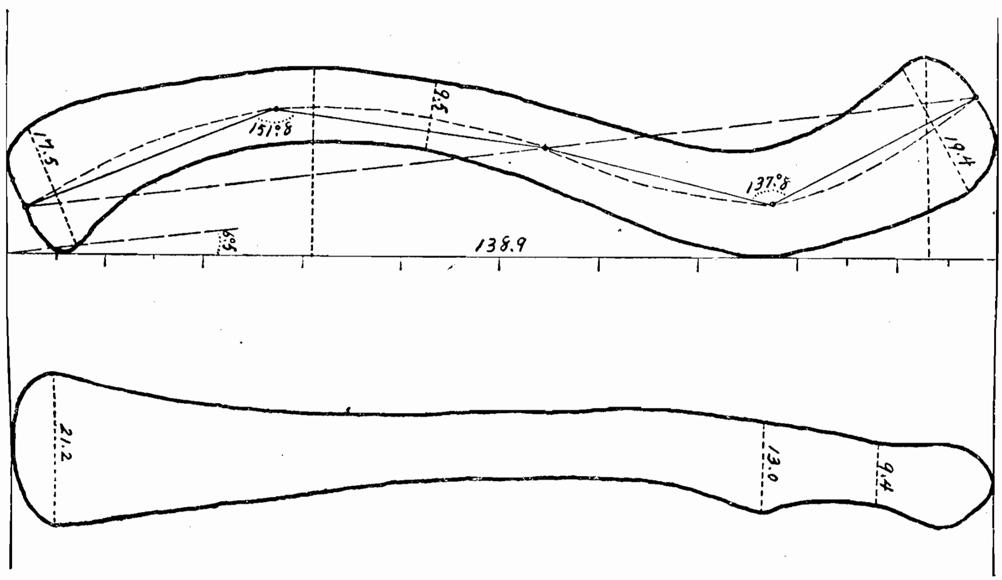


Fig. X. Horizontal and Vertical Type Contours Based on 72 ♂ Chinese Clavicles from Hsiu Chiu Shan (R+L)

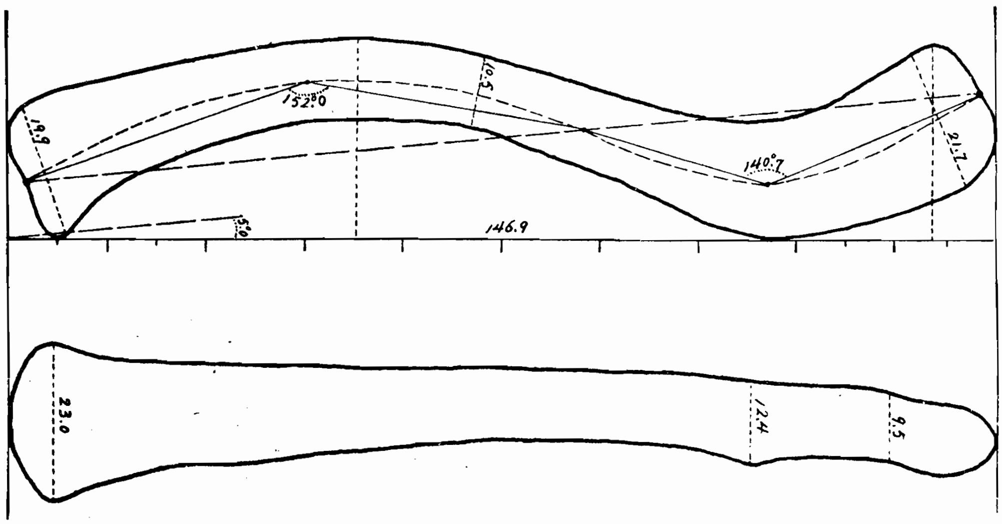
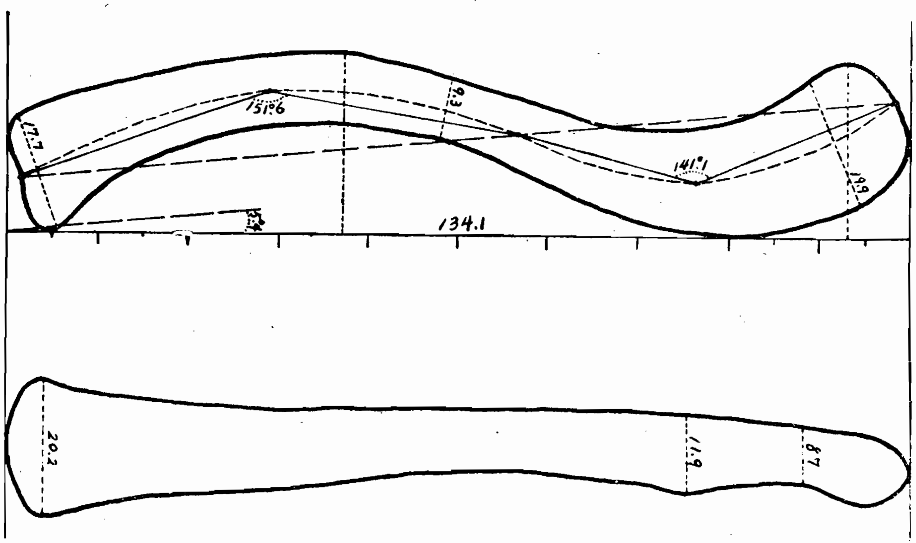


Fig. XI. Horizontal and Vertical Type Contours Based on 36 ♀ Chinese Clavicles from Hsiu Chiu Shan (R+L)



VI. *Comparison of Horizontal and Vertical Type Contours.* It is more interesting and suggestive to make similar comparisons of various groups based on their average (or type) contours. It is not accurate enough, as suggested by Parsons, to construct the average contour of any section from a few points determined by measurements. The more points are used in plotting, the more accurate the features of the mean contour will be. The process of constructing the clavicle type contour is similar to that employed in constructing the cranial type. The maximum length of the bone is first divided into ten equal parts (see Fig. IV) and perpendiculars are drawn through the points of division, numbered in order from the acromial to the sternal end. The distances of the points where the parallels cut the outline are measured from the base-line. As the shapes of the two ends of the clavicle are not determined accurately enough in this way, the first two and last two divisions are also bisected by parallels. The lengths along the 14 parallels, together with the contour measurements in each plane are averaged. From these values the average, or type, contour in either plane can be readily constructed, each sex and side being considered separately. Figs. IV-VII show the male and female average contours of both sections on the right and left sides for the larger Hsiu Chiu Shan series. Figs. VIII-XI reproduce the contours of each sex for both the Hsiao T'un and Hsiu Chiu Shan series formed from the pooled means of both sides. A glance at these figures reveals at once the following facts:

(1) In the horizontal plane the maximum perpendicular of the acromial end is always located in the second half of the first division, while the maximum perpendicular of the diaphysis is located without exception in the 7th division.

(2) The position of the minimum breadth always falls between the 5th and 6th parallels (see the horizontal contours, Figs. IV-XI), while that of the conoid tubercle invariably falls in the third division (see the vertical contours, Figs. IV-XI).

(3) In the vertical plane the minimum depth of the acromial part always lies in the first half of the second division, while the maximum depth of the sternal part always lies in the second half of the last division. It is clear that on the average these features of the clavicle occupy definite positions with regard to the maximum length, regardless of side, sex and different series considered.

Some interesting comparisons may be made. In the first place, the Hsiu Chiu Shan average horizontal or vertical type contour of the right side in each sex may be superposed on the corresponding ones of the left reversed, i.e. Figs. IV and V, and VI and VII are superposed with the base-line and the last parallels coincident so that average side differences will be at once apparent. These

Fig. XII. Bilateral Comparison of the Horizontal and Vertical Type Contours of the Hsiu Chiu Shan Clavicles: (A) Male and (B) Female

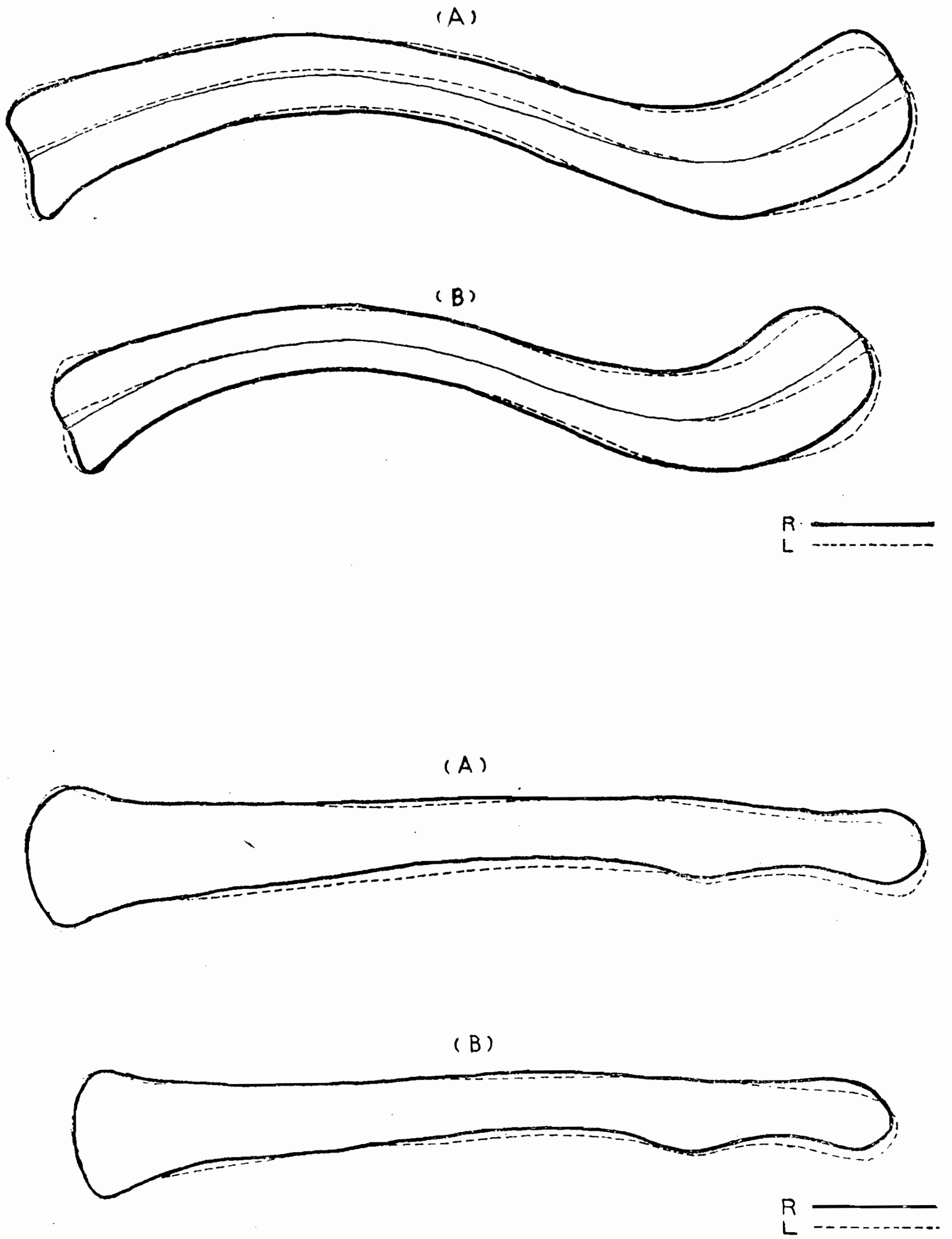


Fig. XIII. Sexual Comparisons of the Horizontal and Vertical Type Contours of the Chinese Clavicles: (A) Hsiao T'un Type and (B) Hsiu Chiu Shan Type

