THE HITZFELDER BONE COLLECTION

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1978. L. Scruggs, J. Gunn, and N. Hitzfelder. The Hitzfelder Bone Collection. *La Tierra* 5(2), pp.20-31.

The purpose of this study is to assess and re-examine the Hitzfelder Cave skeletal collection. In addition, a brief summary of the previous excavations of the cave is included. It is hoped that the osteological study presented will be of assistance in comparative studies with other osteological information from burials within the area.

History of the Hitzfelder Cave Excavation

The Hitzfelder ranch is located 30 miles north of San Antonio and five miles east of Highway 281 North, on Farm Road 1863 in Bexar County. The cave is situated on a rounded limestone hill rising approximately 175 feet above and 100 yards to the west of Cibolo Creek. The limestone shaft drops 79 feet into the southern edge of the Edwards Formation (see Figure 1).

In 1962 Mr. Norman Hitzfelder, in hopes of discovering a water source, began removing rock and soil that blocked the shaft of the cave until he had penetrated to about 30 feet. At this point, according to R. D. Givens, Mr. Hitzfelder encountered a soapstone boulder blocking access to the remainder of the shaft. The boulder was then removed revealing human skeletal material (Givens 1968). Mr. Hitzfelder says there was an alternating sequence of dirt and rock for 10 levels until terminated by the boulder. Each level of dirt was approximately 2 feet thick and capped by a 6 to 8 inch layer of rock.

In 1967, a group of student volunteers from Trinity University led by R. Dale Givens began excavation procedures to remove the skeletal material. The remains were disarticulated and scattered throughout the lower part of the shaft and possibly represented as many as 30 individuals (Givens 1968). R. A. Benfer then visited the site and assigned it the number 41 BX 26. Benfer collected a carbon sample from the cave fill and obtained a radiocarbon date (TX334) which associates the fill and the skeletons at about AD 950 t 190 years (Collins 1970).

The human skeletons were associated with faunal remains and artifacts. Most of the faunal material collected is from small animals and deer. Artifacts included bone awls, bone beads, shell, a stone pendant, and three points from middle to late Archaic periods (Givens 1968; Collins 1970). The last entrance into the Cave in December, 1976 by Logan McNatt and a team of speleologists aided by Max Witkind revealed only a few human skeletal fragments in poor condition.

There still exist questions as to whether this shaft burial represents a particular type of burial indigenous to this region. Controversy has also been evident as to whether some characteristics of the skull fragments can be interpreted as a unique Pre-Sapiens population (Collins 1970).

Osteometric Study

Osteological analysis of the Hitzfelder skeletal collection was initiated by Dr. Joel Gunn of the University of Texas in San