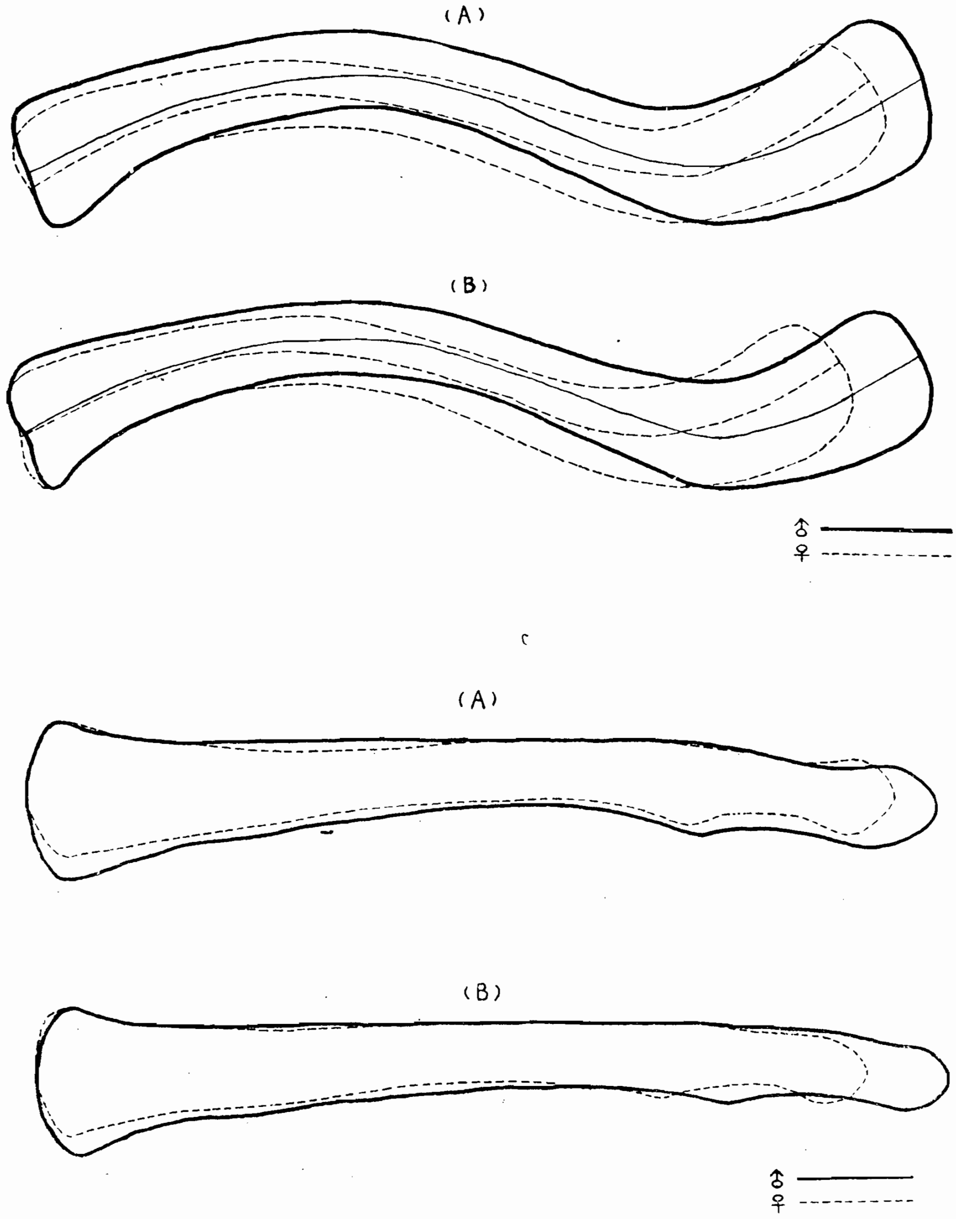
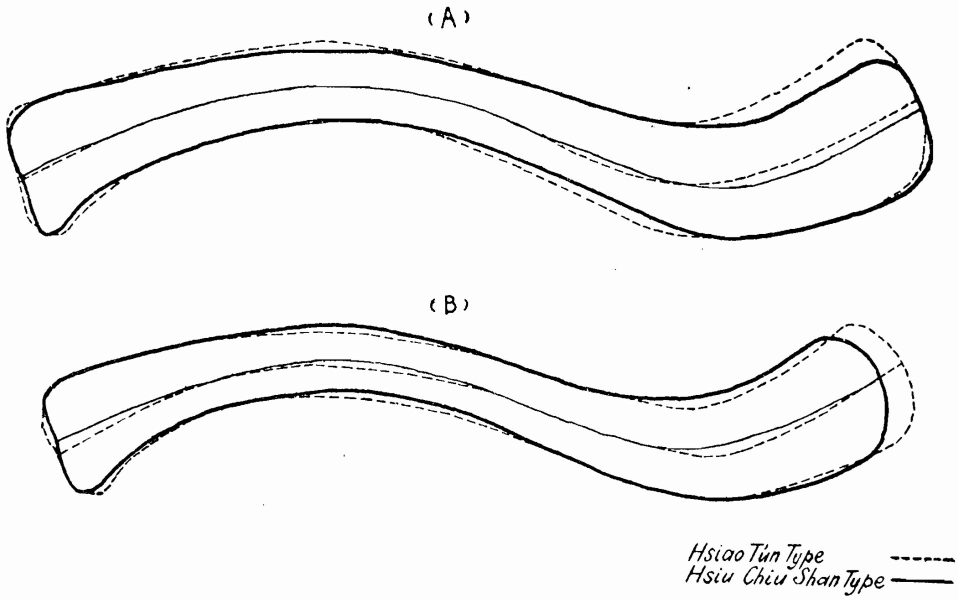
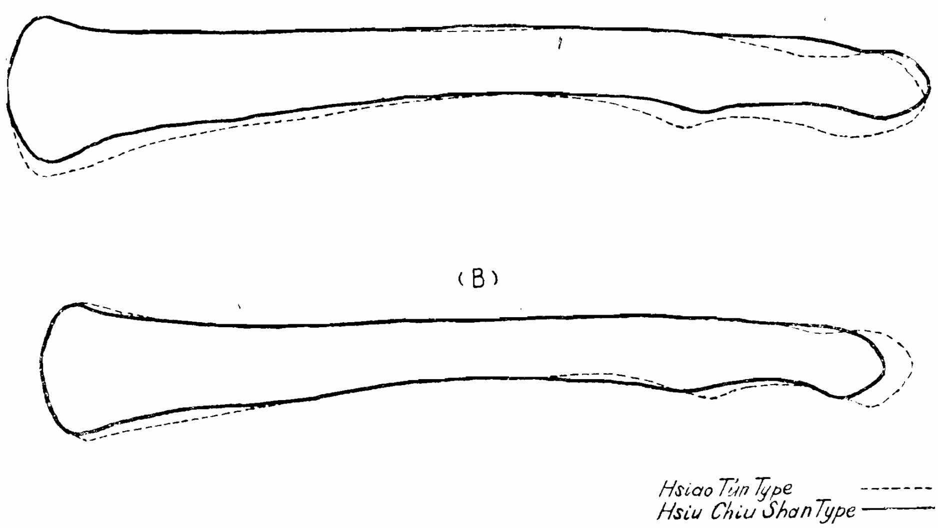


Fig. XIV. Comparisons of the Horizontal and Vertical Type Contours of the Hsiao T'un and Hsiu Chiu Shan Types: (A) Male and (B) Female





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superposed types are shown in Fig. XII (A) and (B), respectively. It will be seen that in both sexes the right contour has the shorter clavicular length and its related chord and arc, the higher acromial end and slightly lower sternal end. These facts accord well with the results of the measurements. Sexual comparisons of the type contours may be considered next. Fig. XIII shows the superposed forms of the male and female contours for both horizontal and vertical sections and both series, viz. Figs. VIII and IX, X and XI put together in the way described above. It is clear that in all dimensions the female contour is sensibly smaller than the male. If the contours of the two sexes are made to coincide at the middle parallel, the outline of the female contour will lie entirely inside the circumference of the male outline. The last comparison of the average contours is made between the Hsiao T'un and Hsiu Chiu Shan types. Fig. XIV shows the superposed figures (Figs. VIII and X, IX and XI being superposed). It is clear that the male Hsiao T'un type is wider and thicker at the two ends as was found from the mean measurements. In the case of females the acromial end of the Hsiao T'un type is not particularly wide, but the total length of the bone is clearly greater than that for the Hsiu Chiu Shan series. The inconsistent results for two sexes are possibly due to the small sizes of some of the series. On the whole, the average type contours compared confirm the results gained from the study of metrical characters presented in the previous section.

VII. *Varieties of Cross-sections of the Clavicle taken at the Middle and at the Level of the Conoid Tubercle.* In addition to the metrical characters considered above, attention may be directed to the shapes of different cross-sections. It has been asserted by some anthropologists[1] that the shapes of bones may be influenced to a certain extent by such factors as muscular activity, the stage of development and pathological conditions, but it is probable that heredity is the dominant factor determining them.

Hrdlička[2] has made a detailed study of the subject in the case of the long bones and the scapula in different races. It has been shown by him that each long bone presents a variety of forms which are reducible to definite types. The frequency of these types differs from race to race and modern White show more variation in the shapes of bones than other races. Unfortunately, the bones he examined do not include the clavicle.