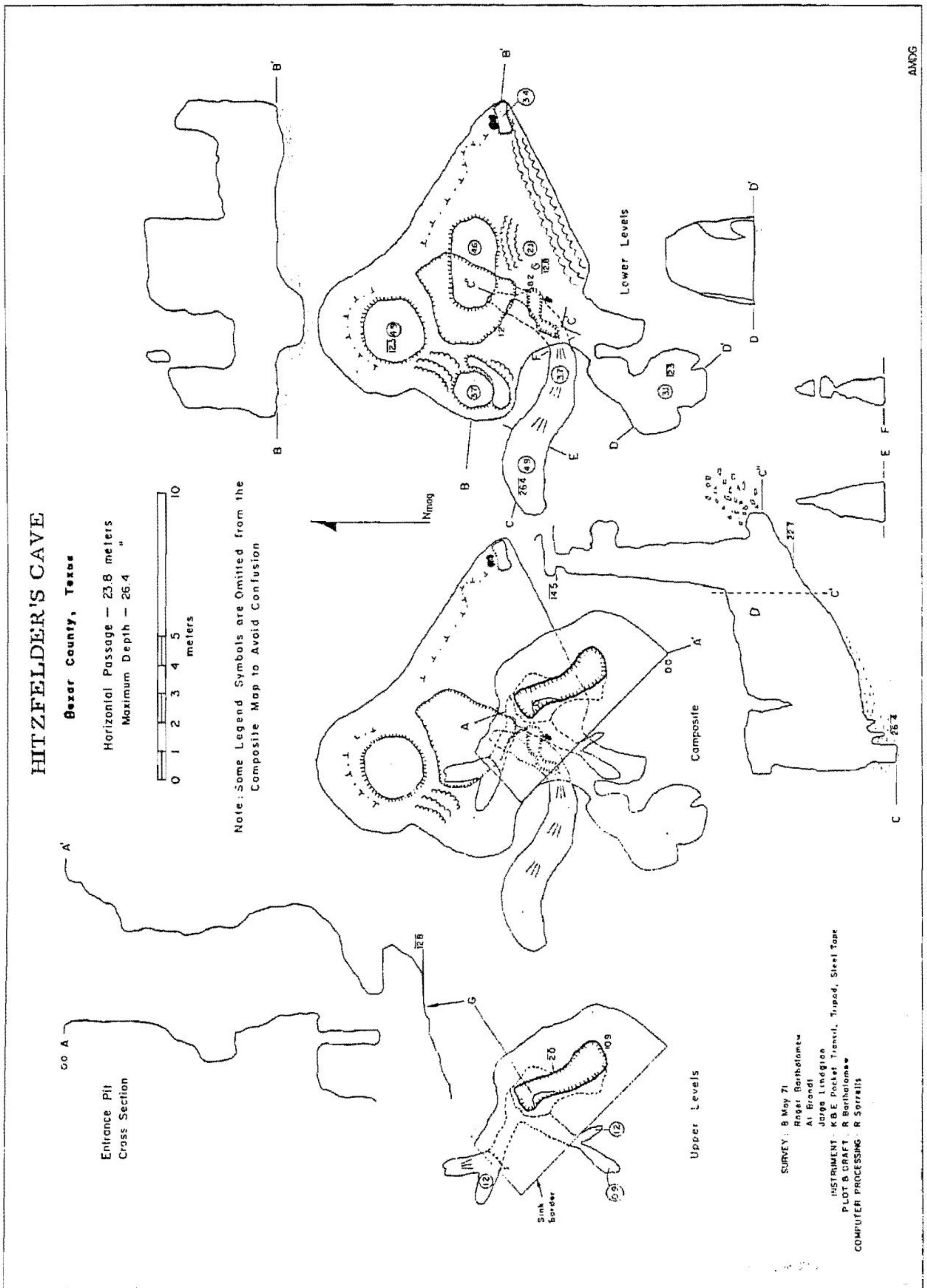

Figure 1. Composite Map of Hitzfelder's Cave. (Adapted from Bartholomew, 1973; courtesy of the Texas Speleological Society.)

Antonio, aided by Raymond Fisher, Mary Smith and Edwin Scruggs.

Attempts to analyze the osteological material from Hitzfelder Cave were constrained by three factors:

1. Skeletal material was disarticulated
2. Excavation lacked adequate control
3. Moisture in the cave often caused the bone to be friable during removal

Under this analysis, the bones: femur, humerus, radius, and ulna were examined to gain possible insights of particular characteristics of this population.

Lower Extremity (Femur)
This section will attempt to give clues to the populations, gender and age through analysis of the femurs. The measurements taken on the femur are shown in Figure 2.

Bass (1971:166) indicates that the epiphysis at the proximal end of
the femur unites with the diaphysis between the age of fourteen and nineteen, and ossification is usually complete by the 22nd year. Ossification is therefore progressive with age.

Two femoral head specimens from the collection were separated from the femur shaft. The epiphyses appeared to be disunited rather than broken, indicating that the epiphyses did not have sufficient time to unite. One femur was identifiable as a left, while the orientation of the other femoral head was questionable. Therefore, we suspect that at least one and perhaps two of the individuals were juveniles. Diameters of these femoral heads could, for the most part, be considered as average. One was 40.0 mm, and the other 42.9 mm. These dimensions indicate that the individuals were approaching maturity. It should also be mentioned that one infant femur shaft was observed.

The sex of femurs is determined by measuring the vertical diameter of the femoral head (Bass 1971:173). Generally femoral heads measuring less than 41. 5 mm are female, while males are usually greater than 45. 5 mm. Femoral heads measuring between 41.5 mm and 44. 5 mm are questionable female, and the questionable male range is from 44. 5 mm to 45. 5 mm.

Measurements of the six fully adult left femoral heads with united epiphyses (see Table 1) indicate that two are probably male (48. 8 mm and 47.1 mm), two are female (38.0 mm and 41.3 mm), and two are questionable.

Therefore, these data suggest that the adult population was equally divided between the sexes.

We noted that the obliteration of the epiphysis union or seal (see Figure 2) varied considerably among the specimens, suggesting that a large segment of the population was less than 22 years of age (Bass 1971); 166). While it would be impractical to measure the rate of ossification of the epipheses, there seems to be a correlation between the depth of the

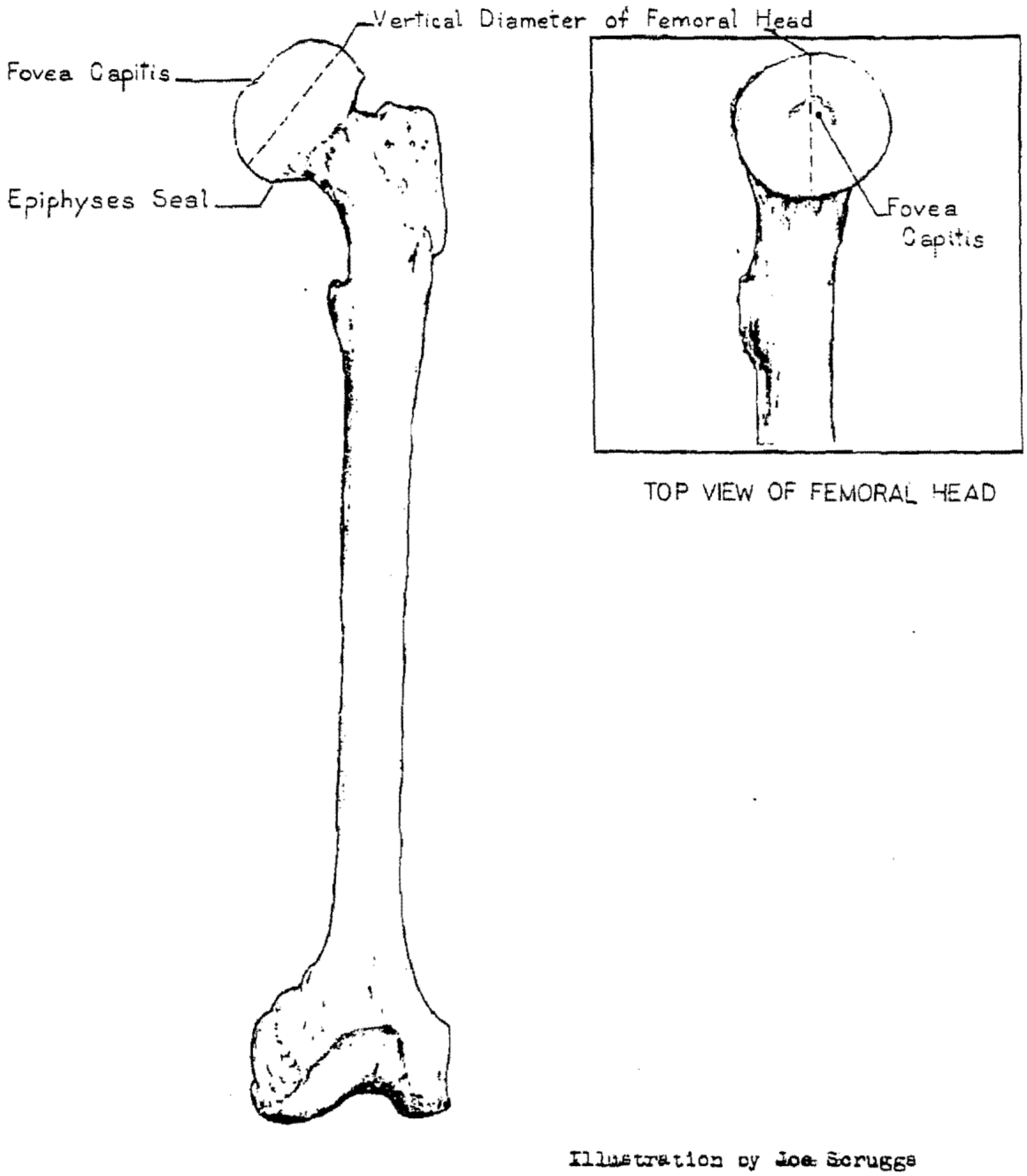

Figure 2. Femur (Left Anterior).

fovea capitis (a small depression on top of the femoral head) and the degree of obliteration of the epiphysis union or seal. Assuming such a correlation, we measured the depth of the fovea capitis in hopes of gaining further information on the relative age of the population (see Table 1).

The depth of the fovea capitis of the two juveniles measured at 4.6 mm while the depth on the other bones ranged from one to 0.0 mm, the point of obliteration. Since the epiphyses seals were obliterated on the specimens with the shallowest fovea capitis, we assume that these measurements of the fovea capitis reflect the age distribution of the population (see Figure 3).

Upper Extremities (Humerus, Ulna, and Radius)
In this section we again attempt to determine the sexual characteristics of the population. In addition, we attempt to determine the amount of functional variation that exists in the population. Typical measurements taken on these three upper limb bones are shown in Figure 4.