[1] For original reports on this subject see Hrdlička, A.: (1) "Study of the normal tibia." *Proceedings of the Association of American Anatomists*, 11th Section, pp. 61–66; (2) "A further contribution to the study of the tibia, relative to its shapes," *Proceedings of the same Association* 12th–13th Sections, 1900, pp. 12–13; (3) "Typical forms of shaft of long bones," *Proceedings of the same Association*, 14th Session, 1901, pp. 55–60.

[2] Hrdlička, A: *loc. cit.*

Fig. XV. Typical Shapes of the English Clavicle, in the Cross-section at the Middle (After Parsons).

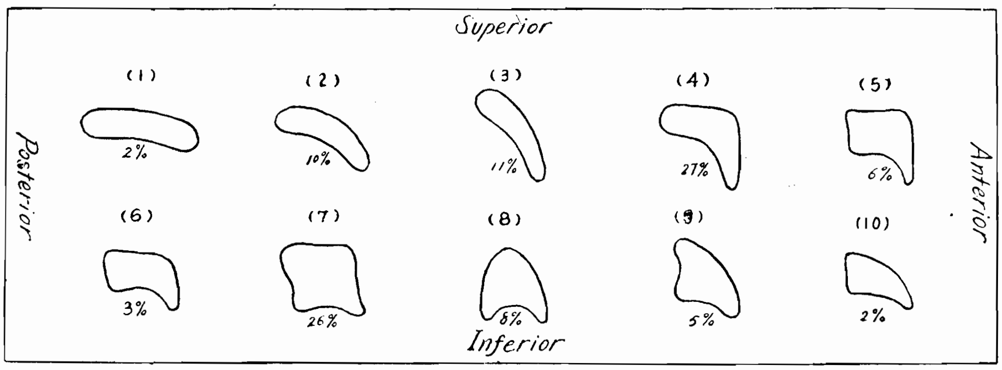


Fig. XVI. Typical Shapes of the Chinese Clavicle, in the Cross-section at the Middle

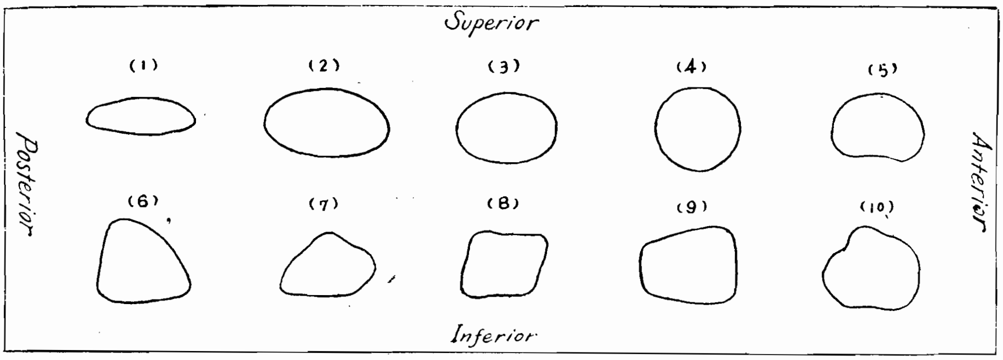
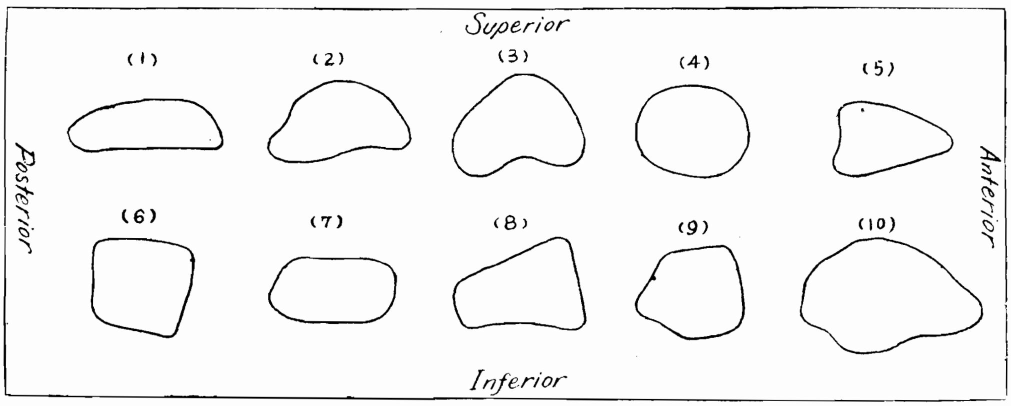


Fig. XVII. Typical Shapes of the Chinese Clavicle, in the Cross-section at the Level of the Conoid Tubercle



The forms of the middle cross-section were first investigated by Parsons.[1] It was found that there are ten types of the shapes at this particular section found among English clavicles. The forms of these types are shown in Fig. XV, (1)–(10). The percentages of occurrence for each type are given below each form. It will be seen that the highest percentages are found in the case of types 4 and 7, so the dominant shapes of the English clavicles are of either 'triangular' or 'quadrilateral' form, accounting for 27% and 26%, respectively. Since then no comparative material for other races has been added.

In the present paper the shapes of two particular sections are chosen for study, viz. (*a*) the section at the middle, i.e. is the plane where measurements of the horizontal and vertical diameters are taken, (*b*) the section at the level of the conoid tubercle. As there are various forms of this tubercle, the section through it may show some interesting shapes which are not necessarily similar to those at the middle.

Let us consider the forms at the middle first. After an analysis and grouping of shapes of the clavicular shaft based on all specimens available, 10 different types were arbitrarily distinguished. The typical forms of these types[2] are shown in Fig. XVI, (1)–(10).[3] It will be seen that the forms classified differ quite distinctly from one another. The first three are more or less oval in form, but their outlines can still be distinguished clearly as 'narrowly oval,' 'intermediately oval' and 'oval' in form. They all present two surfaces and two borders, the surfaces being usually superior and inferior while the borders are anterior and posterior. The fourth type is practically a circle and no 'edges' can be clearly differentiated. The fifth form is quite different from those already discussed as it has a flattened inferior base and a roundly convex surface in other directions. The sixth type is roughly triangular in form and the three surfaces represented may be called anterior, posterior and inferior. The 7th–9th types are all 'quadrilateral' with four definite 'edges.' In the case of the 7th type, the posterior and inferior lengths are larger than the anterior and superior ones,

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[1] Parsons, F. G.: *loc. cit.*

[2] The typical examples of these 10 types, arranged in order, are represented by nos. 210(L), 4 (L), 81 (R), 73 (R), 13 (R), 60 (L), 203 (R), 23 (R), 187 (R) and 3 (R). All these are male Hsiu Chiu Shan specimens.

[3] In dealing with the types of the cross-section, both the Hsiao T'un and Hsiu Chiu Shan series are considered together, since the former series is very small. A common mistake made by some authors is to determine the 'type' of a series by selecting one or two bones which are assumed to be typical. In fact the forms of human bones, modern as well as ancient, are very variable and from a statistical point of view, it is only possible to deduce results of value by dealing with a large sample.

the 8th is somewhat square in form, and the 9th has equivalent lengths of superior and inferior surfaces but its anterior length is apparently greater than its posterior one. The last form is a peculiar type of somewhat quadrilateral form and its posterior surface appears to be convex but its inferior surface is very flattened.

The frequencies and corresponding percentages of all these types for both sides, sexes and for the total number of bones are provided in Table VII. Considering the percentage values of these types deduced from all cases it is seen that the highest value (43.2%) is found for the third type, that is a 'slightly oval form' with its long axis laid horizontally. The next highest percentages are found for the second, fourth and fifth types, ranging from 10.7 per cent. to 13.6 per cent. The forms of these three types are either oval or roundish. The percentages of the remaining types are all smaller than 7. It is clearly seen that a roundish form is the dominant shape of the Chinese clavicle and this is evidently different from the dominant shape of the English clavicle. Comparing the percentages between the two sides and two sexes provided in the same table, the differences are seen to be scarcely significant[1] when taking into consideration the small number of cases represented. In other words, the percentage distributions of shapes of the clavicular shaft taken at the middle in the Chinese specimens are closely similar regardless of side and sex. In the present material, the frequency of the same type on both sides amounts to 46.8 per cent., which is fairly high.

We have only similar data for the English clavicle observed by Parsons. Among the types shown in Figs. XV and XVI, there are only three forms (viz., nos. 1, 6, and 8 in Fig. XVI corresponding with nos. 1, 9 and 7 in Fig. XV) which are somewhat similar and commonly occurring in both races. The other seven types in each set show no correspondence. When a careful comparison of the general features of these types is made, there are two essential differences found between the shapes of the Chinese and English bones, namely: (*a*) The Chinese sections are dominantly of the oval or round form, while the English of the angular or quadrilateral form, and (*b*) the types of shapes in the latter race frequently present clearly concave inferior or postero-inferior surfaces, while those of the former usually show a flat or slightly convex form of the corresponding surfaces. These divergence can hardly be satisfactorily explained as being due to factors other than racial heredity. It has been stated by some anatomists[2]

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[1] The largest bilateral difference of percentages is found in the third type (11.7), while the largest sexual one is found in the 7th type (5.0). But in either case the ratio of the difference to its probable error is less than 2.6 so it is possibly insignificant.

[2] The statement has frequently been made in text-books of anatomy.

Table VII. Percentages of 10 Typical Forms of the Chinese Clavicle in the Cross-section at the Middle

Side and Sex	*No.*	*Forms of the cross-section*									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		%	%	%	%	%	%	%	%	%	%
Right side: (♂+♀)	102	—	12.7 (13)	37.3 (38)	10.8 (11)	15.7 (16)	4.9 (5)	5.9 (6)	7.8 (8)	3.9 (4)	1.0 (1)
Left side: (♂+♀)	104	2.9 (3)*	11.5 (12)	49.0 (51)	10.6 (11)	11.5 (12)	2.9 (3)	4.8 (5)	5.8 (6)	1.0 (1)	—
Males: (R+L)	122	2.5 (3)	13.9 (17)	42.6 (52)	9.8 (12)	12.3 (15)	3.3 (4)	7.4 (9)	4.9 (6)	2.5 (3)	0.8 (1)
Females: (R+L)	84	—	9.5 (8)	44.0 (37)	11.9 (10)	15.5 (13)	4.8 (4)	2.4 (2)	9.5 (8)	2.4 (2)	—
All cases	206	1.5 (3)	12.1 (25)	43.2 (89)	10.7 (22)	13.6 (28)	3.9 (8)	5.3 (11)	6.8 (14)	2.4 (5)	0.5 (1)

* Figures in brackets under the percentages indicate the numbers of cases in each group.