Several statistical tests were run on these measurements of the humerus, ulna, and radius from the Hitzfelder collection to determine if the specimens were all from the same statistical population.

In general, measurements on the more basic parts of the bones such as shaft diameters, main parts of articulations, etc. , seemed to show that the bones were from the same statistical sample. More extreme parts of the bones such as the diameters of the capitulum and trochlea (surfaces that artiCulate to the radius and ulna respectively) appeared to be from different populations. We surmise from this that we are dealing with a single morphological population which is somewhat variable in functional characteristics.

Bass states that sex determination can be accomplished by analysis of certain diagnostic areas of the long bones. He also says that sex differences in typical long bones is a matter of size (Bass 1971:117). Hrdlicka, according to Brothwell, shares this same viewpoint and also contends that the sexual differences lie in the regions of articulation (Brothwell 1965:65). Brothwell also states that bones in general become thicker and stronger as greater demands are made on them due to the bone tissue adapting to the needs of the individual (Brothwell 1965:21).

Bass believes that more massive bones in males is an expression of dimorphism. He also states that the septal aperture in the olecranon fossa at the distal end of the humerus can be useful as a sex indicator (Bass 1971).

Hrdlicka (Cited in Bass) says that this septal aperture or supratrochlear foramen occurs more frequently in females than males (Bass 1971:117). The bones of the forearm (radius and ulna) are more difficult to use in determining sex than the humerus because there are virtually no diagnostic features on which to differentiate.

If we assume that the further a long bone is from the trunk of the body the more functional its morphology, then the humerus should be more dimorphic and less functional than are the radius and ulna in their morphology. In fact, Hrdlicka and Bass felt that the overall size and articulating surfaces of the upper limb bones reflect variation due to function. Our model simply localizes function in the forearm and sexual dimorphism in the upper arm.