Table VIII. Percentages of 10 Typical Forms of the Chinese Clavicle in the Cross-section at the Level of the Conoid Tubercle

Side and Sex	*No.*	*Forms of the cross-section*									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		%	%	%	%	%	%	%	%	%	%
Right side: (♂+♀)	103	4.9 (5)*	39.8 (41)	11.7 (12)	16.5 (17)	12.6 (13)	2.9 (3)	2.9 (3)	5.8 (6)	1.0 (1)	1.9 (2)
Left side: (♂+♀)	103	7.8 (8)	34.0 (35)	19.3 (20)	13.6 (14)	13.6 (14)	2.9 (3)	4.9 (5)	1.0 (1)	1.0 (1)	1.9 (2)
Males: (R+L)	125	4.8 (6)	44.8 (56)	13.6 (17)	12.8 (16)	7.2 (9)	4.0 (5)	4.8 (6)	4.0 (5)	0.8 (1)	3.2 (4)
Females: (R+L)	81	8.6 (7)	24.7 (20)	18.5 (15)	18.5 (15)	22.3 (18)	1.2 (1)	2.5 (2)	2.5 (2)	1.2 (1)	—
All cases	206	6.3 (13)	36.9 (76)	15.5 (32)	15.1 (31)	13.1 (27)	2.9 (6)	3.9 (8)	3.4 (7)	1.0 (2)	1.9 (4)

[1] Figures in brackets under the percentages indicate the numbers of cases in each group.

that the rounded form of the shaft of any bone is an acquired character, possibly due to mal-development resulting from mal-nutrition, but this hypothesis is hardly established, as no good evidence in support of it has been furnished. So far as the present material is concerned, although the Hsiao T'un and Hsiu Chiu Shan series evidently represent the bones of two different classes, yet their percentage distributions of types of the cross-section are not markedly different from each other.

The types of shapes at the level of the conoid tubercle is considered next. The cross-section is made at the place where the depth of the vertical section is taken (see measurement 26). Examining the forms of this section obtained from all specimens, there are again found (see Fig. XVII) ten different types[1] which can be more or less clearly distinguished from one another. Among these there are four types which are similar to those found at the middle section: viz. nos. (1), (4), (6) and (8) of the conoid section correspond in order to nos. (1), (4), (8) and (9) of the middle section. The forms of the ten types are shown in Fig. XVII. It can be seen that the areas represented are larger than the corresponding ones obtained at the middle. In the conoid section several forms have concave inferior surfaces. This condition was not found in the shapes of the middle section. Several of the types show a moderately or markedly prominent projection at the region of the tubercle.

Besides the similar types just referred to, the remaining six types may be described. The second type presents two surfaces. The superior surface is very much curved upwards and the inferior one is curved in the same direction but to a slight degree. The third type is somewhat like the shape of a water-caltrops but the bending ends being less sharpened. The fifth type is triangular in form with superior, inferior and posterior sides, and the last one appears concave when viewed medially. The seventh type has an oblong form and the horizontal lengths are definitely larger than the vertical ones. The ninth type is somewhat like the last type of the middle section, but its convex projection is directed medially instead of anteriorly. The last type is very peculiar in form: at the middle of the inferior surface, a markedly round projection is directed downwards. This was only found in one case out of the total number of specimens. The frequencies of occurrence of these types and their corresponding percentages for each side, and either sex, as well as for the total available cases, are given in Table VIII. Judging from the percentages shown at the foot of the table, it is clear that the dominant type of this section is the second one (36.9 per cent.). The next largest values are found in the third to fifth types with percentages from 13.1 to 15.5. Other types occur much less frequently (all less than 7 per cent.). The occurrence of the same type on both sides is found in 54.6 per cent. of cases, which is slightly larger than the corresponding value for the middle cross-section. The lateral differences of percentages are

[1] The typical samples of these types, arranged in order, are nos. 63 (L), 5 (R), 32 (R), 218 (R), 15 (L), 9 (L), 100 (R), 210 (L), 111 (L) and 201 (L). All belong to the male specimens from Hsiu Chiu Shan.

all small, and the same is true in the case of the sexual differences,[1] except that the male value is particularly high for the second type, and particularly low for the fifth one. This fact indicates clearly that the anterior border of male specimens is more frequently thicker and stouter.

Owing to the absence of comparative material, it is not possible to deal with the types of this section inter-racially. It must be remembered that in both sections the types are only presented tentatively on the basis of the available material. Hence it cannot be supposed that they represent all possible shapes of the Chinese clavicles. When more abundant samples of the same bone are examined some new types may be added, and consequently the distribution of frequencies may be altered to a certain extent.

VIII. *Other Morphological Features.* The non-metrical morphological characters of the clavicle present some interesting relations which are of no less importance than the metrical characters for purposes of racial differentiation. Of these, four features—(1) the deltoid tubercle, (2) the conoid tubercle, (3) the costal tubercle and (4) the nutrient foramen are considered in the present section.

(1) Deltoid tubercle. The anterior surface of the clavicle at the acromial end is usually a rough surface which is concave when viewed in front. In several cases, there are found at the inner side of this concave curve a tubercle, termed the deltoid tubercle, from which the deltoid muscle takes its origin. The form of the tubercle varies considerably, from a rough impression to a very marked projection. Frequently there is no tubercle at all to be found in this region. For convenience of comparison the degree of prominence of the tubercle, following Black's classification,[2] is divided into three groups: (*a*) small and faint projection, (*b*) moderate size and (*c*) large and marked.[3] The result of observation of this character in several series is summarized in Table IX. It can be seen that the percentages of absence of the tubercle for all the Chinese series are decidedly high, especially for the ancient series, when compared with that for a non-Asiatic group, although the last is a short and somewhat heterogeneous series. The percentages for presence of the tubercle for the Chinese groups range from 9.8 to 35.4, and the cases included occur most frequently in the 'small' or 'intermediate' divisions. The question whether the frequent absence and small size of the deltoid tubercle when present, is a characteristic of other Mongolian races

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[1] In the former case, the ratio of the difference to its probable error is 4.6, while in the latter case the ratio is 4.3. The remaining values of the ratio are all less than 3.

[2] D. Black: *loc. cit.*, pp. 83–87.

[3] In classifying the bones, three reference specimens representing the three groups were picked out for guidance. The result of the present grouping may be reasonably assumed to be comparable with Black's.

Table IX. Comparisons of the Frequencies of Occurrence of the Deltoid Tubercle and of Grades of its Size for Different Series

Series	Side & Sex	No.	Absence of tubercle	Presence of tubercle			
				small	medium	large	total
Sha Kuo T'un	...	71	% 90.2 (64)‡	% 5.6 (4)	% 1.4 (1)	% 2.8 (2)	% 9.8 (7)
Yang Shao	♂+♀*	45	80.1 (36)	6.6 (3)	13.3 (6)	—	19.9 (9)
Hsiao T'un	♂+♀	34	70.6 (24)	20.6 (7)	8.8 (3)	—	29.4 (10)
North China, recent	♂+♀	46	67.5 (31)	15.2 (7)	13.0 (6)	4.3 (2)	32.5 (15)
Hsiu Chiu Shan	♂+♀	144	64.6 (93)	22.2 (32)	11.1 (16)	2.1 (3)	35.4 (51)
Non-Asiatic	—	20	10.0 (2)	15.0 (3)	65.0 (13)	10.0 (2)	90.0 (18)
Hsiu Chiu Shan	Right (♂+♀)	72	63.9 (46)	18.0 (13)	13.9 (10)	4.2 (3)	36.1 (26)
Hsiu Chiu Shan	Left (♂+♀)	72	65.3 (47)	19.4 (14)	13.9 (10)	1.4 (1)	34.7 (25)
Hsiu Chiu Shan	♂ (R+L)	84	66.7 (56)	19.0 (16)	11.9 (10)	2.4 (2)	33.3 (28)
Hsiu Chiu Shan	♀ (R+L)	60	61.7 (37)	26.7 (16)	10.0 (6)	1.6 (1)	38.3 (23)

‡ Figures in brackets indicate the absolute frequencies.
* Specimens of both sides are pooled.

or not will be worth investigating. Judging from the value of the percentages, the Hsiao T'un, North China and Hsiu Chiu Shan series appear to differ insignificantly from one another, but each is apparently different from the Yang Shao and Sha Kuo T'un series. In the modern series examined in this paper, the occurrence of the tubercle is less frequent on the right side than on the left, and in the female than in the male, but the difference of the percentages in either case is not large.[1]

(2) Conoid tubercle. On the posterior border of the bone at the junction of the middle and outer thirds there appears a blunt, rounded eminence called the conoid tubercle, to which the conoid division of the coraco-clavicular ligament is attached. Intra-racially, the conoid tubercle varies greatly in size. For

[1] The range of the ratios of the differences to their probable errors is from .02 to .82, all indicating insignificant differences.

Table X. Comparisons of Various Sizes of the Conoid Tubercle. for Different Series

Series	Side & Sex	No.	*Size of Tubercle* small	medium	large
			%	%	%
Sha Kuo T'un	—	71	25.3 (18)*	29.6 (21)	45.1 (32)
Yang Shao	♂+♀†	14	14.4 (2)	42.8 (6)	42.8 (6)
Hsiao T'un	♂+♀	36	16.7 (6)	36.1 (13)	47.2 (17)
North China, recent ..	♂+♀	46	13.0 (6)	34.8 (16)	52.2 (24)
Hsiu Chiu Shan	♂+♀	144	18.1 (26)	37.5 (54)	44.4 (64)
Non-Asiatic	—	20	10.0 (2)	60.0 (12)	30.0 (6)
Hsiu Chiu Shan	Right (♂+♀)	72	18.1 (13)	36.1 (26)	45.8 (33)
Hsiu Chiu Shan	Left (♂+♀)	72	18.1 (13)	38.9 (28)	43.0 (31)
Hsiu Chiu Shan	♂ (R+L)	84	16.7 (14)	36.9 (31)	46.4 (39)
Hsiu Chiu Shan	♀ (R+L)	60	20.0 (12)	38.3 (23)	41.7 (25)

* Figures in brackets indicate the absolute frequencies.
† Specimens of both sides are pooled.

comparative purposes the tubercle, as suggested by Black, is classified into three groups—small, medium and marked—in accordance with the degree of its prominence on the bone. The absolute and relative frequencies of this feature in the two new series, together with Black's data, are arranged in order in Table X. For all the Chinese series the conoid tubercle is very markedly developed. The percentages of the 'marked' group for them vary from 43 to 52, all being higher than that for the non-Asiatic series. There are no appreciable differences between the percentages for the different Chinese series, the last three—Hsiao T'un, North China and Hsiu Chiu Shan—being particularly close. In the case of the two new series the percentages for each sex and for each side are available. From the figures shown the sexual as well as lateral differences of the percentages appear to be insignificant, taking into account their large probable errors.