Due to the fragmentary nature of the bones, the only criteria available for sexing the humeri of the Hitzfelder collection was the presence of a

RIGHT FEMUR		LEFT FEMUR		QUESTIONABLE	
VERTICAL DIAMETER OF HEAD	DEPTH OF FOVEA CAPITIS	VERTICAL DIAMETER OF HEAD	DEPTH OF FOVEA CAPITIS	VERTICAL DIAMETER OF HEAD	DEPTH OF FOVEA CAPITIS
44.4 mm	3.2 mm	48.8 mm	2.1 mm	43.2 mm	0.9 mm
46.3 mm	0.0 mm	47.1 mm	2.6 mm	42.9 mm	4.6 mm
43.2 mm	2.2 mm	41.3 mm	0.0 mm	38.0 mm	1.4 mm
40.0 mm	4.0 mm	40.0 mm	4.6 mm	—	1.7 mm
46.25mm	3.3 mm	44.2 mm	0.0 mm	—	—
—	—	43.0 mm	0.0 mm	—	—
—	—	38.0 mm	0.0 mm	—	—

Table 1. Measurements of Six Adult Femoral Heads With Sealed Epiphyses.

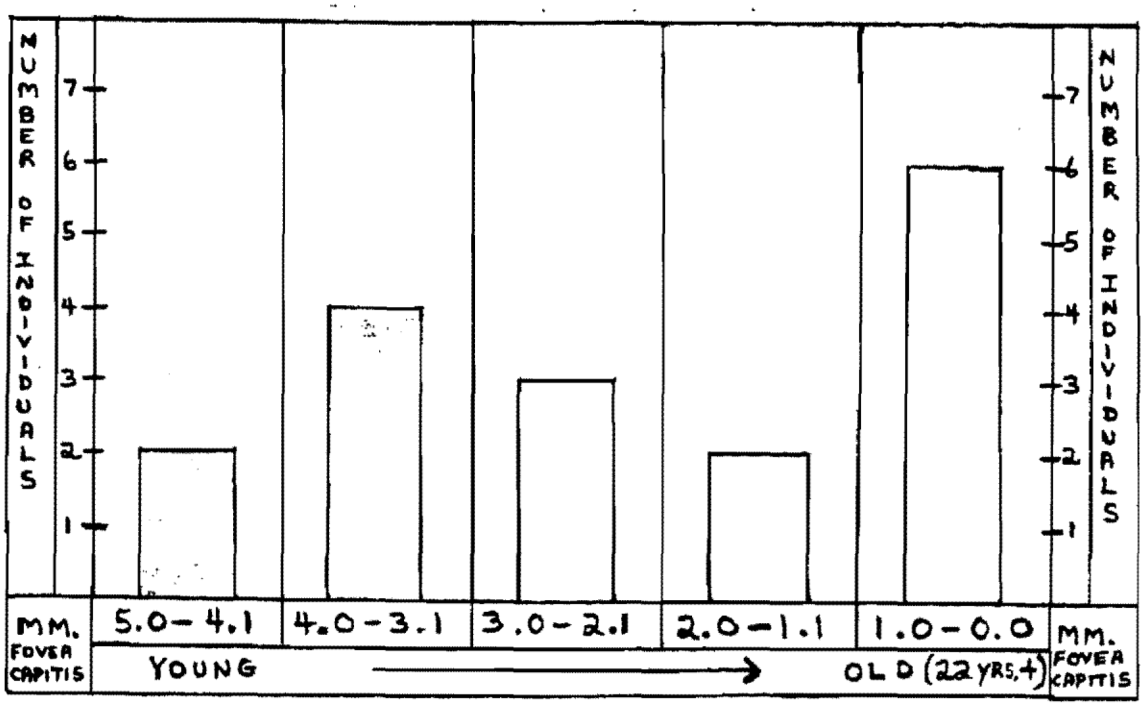

Figure 3. Age Distribution as Indicated by Depth of Fovea Capitis.

septal aperture in the oledranon fossa. ProCeeding from this determination, we can infer graphically by extrapolation the sex of the ulna and radius from the robusticity of articulating surfaces of the humerus, the troChlea (articulates to ulna) and the Capitulum (articulates to radius).

Figure 5 shows the extrapolated determination of sex for the right radius on the basis of size through the articulation with the capitulum of the right humerus.