(3) Costal tubercle. On the inferior surface near the sternal end there is a rough impression of variable size and shape termed the costal tubercle. It may be an elevation, a rough depression, or a deep excavation over the greater part of its area, in the bones of certain races. It gives attachment to the costo-clavicular ligament by which the clavicle is bound to the first rib. According to Black's study on this subject, the forms of this tubercle are grouped as 'excavated' and 'non-excavated.' The latter group is again sub-divided into three classes—small, medium and large—in accordance with the relative eminence of the tubercle. But in some cases these classes cannot be clearly distinguished from one another. For simplicity, the costal tubercle of the new specimens is merely noted in this paper as being excavated or not excavated. A

Table XI. Comparisons of Forms of the Costal Tubercle for Different Series

Series	*Side and Sex*	*No.*	*Excavated*	*Not excavated*
Sha Kuo T'un	—‡	55	% 48.8 (27)*	% 51.2 (28)
Yang Shao	♂+♀†	16	37.5 (6)	62.5 (10)
Hsiao T'un	♂+♀	32	43.7 (14)	56.3 (18)
North China, recent	♂+♀	45	28.3 (13)	71.7 (32)
Hsiu Chiu Shan	♂+♀	144	43.8 (63)	56.2 (81)
Non-Asiatic	—	20	15.0 (3)	85.0 (17)
English	♂+♀	50	10.0 (5)	90.0 (45)
Hsiu Chiu Shan	Right (♂+♀)	72	48.6 (35)	51.4 (37)
Hsiu Chiu Shan	Left (♂+♀)	72	38.9 (28)	61.1 (44)
Hsiu Chiu Shan	♂ (R+L)	84	44.0 (37)	56.0 (47)
Hsiu Chiu Shan	♀ (R+L)	60	46.4 (28)	53.6 (32)

* Figures in brackets indicate the absolute frequencies.

† Specimens of both sides are pooled.

‡ Both the Sha Kuo T'un and Non-Asiatic series are unsexed and the percentages for these are cited from Black's paper.

summary of the percentage distributions for this feature for different series is presented in Table XI. It can be seen that the percentages of the 'excavated' group are particularly high in the Chinese clavicles examined. The 'excavated' percentages for the Hsiao T'un and Hsiu Chiu Shan specimens are very close and each is slightly different from those for the other Chinese series. The percentages for all the Chinese material are definitely higher than those for English and other non-Asiatic groups. Black has suggested that a deep excavation over the site of attachment of the costo-clavicular ligament implies a stronger ligamentous attachment over this area, possibly as a result of variable, violent working strain. If this be true, it is rather difficult to explain the fact that the Sha Kuo T'un clavicles show a higher percentage of excavations than those of the recent northern Chinese, both observed by the same investigator. while the two sets of specimens from Hsiao T'un and Hsiu Chiu Shan which have been supposed to represent different social classes have closely similar frequencies of excavation. According to the usual custom of the Chinese, the right shoulder is more frequently used for carrying or lifting weights than the left, while men are more likely to receive working strain than women. But judging from the figures given at the foot of the table the frequency of excavation of the bone between the two sides, as well as between the sexes, does not show significant differences.[1] A similar result is found for Black's material. These facts hardly support his hypothesis of strains. From the meagre evidence available we can only say for the present that there is a clear racial distinction so far as the occurrence of the excavated depression on the clavicle is concerned. The percentages of this feature for the Chinese series are decidedly higher than those for European series.

(4) Nutrient Foramina. The number and position of the nutrient foramina on the clavicular bone, like other clavicular characters, are subject to a wide variation. In the general case usually only one nutrient foramen is located on the posterior surface near the junction of the lateral third with the medial two-thirds, and it is often directed toward the lateral end. But quite frequently more than one foramen are found in the bone, and in a few cases no definite foramen can be detected. In the latter cases the bones are nourished by the numerous small apertures found at the two ends. The percentages of the various conditions observed for the Chinese as well as the English specimens are summarized in the following table:

Specimens	*No.*	*number of foramina occurred*			
		single	*double*	*multiple*	*no definite foramen*
Chinese	206	60.2% (124)	28.1% (58) *	7.8% (16)	3.9% (8)
English	286	64.2% (183)	26.2% (75)	4.9% (14)	4.9% (14)

* In the first case, the ratio = 1.8; in the second one, the ratio = .4.

It is clear that the percentage distributions of the nutrient foramen for the two different races are remarkably similar, although the Chinese series has a slightly higher percentage in the case of double as well as in the case of multiple foramina. So far as the present material is concerned, it has been found that the foramina do not always appear on the posterior surface. They are, in several cases, found variously on the inferior surface, on the border between the posterior and inferior surfaces, and on the anterior surface. Out of all specimens examined there are 58 per cent. of cases in which the foramina are situated on the posterior surface, and these are mostly single. When the specimen possesses more than one foramen, the position of one of them is often on the inferior surface or its neighboring border.

IX. *Summaries.* The object of the present study is to throw new light on the features of the Chinese clavicle, and to compare their sizes and shapes bilaterally and sexually among themselves and inter-racially with previously published data for Chinese and other series. Two series of clavicles which were collected from different regions of the country—representing populations of the Sui-T'ang dynastics and of modern date—are studied by metrical and non-metrical methods. The material examined consists of 151 male and 95 female specimens, and of these 122 are right and the remaining 124 left bones. 27 linear and angular measurements, taken either directly or from the horizontal and vertical contours of the bone, are employed and the majority of these are newly designed for purposes in view. The ten indices relating to the shapes of different parts of the bone are constructed from pairs of the absolute measurements. Several of these are also new. The shapes of two different cross-sections are differentiated and classified into definite groups which may serve as basic material for comparison with similar data for other racial groups. Four of the more interesting morphological features of the bone are examined and compared with the available data for other Chinese and non-Chinese series. On the basis of the quantitative analysis given above, some tentative results are arrived at and these are summerised below:

(1) The lateral differences of several clavicular characters are quite marked. The right clavicles are, on the average, shorter, stouter and more curved, and their acromial ends project more in the upward direction. These relations are clearly demonstrated by linear and angular measurements and indices. The question whether the asymmetry of these clavicular characters is inborn, or acquired during life cannot be answered conclusively in the present state of our knowledge.

(2) Average absolute measurements of the Chinese clavicle generally show a marked differentiation between the two sexes. In nearly all characters the males are predominant, e.g. the male bones are altogether longer, wider and more massive on the average. Judging from the angular measurements taken, the curvature of the bone does not distinguish the two sexes, though it has often been supposed to. No marked sexual differences are found in the measurements of shape.

(3) The significant distinction between the Hsiao T'un and Hsiu Chiu Shan clavicles is not found in the middle part of the shaft but at the two extremities of the bone. The two extremities of the Hsiao T'un type seem to be wider and thicker. This fact suggests that the Hsiao T'un bones had stronger muscular attachments at the parts referred to.

(4) Judging by the result of a comparison of the maximum clavicular length and the claviculo-humeral index, the mean values of different Chinese series are not sensibly divergent from one another. When compared with those of the other races, the Chinese average values appear in an intermediate position. These measurements seem to be of some value in distinguishing different families of races.

(5) The variation of the clavicular characters leads to conclusions similar to those deduced from most other anthropological characters. The male variability is on the average larger than the female. For the same sex the right side tends to be more variable than the left. Significant differences in variability are found more frequently in sexual than in lateral comparisons.

(6) There is no close association between the dominance of size and the dominance of the variation.

(7) Average horizontal and vertical type contours of the clavicle are constructed for the two series, the two sexes and the two sides separately. The results obtained from various comparisons of the average contours confirm the conclusions deduced from the direct measurements.

(8) The shapes of the cross-section at the middle of Chinese clavicles are very variable. For comparative purposes, they are divided into ten types (see Fig. XVI). The dominant type is found in the third form (43.2%), viz. an oval form with the long axis in a horizontal position. The percentage distributions of these shapes for different series of Chinese clavicles are closely similar to one another. The typical shape of the Chinese bone is obviously different from that of the English. The former is characterized by a round or oval outline with flat or somewhat convex edges, while the latter is characterized by an angular

or quadrilateral outline with concave inferior or postero-inferior surfaces. The dissimilarity of the shapes for the two races may be mainly accounted for by the factor of racial variation.

(9) The forms of the cross-section at the level of the conoid tubercle are also divided into ten types (see Fig. XVII). The dominant shape is found in the second one (36.9%), viz. a form with a convex superior and a concave inferior surface. The general shape of this section has a slightly concave inferior surface and presents an inward projection in some cases at its posterior border, indicating the presence of the conoid tubercle.

(10) Judging by the percentage distributions of shapes in the two cross-sections, the lateral differences are all negligible. The bilateral occurrence of the same form on both sides range from 46.8% to 54.6% showing that the shapes of different sections are the same on both sides in nearly half of the total number of the bone. With few exceptions, sexual differences in the shapes are usually not so marked as in the majority of metrical characters.

(11) The shapes of the vertical section seem to be much less variable than those of the horizontal one.

(12) The Chinese clavicles, when compared with those of the other races, show a low percentage of occurrence of the deltoid tubercle and a high percentage of occurrence of conoid tubercles. Intra-racially, no marked differences are found between the sides, sexes and samples drawn from different regions.

(13) The percentage of 'excavated' costal tubercles found among the Chinese clavicles is also considerably higher than those found in non-Asiatic groups. From various considerations it seems that this can hardly be explained as being due to excessive working strain.

(14) The percentage distributions of the occurrence of nutrient foramina for the Chinese and English clavicles are not appreciably different. In the former specimens there are 60.2 per cent. of cases with a single foramen and the remaining bones possess double or multiple foramina. The position of the foramen is frequently found on the posterior surface near the lateral third of the bone.

It should be noted that the above results can only be regarded as tentative, owing to the fact that the samples used are not large ones, while comparative data are extremely scanty. When more abundant material becomes available it may be hoped that the conclusions reached here will be confirmed and extended. This study supplies an improved technique for investigating features of the clavicle, and the writer hopes that this will be adopted by other workers in the study of new series.

Finally, the writer wishes to thank most heartily Dr. G. M. Morant, London, for his many helpful suggestions and criticisms of this paper.