The full range of measurements taken on the right radius heads and right humerus capitulum are plotted on a vertical and horizontal line respectively. The points at which these measurements were placed was derived in this manner: each square on the grid represents 5 units on a side, therefore the vertical and horizontal lines represent 100 units each. The difference between the two extremes of measurements for each line was divided by 100 to determine the value of each unit resulting in .0255 and .073 for the vertical and horizontal lines respectively. Proceeding from this, the point at which each measurement was plotted was determined by taking the differences between the lowest measurement on its respective line and the measurement itself, then dividing that result by the value of a unit previously determined.

After each point is plotted, a correlation between the two articulating bones was projected by extending lines from the points to a mean represented by a line bisecting the grid at an angle of 45°. ((Editor's note: This assumes a perfect correlation.))

Since the division of sex can be determined for the humerus by using robusticity and the septal aperture as indicators, this point of division can be extended as a broken line to the mean or correlation line and then to the vertical line resulting in an extrapolated division of sex for the radius bone.

Three additional graphs identical to this one were constructed to determine in the same manner the division of sex for the remaining bones of the forearm, left radii and ulnas, and right ulnas. On the basis of this analysis, each bone of the upper extremities was labeled as to sex.

If we assume the division of labor among the Hitzfelder population to have been that of typical hunters and gatherers, then we might expect females to be relatively unspecialized and males to be relatively specialized. The consequence of this should be more variation in male functional morphology than in female.

Table 2 shows the coefficient of variation (standard deviation divided by the mean) for all of the measurements not on the articulations between the humerus and the radius and ulna. In all cases except one, the amount of variation in the presumed male population is less than in the female (see direction of arrows in the table). While the sample sizes are small and our method of sexing the radius and ulna tenuous, the results seem to clearly show that our hypothesis of greater male variability is incorrect.

Conclusions

This study of the Hitzfelder bone collection is intended to contribute to osteological knowledge of prehistoric Texas. Archaeological investigations such as this may provide information necessary to infer characteristics of the cultures once indigenous to the area. Although the Hitzfelder

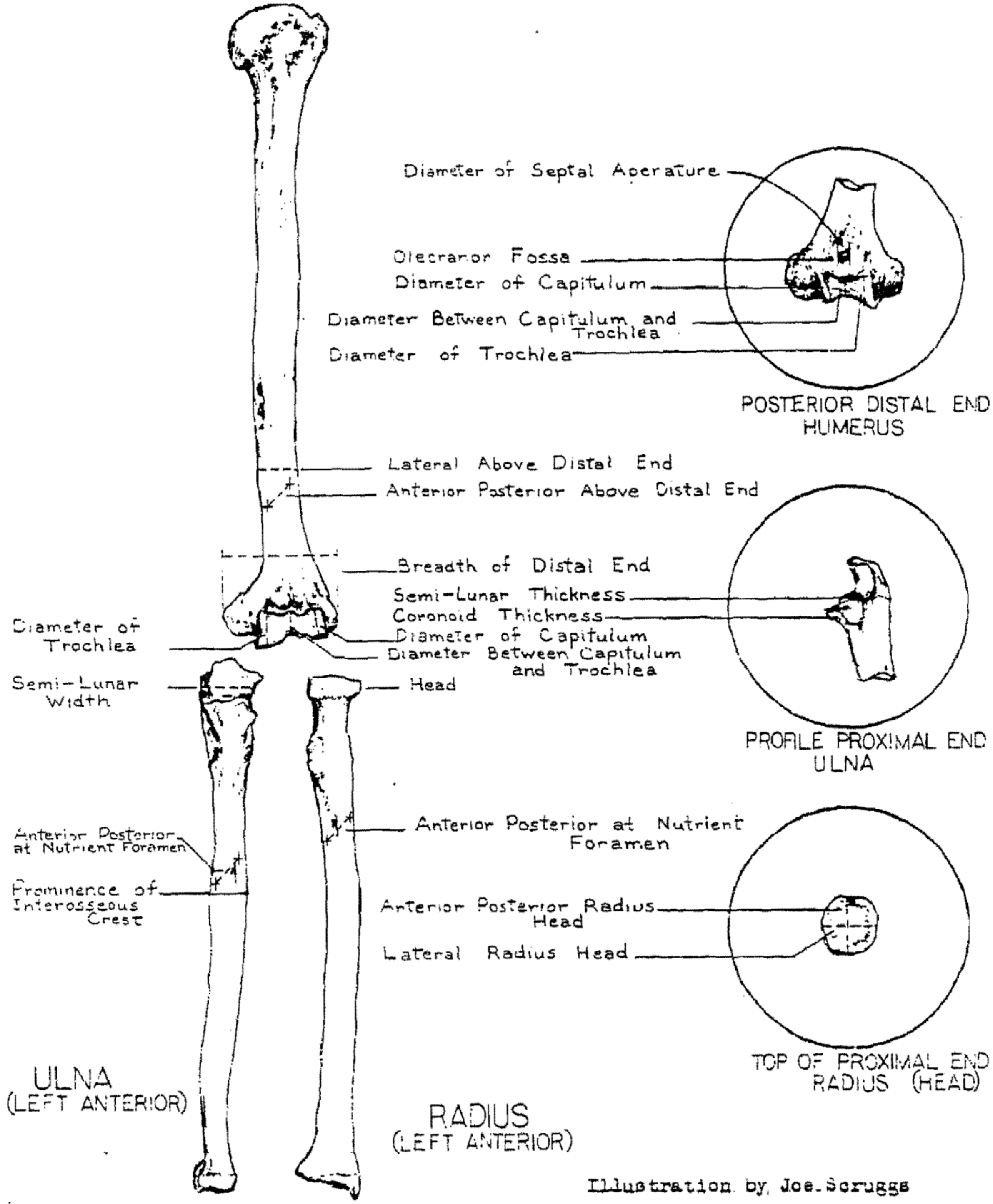

Figure 4. Humerus. (Left Anterior).