Appendix I. Mean Constants of the Clavicular Characters in Both Sexes for the Hsiao T'un and Hsiu Chiu Shan Series

Character					
			Paired		
	No.	*Right*	*Left*	*No.*	*R.+L.*
a. Absolute measurements:					
(1) Maximum length of the clavicle	6	144.7	149.0	12	146.8
(2) Transverse diameter of the shaft at the middle	6	13.8	13.5	12	13.7
(3) Sagittal diameter of the shaft at the middle	6	10.8	11.3	12	11.1
(4) Circumference of the shaft at the middle	6	39.6	38.6	12	39.1
(5) Total arc of the clavicle	6	153.5	155.7	12	154.6
(6) Outer arc	6	71.6	63.1	12	67.3
(7) Inner arc	6	83.2	92.1	12	87.7
(8) Total chord of the clavicle	6	141.5	145.2	12	143.4
(9) Outer chord	6	61.8	58.6	12	60.2
(10) Inner chord	6	75.4	89.0	12	82.2
(11) First segment	6	34.8	34.9	12	34.9
(12) Second segment	6	31.0	27.7	12	29.3
(13) Third segment	6	35.1	41.8	12	38.5
(14) Fourth segment	6	43.3	48.2	12	45.8
(15) Maximum perpendicular of the acromial end	6	33.3	31.2	12	32.2
(16) Maximum subtense of the diaphysis	6	30.7	31.6	12	31.1
(17) Maximum breadth of the acromial end	6	24.5	24.4	12	24.5
(18) Maximum breadth of the sternal end	6	22.4	21.3	12	21.9
(19) Minimum breadth of the shaft	6	12.6	11.4	12	12.0
(20) Distance of the position of the minimum breadth	6	58.9	67.6	12	63.3
(24) Minimum depth of the acromial end	6	11.5	11.0	12	11.2
(25) Maximum depth of the sternal end	6	26.3	25.8	12	26.1
(26) Depth at the level of the conoid tubercle	6	14.9	14.0	12	14.4
(27) The distance of the position of the conoid tubercle	6	36.4	38.6	12	37.5
b. Measurements of shape:					
(21) Outer angle	6	134°.2	145°.4	12	139°.8
(22) Inner angle	6	151°.0	154°.9	12	152°.9
(23) Inclination of the entire clavicular chord	6	6°.6	5°.4	12	6°.0
(28) Caliber index	6	27.4	25.9	12	26.6
(29) Shaft index at the middle	6	77.9	83.8	12	80.9
(30) Length-height index of the clavicle	6	21.2	20.9	12	21.1
(31) Claviculo-humeral index	6	46.0	48.1	12	47.1
(32) Total curvature index	6	92.2	93.7	12	92.5
(33) Index of the two arcs	6	86.1	70.7	12	78.4
(34) Sterno-acromial breadth index	6	91.6	87.4	12	90.5
(35) Sterno-acromial depth index	6	43.9	43.6	12	43.8
(36) Minimum breadth position index	6	40.8	45.4	12	43.1
(37) Position index of the conoid tubercle	6	25.2	26.3	12	25.7

All linear measurements are taken in m.m. and 3 angular measurements in degrees.

(*Continued*)

Hsiao T'un												
Male						*Female*						
All						*Paired*						
No.	*Right*	*No.*	*Left*	*No.*	*R.+L.*	*No.*	*Right*	*Left*	*No.*	*R.+L.*	*No.*	*Right*
7	146.0	7	149.6	14	147.8	5	137.9	140.0	10	139.0	7	137.4
7	14.0	7	13.8	14	13.9	5	12.2	12.0	10	12.1	7	12.2
7	10.9	7	11.1	14	11.0	5	9.4	9.5	10	9.4	7	9.1
7	40.0	7	39.0	14	39.5	5	34.5	34.0	10	34.2	7	33.2
7	155.1	6	155.7	13	155.4	5	42.1	143.4	10	142.7	6	142.0
7	71.9	6	63.1	13	67.8	5	67.2	65.2	10	66.2	6	67.1
7	83.6	6	92.1	13	87.5	5	74.7	77.2	10	76.0	6	74.3
7	143.7	6	145.2	13	144.4	5	129.9	133.5	10	131.7	6	129.1
7	62.7	6	58.6	13	60.8	5	57.0	59.1	10	58.1	6	56.7
7	79.1	6	89.0	13	83.6	5	72.7	74.3	10	73.5	6	72.4
7	35.5	6	34.9	13	35.2	5	30.2	30.1	10	30.1	6	30.0
7	30.4	6	27.7	13	29.1	5	31.2	33.1	10	32.2	6	31.1
7	36.9	6	41.8	13	39.2	5	36.9	37.4	10	37.2	6	36.5
7	44.6	6	48.2	13	46.3	5	36.5	38.2	10	37.4	6	36.6
8	31.4	6	31.2	14	31.6	5	28.1	27.7	10	27.9	6	28.3
9	31.3	6	31.6	15	31.4	5	26.3	26.4	10	26.3	6	26.2
7	24.6	6	24.4	13	24.5	4	17.7	17.1	8	17.4	6	18.0
7	23.0	6	21.3	13	22.2	4	19.4	19.6	8	19.5	6	19.0
7	12.8	6	11.4	13	12.2	5	9.7	9.6	10	9.6	6	9.8
7	61.6	6	67.1	13	64.4	5	49.1	52.1	10	50.6	6	48.9
7	11.3	7	10.9	14	11.1	5	9.7	9.2	10	9.5	6	9.5
7	26.3	6	25.8	13	26.2	5	21.5	21.0	10	21.2	6	21.6
7	14.7	7	13.9	14	14.3	5	13.0	12.2	10	12.6	6	13.1
7	38.3	7	38.6	14	38.5	5	32.0	32.7	10	32.3	6	31.8
7	137°.8	6	145°.4	13	141°.3	5	136°.3	137°.9	10	137°.1	6	136°.5
7	152°.3	6	154°.9	13	153°.5	5	151°.0	152°.9	10	152°.0	6	152°.1
7	6°.1	6	5°.4	13	5°.8	5	7°.0	6°.2	10	6°.6	6	7°.1
7	27.6	7	25.7	14	26.7	5	25.0	24.6	10	24.8	7	24.7
7	79.6	7	81.7	14	80.6	5	76.1	80.7	10	78.4	7	75.9
7	21.4	6	20.9	13	21.2	5	19.2	19.1	10	19.1	6	19.8
7	46.9	6	48.1	13	47.4	5	48.0	50.1	10	49.1	7	47.9
7	92.5	6	93.7	13	93.0	5	90.7	93.2	10	91.9	6	90.9
7	88.6	6	70.7	13	80.3	5	91.0	89.2	10	90.1	6	91.4
7	92.1	6	87.4	13	89.9	4	109.5	114.1	8	111.8	6	108.8
7	43.0	6	43.6	13	43.3	5	45.1	43.3	10	44.2	6	43.9
7	42.2	6	45.4	13	43.7	5	35.6	39.3	10	37.4	6	36.6
7	25.8	7	26.2	14	26.0	5	23.1	23.2	10	23.2	6	23.5

(*Continued*)

All				Male · Paired						
No.	*Left*	*No.*	*R.+L.*	*No.*	*Right*	*Left*	*No.*	*R.+L.*	*No.*	*Right*
5	140.0	12	138.5	39	144.1±1.10	149.6±1.05	78	146.9± .76	53	146.0± .95
5	12.0	12	12.1	45	12.9± .15	12.9± .14	90	12.9± .10	58	12.8± .13
5	9.5	12	9.2	45	10.6± .11	10.5± .10	90	10.5± .08	58	10.6± .10
5	34.0	12	34.1	45	37.3± .31	37.3± .33	90	37.3± .23	58	37.4± .27
5	143.4	11	142.6	36	153.5±1.18	155.7±1.16	72	154.6± .83	49	154.0±1.01
5	65.2	11	66.3	36	66.2±1.23	64.2±1.14	72	65.2± .84	49	69.4±1.05
5	77.2	11	75.6	36	86.8±1.18	92.0±1.22	72	89.4± .84	49	84.6±1.01
5	133.5	11	131.1	36	141.7±1.11	143.7±1.10	72	142.7± .78	49	141.6± .95
5	59.1	11	57.8	36	58.2±1.02	58.8± .96	72	58.5± .70	49	58.9± .87
5	74.3	11	73.3	36	82.6± .98	85.9±1.11	72	84.2± .78	49	80.9± .93
5	30.1	11	30.0	36	33.6± .63	33.9± .54	72	33.8± .41	49	34.0± .54
5	33.1	11	32.0	36	29.4± .90	27.1± .96	72	28.3± .65	49	30.8± .77
5	37.4	11	36.9	36	40.7± .75	41.4± .46	72	41.1± .44	49	39.2± .64
5	38.2	11	37.4	36	44.5± .80	46.2± .60	72	45.4± .50	49	43.4± .68
5	27.7	11	28.0	37	29.7± .40	28.0± .32	74	28.8± .26	51	29.9± .34
5	26.4	11	26.2	49	29.4± .30	29.9± .28	98	29.7± .21	62	29.3± .27
5	17.2	11	17.6	36	21.9± .31	21.5± .34	72	21.7± .23	46	22.2± .28
5	19.6	11	19.3	36	19.7± .31	20.1± .33	72	19.9± .23	49	19.8± .26
5	9.6	11	9.7	36	10.5± .12	10.4± .13	72	10.4± .09	49	10.6± .11
5	52.1	11	50.4	36	70.1±2.01	70.7±2.02	72	70.4±1.43	49	67.0±1.72
5	9.2	11	9.4	42	9.5± .15	9.4± .12	84	9.5± .09	51	9.6± .13
5	21.0	11	21.3	42	23.2± .38	22,8± .33	84	23.0± .25	50	23.5± .34
5	12.2	11	12.7	42	12.5± .21	12.3± .23	84	12.4± .16	51	12.6± .20
5	32.7	11	32.2	40	34.4± .52	35.9± .59	80	35.2± .39	49	34.0± .47
5	137°.9	11	137°.2	36	139°.5± .92	141°.9± .99	72	140°.7± .67	49	139°.3± .78
5	152°.9	11	152°.5	36	151°.4± .64	152°.9± .65	72	152°.0± .41	49	151°.9± .55
5	6°.2	11	6°.7	36	5°.3± .18	4°.7± .19	72	5°.0± .13	49	5°.4± .15
5	24.6	12	24.6	39	26.0± .25	25.4± .25	78	25.7± .17	53	25.9± .22
5	80.7	12	77.9	44	82.8±1.30	82.1±1.10	88	82.5± .85	57	83.3±1.14
5	19.1	11	19.5	38	20.7± .30	20.5± .20	76	20.6± .18	51	20.5± .26
5	50.1	12	48.8	36	47.5± .30	48.5± .25	72	48.0± .20	48	47.1± .26
5	93.2	11	91.9	36	92.0± .21	92.6± .21	72	92.3± .15	49	92.0± .18
5	89.2	11	90.4	36	79.3±2.16	70.4±2.06	72	74.8±1.49	49	85.0±1.86
5	112.7	11	110.6	36	91.3±1.08	94.2±1.61	72	92.7± .97	46	91.1± .95
5	43.3	11	43.6	42	41.7± .72	41.9± .63	84	41.8± .48	50	41.2± .67
5	39.3	11	37.3	36	48.3±1.38	47.7±1.27	72	48.0± .93	49	46.0±1.18
5	23.2	11	23.4	39	23.4± .32	24.5± .32	78	23.9± .23	48	24.5± .26