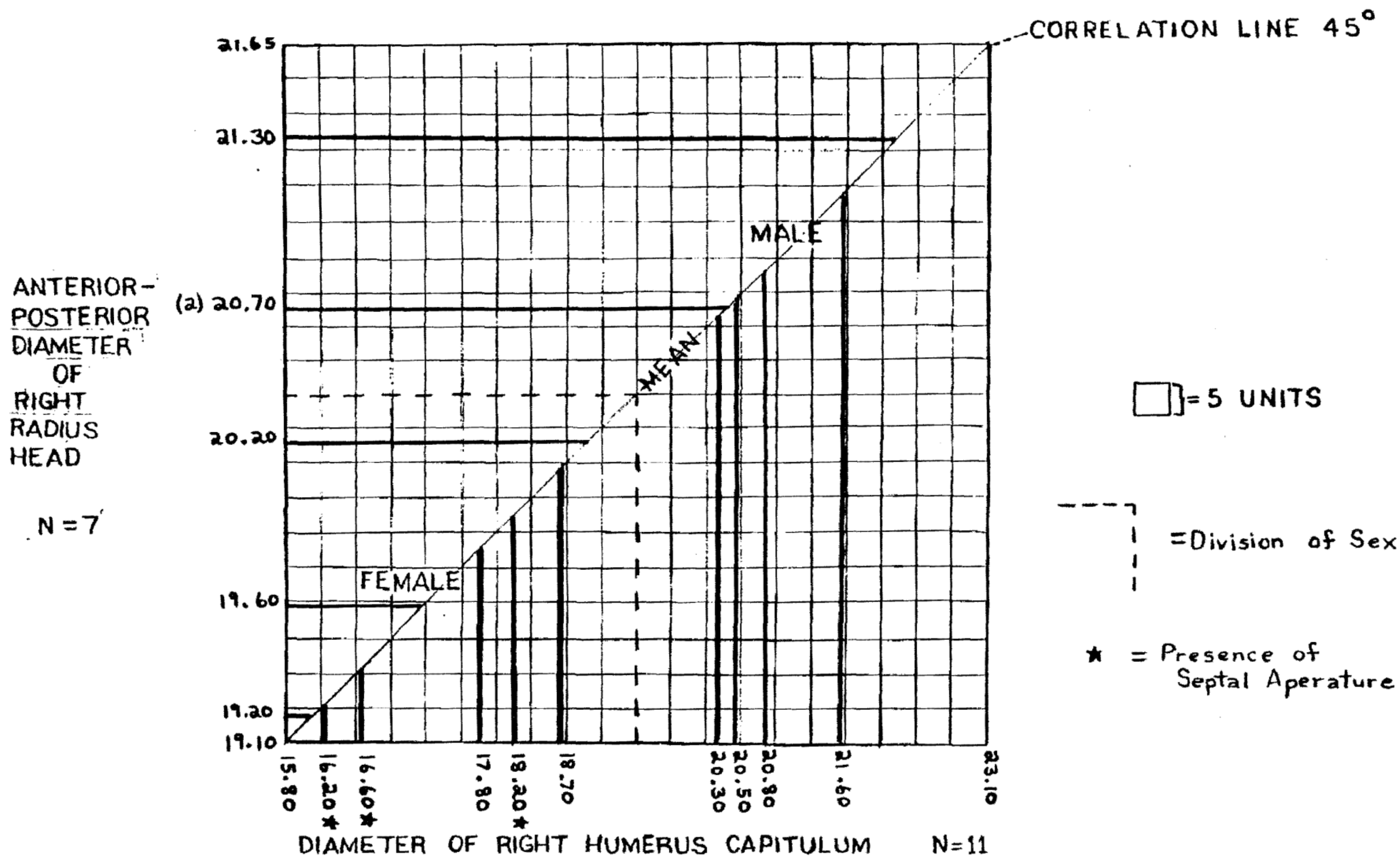

Figure 5. Graphic Extrapolation of Sex of Individual. (Assumes r = 1).

ULNA (ANTERIOR–POSTERIOR AT NUTRIENT FORAMEN)					
RIGHT			LEFT		
N= 7	MALE	.011861	N= 6	MALE	.012248
N= 1	FEMALE	ϕ	N= 10	FEMALE	.017107
RADIUS (ANTERIOR–POSTERIOR AT NUTRIENT FORAMEN)					
RIGHT			LEFT		
N= 3	MALE	.000840	N= 2	MALE	.012295
N= 2	FEMALE	.011810	N= 2	FEMALE	.004045
HUMERUS (ANTERIOR–POSTERIOR ABOVE DISTAL END)					
RIGHT			LEFT		
N= 7	MALE	.008919	N= 3	MALE	.003725
N= 6	FEMALE	.012384	N= 12	FEMALE	.011445
HUMERUS (LATERAL ABOVE DISTAL END)					
RIGHT			LEFT		
N= 7	MALE	.008475	N= 3	MALE	.005027
N= 6	FEMALE	.011187	N= 12	FEMALE	.013855

Table 2. Coefficient of Variation of Male and Female Upper Extremities.

burial site may not be a rare type of site, the peculiarities of shaft burials still raise many unanswered questions about prehistoric burial practices.

Accuracy in osteometric analysis is due in part to the condition of the skeletal remains involved. Since no articulated skeletons were available for study, we attempted to devise a method to make use of disarticulated collections of bones. Perhaps in a more developed form this methodology will allow us to make sound inferences from the many similar bone collections in the Texas area.

It is our hope that the model engineered for this analysis will allow a further understanding of past cultures and the effect those lifeways had on osteological remains found by archaeologists.

Acknowledgments
We thank the following for their aid in this study: Ray Fisher, Mary Smith, Joe Scruggs, and the Texas Speleological Association: Glenn Darilek (Editor), Roger Bartholomew (author of cave map), and Logan McNatt.

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