(*Continued*)

Hsiu Chiu Shan						
All				*Paired*		
No.	*Left*	*No.*	*R.+L.*	*No.*	*Right*	*Left*
61	147.5± .85	114	146.8± .60	24	132.7±1.02	135.3±1.02
62	12.9± .12	120	12.9± .10	32	11.6± .16	11.4± .15
62	10.5± .09	120	10.5+ .07	32	9.2± .13	9.1± .12
62	37.5± .28	120	37.5+ .21	32	33.5+ .36	33.2± .35
58	155.9± .92	107	155.1± .62	18	141.4+1.28	142.6±1.39
58	63.3± .89	107	66.1± .72	18	63.1±1.37	62.0±1.22
58	92.7± .97	107	89.0± .75	18	77.5±1.32	81.4±1.24
58	144.2± .87	107	143.0± .60	18	129.7±1.23	131.9±1.19
58	59.5± .75	107	59.2± .60	18	54.2±1.13	55.3±1.14
58	86.3± .88	107	83.8± .67	18	74.3±1.18	77.7±1.08
58	33.7± .43	107	33.9± .31	18	31.8± .58	31.4+ .65
58	27.3± .75	107	28.9+ .57	18	25.7±1.18	27.8±1.00
58	42.3± .36	107	40.9+ .52	18	38.6± .98	37.6± .96
58	46.5± .48	107	45.1+ .48	18	39.4+ .92	39.6± .68
59	28.2± .25	110	29.0± .21	23	27.0± .41	25.5± .43
70	30.1± .23	132	29.7± .16	29	27.9± .35	27.4± .38
50	21.6± .29	96	21.9± .22	18	19.8± .46	19.9± .45
58	20.3± .27	107	20.1± .18	18	17.5± .25	17.9± .35
58	10.3± .11	107	10.4± .07	18	9.4± .19	9.2± .14
58	70.7±1.59	107	69.0±1.20	18	64.3±2.34	65.6±2.41
60	9.2± .10	111	9.4± .09	28	8.6± .16	8.5± .21
59	22.6± .28	109	23.0± .21	25	20.2± .31	20.0± .28
60	12.4± .19	111	12.5± .15	29	11.9± .24	11.7± .30
58	36.1± .49	107	35.2± .32	23	31.6± .49	32.9± .59
58	142°.0± .78	107	140°.8± .52	18	139°.6±1.46	142°.6±1.30
58	153°.1± .51	107	152°.5± .41	18	150°.9± .87	152°.3± .92
58	4°.9± .15	107	5°.1± .11	18	5°.6± .24	5°.2± .19
61	25.5± .20	114	25.7± .15	24	25.4± .34	24.6± .35
62	81.9± .93	119	82.6± .77	32	79.6±1.18	80.3±1.13
63	20.4± .16	114	20.5± .14	23	20.7± .33	20.3± .29
48	48.4± .21	96	47.7± .18	18	47.0± .37	48.0± .29
58	92.5± .16	107	92.2± .11	18	91.9± .34	92.4± .27
58	70.0±1 63	107	76.8±1.51	18	81.7±2.59	78.1±2.22
50	93.2±1.36	96	92.2± .88	18	87.8±2.31	91.7±2.80
59	41.5± .54	109	41.4± .44	24	43.3±1.02	43.8±1.14
58	47.8±1.00	107	47.0± .79	18	47.1±1.82	49.9±1.52
58	24.5± .26	106	23.9± .19	23	23.7+ .32	24.5± .38

(Continued)

Female							
		All					
No.	R.+L.	No.	Right	No.	Left	No.	R.+L.
48	133.9± .72	32	133.8± .89	33	135.6± .87	65	134.7± .58
64	11.5± .11	37	11.7± .16	37	11.5± .14	74	11.6± .10
64	9.1± .09	37	9.2± .12	37	9.1± .11	74	9.2± .09
64	33.4± .25	37	33.9± .34	37	33.2± .32	74	33.6± .24
36	142.0± .95	23	142.3±1.14	30	144.3±1.08	53	143.4± .77
36	62.5± .92	23	63.8±1.21	30	61.2± .95	53	62.3± .75
36	79.5± .91	23	78.6±1.17	30	83.0± .96	53	81.1± .77
36	130.3± .86	23	130.6±1.10	30	132.6± .92	53	131.7± .69
36	54.7± .80	23	54.1±1.00	30	55.1± .89	53	54.6± .65
36	76.0± .80	23	75.8±1.04	30	78.0± .84	53	77.1± .67
36	31.6± .44	23	31.6± .52	30	31.1± .50	53	31.3± .41
36	26.7± .77	23	25.1±1.04	30	27.2± .78	53	26.3± .66
36	38.1± .69	23	39.1± .87	30	37.9± .75	53	38.4± .55
36	39.5± .57	23	39.2± .82	30	40.1± .53	53	39.7± .48
46	26.2± .30	32	26.4± .35	33	26.4± .36	65	26.4± .27
58	27.6± .26	42	27.6± .29	40	27.3± .32	82	27.4± .34
36	19.9± .31	23	19.7± .41	29	20.4± .35	52	20.1± .27
36	17.7± .21	23	17.4± .23	29	17.9± .28	52	17.7± .18
36	9.3± .12	23	9.5± .17	30	9.2± .11	53	9.3± .09
36	65.0±1.68	23	57.2±2.09	30	68.9±1.87	53	63.8±1.44
56	8.6± .13	35	8.7± .15	36	8.7± .19	71	8.7± .12
50	20.1± .21	33	20.1± .26	32	19.9± .24	65	20.0± .18
58	11.8± .19	36	11.9± .21	36	11.9± .27	72	11.9± .18
46	32.3± .38	29	31.6± .44	32	32.8± .51	61	32.2± .33
36	141°.1± .98	23	134°.9±1.29	30	140°.1±1.03	52	140°.5± .82
36	151°.6± .63	23	150°.8± .77	30	152°.0± .70	53	151°.5± .56
36	5°.4± .15	23	5°.9± .23	30	5°.3± .15	53	5°.6± .14
48	25.0± .24	32	25.3± .30	33	24.7± .31	65	25.0± .21
64	79.9± .82	37	79.4±1.10	37	80.0±1.05	74	79.7± .76
46	20.5± .22	32	20.7± .27	32	20.3± .25	64	20.5± .18
36	47.5± .24	25	46.0± .31	37	46.8± .23	52	47.5± .22
36	92.1± .22	23	91.8± .31	30	91.9± .21	53	91.9± .18
36	79.9±1.71	23	82.4±2.29	30	74.8±1.72	53	78.1±1.43
36	89.7±1.81	23	89.8±2.04	29	90.4±2.18	52	90.2±1.48
48	43.5± .76	32	42.4± .88	32	43.3± .99	64	42.8± .41
36	48.5±1.19	23	43.0±1.62	30	50.6±1.18	53	47.3±1.02
46	24.1± .25	29	23.8± .29	29	24.4± .34	58	24.1± .23

Appendix II. Variabilities of the Clavicular Characters and Their Homologous Correlations for the Hsiu Chiu Shan Series

Character	*No.*	*Right (paired)*		*Left (paired)*	
		σ	v	σ	v
a. Absolute measurements:					
(1) Maximum length of the clavicle	39	10.2± .8	7.1± .8	9.8± .8	6.6± .7
(2) Transverse diameter of the shaft at the middle	45	1.5± .1	11.6±1.2	1.4± .1	11.0±1.1
(3) Sagittal diameter of the shaft at the middle	45	1.1± .1	10.4±1.1	1.0± .1	9.5±1.0
(4) Circumference of the shaft at the middle	45	3.1± .1	8.3± .8	3.3± .2	8.9± .9
(5) Total arc of the clavicle	36	10.5± .8	6.8± .8	10.4± .8	6.7± .8
(6) Outer arc	36	10.9± .9	16.5±1.9	10.1± .8	16.0±1.9
(7) Inner arc	36	10.5± .8	12.1±1.4	10.9± .9	11.8±1.4
(8) Total chord of the clavicle	36	9.9± .8	6.9± .8	9.8± .8	6.8± .8
(9) Outer chord	36	9.0± .7	15.5±1.8	8.5± .7	14.5±1.7
(10) Inner chord	36	9.7± .8	11.8±1.3	9.9± .8	11.6±1.3
(11) First segment	36	5.6± .5	16.8±1.9	4.8± .4	14.1±1.6
(12) Second segment	36	8.0± .6	27.1±3.3	8.5± .7	31.3±3.9
(13) Third segment	36	6.6± .5	16.2±1.9	4.1± .3	9.9±1.1
(14) Fourth segment	36	7.1± .6	15.9±1.8	5.4± .4	11.6±1.3
(15) Maximum perpendicular of the acromial end	37	3.6± .3	12.0±1.4	2.9± .2	10.4±1.2
(16) Maximum subtense of the diaphysis	49	3.1± .2	10.6±1.0	2.9± .2	9.6± .9
(17) Maximum breadth of the acromial end	36	2.8± .2	12.9±1.0	3.0± .2	14.0±1.1
(18) Maximum breadth of the sternal end	36	2.7± .2	13.7±1.6	3.0± .2	14.9±1.7
(19) Minimum breadth of the shaft	36	1.1± .1	10.4±1.2	1.2± .1	11.4±1.3
(20) Distance of the position of the minimum breadth	36	17.9±1.4	25.4±3.0	18.0±1.4	25.6±3.1
(24) Minimum depth of the acromial end	42	1.4± .1	14.7±1.6	1.1± .1	11.7±1.3
(25) Maximum depth of the sternal end	42	3.6± .3	15.5±1.7	3.2± .2	14.0±1.5
(26) Depth at the level of the conoid tubercle	42	2.1± .2	16.8±1.8	2.2± .2	18.0±1.9
(27) The distance of the position of the conoid tubercle	40	4.9± .4	14.3±1.6	5.5± .4	15.3±1.7
b. Measurements of shape:					
(21) Outer angle	36	8.1± .7	—	8.8± .7	—
(22) Inner angle	36	5.7± .5	—	5.8± .5	—
(23) Inclination of the entire clavicular chord	36	1.6± .1	—	1.7± .1	—
(28) Caliber index	39	2.4± .2	—	2.3± .2	—
(29) Shaft index at the middle	44	12.8± .9	—	10.9± .8	—
(30) Length-height index of the clavicle	38	2.8± .2	—	1.8± .1	—
(31) Claviculo-humeral index	36	2.7± .2	—	2.2± .4	—
(32) Total curvature index	36	1.9± .2	—	1.8± .2	—
(33) Index of the two arcs	36	19.3±1.5	—	18.4±1.5	—
(34) Sterno-acromial breadth index	36	9.6± 8	—	14.3±1.1	—
(35) Sterno-acromial depth index	42	7.0± .5	—	6.1± .5	—
(36) Minimum breadth position index	36	12.2±1.0	—	11.3± .9	—
(37) Position index of the conoid tubercle	39	3.0± .2	—	2.9± .2	—

(*Continued*)

Male									
R. L.	No.	*R.+L.* (*paired*)		No.	*R.+L.* (*all*)		No.	*Right* (*paired*)	
		σ	ν		σ	ν		σ	ν
.88±.02	78	10.0± .5	6.8± .5	114	9.4± .4	6.4± .3	24	7.5± .7	5.6± .8
.76±.04	90	1.5± .1	11.6± .8	120	1.6± .1	12.4± .5	32	1.4± .1	12.1±1.4
.56±.07	90	1.1± .1	10.5± .7	120	1.1± .1	10.5± .5	32	1.1± .1	12.0±1.4
.79±.04	90	3.2± .2	8.6± .6	120	3.3± .1	8.9± .4	32	3.1± .3	9.3±1.1
.79±.04	72	10.4± .6	6.8± .5	107	9.5± .4	6.2± .3	18	8.1± .9	5.7± .9
.80±.04	72	10.5± .6	16.2±1.3	107	11.1± .5	16.7± .8	18	8.6±1.0	13.6±2.2
.76±.05	72	10.7± .6	11.9±1.0	107	11.5± .5	12.9± .6	18	8.3± .9	10.6±1.7
.87±.03	72	9.8± .6	6.9± .6	107	9.2± .4	6.4± .3	18	7.8± .9	6.0±1.0
.65±.06	72	8.8± .5	15.0±1.2	107	9.2± .4	15.5± .7	18	7.1± .8	13.1±2.1
.68±.06	72	9.8± .6	11.7± .9	107	10.3± .5	12.3± .6	18	7.4± .8	10.0±1.6
.47±.09	72	5.2± .3	15.5±1.3	107	4.7± .2	14.0± .7	18	3.7± .4	11.5±1.9
.62±.07	72	8.2± .5	29.0±2.5	107	8.7± .4	30.0±1.5	18	7.4± .8	28.8±5.0
.54±.08	72	5.5± .3	13.4±1.1	107	7.9± .4	19.3± .9	18	6.2± .7	16.0±2.6
.52±.08	72	6.3± .4	13.9±1.1	107	7.3± .3	16.3± .8	18	5.8± .7	14.6±2.4
.80±.04	74	3.3± .2	11.5± .9	110	3.3± .2	11.4± .6	23	2.9± .3	10.7±1.6
.79±.08	98	3.0± .2	10.1± .7	132	2.8± .1	9.4± .4	29	2.8± .3	10.1±1.3
.64±.07	72	2.9± .2	13.5± .8	96	3.2± .2	14.5± .7	18	2.9± .3	14.5±1.7
.76±.05	72	2.8± .2	14.1±1.2	107	2.8± .1	13.9± .7	18	1.6± .2	9.1±1.0
.65±.06	72	1.1± .1	10.6± .9	107	1.1± .1	10.5± .5	18	1.2± .1	12.8±2.1
.54±.08	72	18.8±1.0	25.5±2.2	107	18.4± .9	26.7±1.3	18	14.8±1.7	23.0±2.7
.51±.08	84	1.3± .1	13.6±1.0	111	1.4± .1	14.9± .7	28	1.3± .1	15.0±2.0
.76±.04	84	3.4± .2	14.7±1.1	109	3.2± .2	14.0± .7	25	2.3± .2	11.4±1.6
.49±.08	84	2.1± .1	16.9±1.3	111	2.4± .1	19.2± .9	29	1.9± .2	16.0±2.1
.58±.07	80	5.2± .3	14.8±1.1	107	5.0± .2	14.1± .7	23	3.5± .3	11.1±1.6
.60±.07	72	8.5± .5	—	107	8.0± .4	—	18	9.2±1.0	—
.55±.08	72	5.2± .3	—	107	6.3± .3	—	18	5.5± .6	—
.74±.05	72	1.7± .1	—	107	1.7± .1	—	18	1.6± .2	—
.79±.04	78	2.3± .1	—	114	2.4± .1	—	24	2.5± .2	—
.51±.08	88	11.9± .6	—	119	12.5± .5	—	32	9.9± .8	—
.58±.07	76	2.4± .1	—	114	2.3± .1	—	23	2.3± .2	—
.90±.03	72	2.5± .1	—	96	2.6± .1	—	18	2.3± .3	—
.39±.10	72	1.8± .1	—	107	1.7± .1	—	18	2.2± .2	—
.74±.05	72	18.8±1.1	—	107	23.2±1.1	—	18	16.3±1.8	—
.36±.11	72	12.2± .7	—	96	12.8± .6	—	18	14.5±1.6	—
.69±.05	84	6.5± .3	—	109	6.8± .3	—	24	7.4± .7	—
.46±.09	72	11.8± .7	—	107	12.2± .6	—	18	11.5±1.3	—
.61±.07	78	3.0± .2	—	106	3.0± .1	—	23	2.3± .2	—

(Continued)

Female								
Left (paired)		*ʳR. L.*	*No.*	*R.+L. (paired)*		*No.*	*R.+L. (all)*	
σ	ν			σ	ν		σ	ν
7.4± .7	5.5± .8	.66±.08	48	7.4± .5	5.5± .5	65	6.9± .4	5.1± .3
1.3± .1	11.3±1.4	.75±.05	64	1.3± .1	11.3±1.0	74	1.3± .1	11.2± .6
1.0± .1	11.0±1.4	.73±.06	64	1.0± .1	11.0±1.0	74	1.2± .1	13.0± .7
2.9± .3	8.7±1.1	.82±.04	64	3.0± .2	9.0± .8	74	3.0± .2	9.0± .5
8.8±1.0	6.2±1.0	.96±.10	36	8.4± .7	5.9± .7	53	8.3± .6	5.8± .4
7.7± .9	12.4±2.0	.63±.10	36	8.2± .7	13.1±1.5	53	8.1± .5	13.1± .9
7.8± .9	9.7±1.6	.53±.11	36	8.1± .6	10.1±1.2	53	8.3± .6	10.3± .7
7.5± .8	5.7+ .9	.82±.05	36	7.6± .6	5.8± .7	53	7.5± .5	5.7± .4
7.2± .8	13.0+2.1	.64±.09	36	7.1± .6	13.0±1.5	53	7.0± .5	12.9± .9
6.8± .8	8.9+1.4	.55±.11	36	7.1± .6	9.4±1.1	53	7.2± .5	9.3± .6
4.1± .5	13.1±2.1	.57±.11	36	3.9± .3	12.3±1.4	53	4.5+ .3	14.3±1.0
6.3± .7	22.7±3.8	.74±.07	36	6.9± .5	25.8±3.1	53	7.1± .5	27.0±1.8
6.1± .7	16.1±2.6	.44±.13	36	6.1± .5	16.1±1.9	53	5.9+ .4	16.3±1.0
4.3± .5	10.8±1.7	.21±.15	36	5.1± .4	12.9±1.5	53	5.2± .3	13.2± .9
3.1± .3	12.2±1.7	.35±.12	46	3.0± .2	11.4±1.2	65	3.2+ .2	12.0± .7
3.0± .3	10.9±1.4	.81±.04	58	2.9± .2	10.6± .9	82	4.5± .2	16.5± .9
2.8± .3	14.1±1.6	.77±.07	36	2.8± .2	14.2±1.2	52	2.9+ .2	14.3±1.0
2.2± .3	12.3±1.4	.83±.05	36	1.9± .2	10.7± .9	52	1.9+ .1	10.7± .7
0.9± .1	9.8±1.6	.75±.07	36	1.1± .1	11.8±1.3	53	1.0+ .1	10.8± .7
15.2±1.7	23.1±2.6	.57±.11	36	15.0±1.2	23.0±2.7	53	15.6±1.0	24.4±1.7
1.6± .2	18.8±2.5	.79±.05	56	1.5± .1	17.4±1.6	71	1.5± .1	17.2±1.0
2.1± .2	10.6±1.4	.85±.04	50	2.2± .2	11.0±1.1	65	2.2± .1	11.0± .7
2.4± .2	20.5+2.6	.91±.02	58	2.2± .1	18.6±1.7	72	2.3± .1	19.3±1.1
4.2± .4	12.6±1.8	.77±.06	46	3.8± .3	11.9±1.2	61	3.8± .2	11.8± .7
8.2± .9	—	.65±.09	36	8.7± .7	—	52	8.8± .6	—
5.7± .7	—	.85±.04	36	5.6± .5	—	53	6.0± .4	—
1.2± .1	—	.81±.05	36	1.4± .1	—	53	1.5± .1	—
2.6± .3	—	.76±.06	48	2.5± .2	—	65	2.5± .2	—
9.5± .8	—	.56+.08	64	9.7± .6	—	74	9.7± .5	—
2.1± .2	—	.80±.05	46	2.2± .2	—	64	2.2± .1	—
1.8± .2	—	.89±.03	36	2.1± .2	—	52	2.3± .2	—
1.7± .2	—	.79±.06	36	2.0± .2	—	53	1.9± .1	—
14.0±1.6	—	.50±.12	36	15.2±1.2	—	53	15.5±1.0	—
17.6±2.0	—	.69±.10	36	16.1±1.3	—	52	15.8+1.1	—
8.3± .8	—	.54±.10	48	7.8± .5	—	64	4.9± .3	—
9.6±1.1	—	.60±.10	36	10.6± .8	—	53	11.0± .7	—
2.7± .3	—	.73±.07	46	2.5+ .2	—	58	2.6+ .2	—