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THE ASTRAGALUS AND CALCANEUS OF THE ROMAN PEOPLE OF GORDION IN ANATOLIA

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Gordion is in a valley through which runs the Ankara-İstanbul railway. It is near the Porsuk river and approximately 113 km. south-west of Ankara. This old settlement known to-day as 'Yassıhüyük' was the capital of Phrygia.[1]

Excavations have been carried out in Gordion under the auspices of Pennsylvania University.[2] During these excavations well-preserved human skeletons came to light from the tombs belonging to Hittite, Phrygian and Roman periods, and these were sent off to be examined by Ord. Professor Dr. M. Şenyürek, Chairman of the Division of Palaeoanthropology of the University of Ankara. Here I would like to thank him for allowing me to examine this valuable material. Of this only the Roman skeletons were given to me for investigation and these numbered about 100 individuals.[3] For the purposes of this paper, the astragalus and calcaneus bones alone were examined and the present article is a preliminary report; a fuller version with statistical data will shortly be published.

[1] Young, 1951. pp. 3, 4.

[2] Young, 1951. pp. 3-19; 1953, pp. 3-39.

[3] In this material, the age of the young children was determined by an examination of their teeth by Professor Şenyürek.

The palaeoanthropological, anatomical, embryological and biometrical researches which have been undertaken on the foot and various discussions in this field have without doubt thrown fresh light on the subject. [4] Palaeontological and ontogenetical investigations establish the changes and modifications in the physical structure of the body and also provide evidence to clarify phylogenetical problems. [5] As the palaeontological and geological evidence is not yet complete, it is difficult to follow the entire changes of the human foot through the evolutionary period, for up to the present day fossil remains and ontogenetical researches have only partially enabled us to explain its origin and evolution.

Researches on the various parts of the foot have been carried out by many investigators who have undertaken comparative studies of the problems connected with it. Of these Humphry (1861) [6], Thomson (1889-1890)[7], and Charles (1893-94)[8] were among the first. Pfitzner (1896) [9] examined the astragalus and calcaneus of Alsatians; Volkov (1903, 1904) [10] the osteological variations of the foot bones; Dwight (1907) [11] the foot bones (astragalus and calcaneus) of American Whites and mulattos; Sewell (1904, 1905, 1906) [12] the astragalus of Ancient Egyptians; Laidlaw (1904, 1905) [13] the anatomical and morphological variations of the calcaneus. In addition Adachi and Adachi (1905)[14] undertook researches into the astragalus

[4] Boule, 1912, pp. 171-179; Reicher, 1913. pp. 1-32; Miller, 1920. pp. 218, 220; Schultz, 1923. pp. 395, 396; Schultz, 1925. pp. 247, 248; Grünwald, 1925. pp. 259-279; Straus, 1926. pp. 108, 111; Gregory, 1930. pp. 133-161; Schultz, 1956. pp. 916, 917; Şenyürek, 1950. pp. 301, 302; 1958, p. 514.

[5] Boule, 1912. pp. 171-179; Fraipont, C. 1912. p. 195; Martin, H. 1910. pp. 391-397; Morton, 1926. pp. 310-314; Schultz, 1923. p. 395; 1925, pp. 248, 261; 1926, pp. 476, 499; Straus, 1926. pp. 95, 96, 99, 108, 11; McCown and Keith, 1939. pp. 22-25.

[6] Humphry, 1861. pp. 1-107; Thomson, 1889. pp. 601-639; 1890, pp. 210-217.

[7] Thomson, 1889. pp. 601-639; 1890, pp. 210-217.

[8] Charles, 1893. pp. 1-18; 1894, pp. 272, 273, 276.

[9] Pfitzner, 1896. pp. 409-421; pp. 421-429.

[10] Volkov, 1903. pp. 632-708; 1904, pp. 1-50 and 201-231.

[11] Dwight, 1907. pp. 14-25.

[12] Sewell, 1904. pp. 233-247; 1905, pp. 74-88; 1906, pp. 152-161.

[13] Laidlaw, 1904. pp. 133-143; 1905, pp. 161-177.

[14] Adachi and Adachi, 1905. pp. 310-320.

and calcaneus of Japanese; Aitken (1905) [15] into the characteristics of the European and Oriental astragalus; Hrdlicka (1909) [16] on the astragalus and calcaneus of the natives of Arkansas and Louisiana. Martin. H. (1910) [17] investigated the astragalus of La Quina fossil man; Boule (1912) [18], the astragalus and calcaneus belonging to La Chapelle-aux-Saints fossil man; Fraipont (1812) [19], the astragalus and calcaneus of Spy fossil man and McCown and Keith (1939) [20], the foot bones of Mount Carmel fossil man. Besides these, we can mention publications on the calcaneus and astragalus of Chancelade fossil man by Testut (1889), Vallois, (1946, P. 185), by Pittard and Sauter (1945) [21] on Magdalenian fossil man, and by Verneau (1906) (p. 156) on the astragalus and calcaneus of the Negroids of Grimaldi.

There are works on the ontogenetical and philogenetical problems of the evolution of the foot by Gregory (1916, 1917, 1930) [22], Wood Jones (1929) [23], Miller (1920) [24], Morton (1922, 1924a, b, c, 1926a, b) [25], Schultz (1923, 1924, 1925, 1926, 1956) [26], Weidenreich (1923) [27], Forster (1924) [28], Straus (1926) [29], Wells (1931) [30] and by Barnett (1954) [31] on the various facets that occur upon the neck of the human talus.

Black (1925) [32] measured astragalei and calcanei found in the deposits in the Sha Kuo T'un cave and compared the results with

[15] Aitken, 1905. pp. 489-491.
[16] Hrdlicka, 1909. pp. 171-249.
[17] Martin, H. 1910, pp. 391-397.
[18] Boule, 1912. pp. 171-179.
[19] Fraipont, 1912. p. 195.
[20] McCown and Keith, 1939. pp. 19-39.
[21] Pittard and Sauter, 1945. pp. 184-187.
[22] Gregory, 1916. pp. 329-331; 1927, pp. 603-604; 1930, pp. 140, 148-159.
[23] Wood Jones, 1929. pp. 73-82.
[24] Miller, 1920. pp. 213-245.
[25] Morton, 1922. pp. 305-336; 1924a, b, c, pp. 1-52, 56-90, 368-406 respectively.
[26] Schultz 1923. pp. 389-399; 1924, pp. 149-164; 1925, p. 247; 1926, p. 465; 1956, pp. 887-964.
[27] Weidenreich, 1923. pp. 1-10.
[28] Forster, 1924. pp. 195-245.
[29] Straus, 1926. pp. 427-438; 1927, pp. 93-134.
[30] Wells, 1931. pp. 185-289.
[31] Barnett, 1954. pp. 509-513.
[32] Black, 1925. pp. 12-38.

other Asiatic and non-Asiatic groups. Grünwald (1925) [33] measured the calcaneus of Europeans; Barnett and Napier (1925) [34] published an article on the form of the talus; Barnett (1955) [35] an article on the mammalian talus and Getz (1957) [36] a paper on the tarsus of Lapps. Lisowski, Ashton and Ormerod (1957) [37] examined the astragalus of Late Chalcolithic and Bronze Age people of Jericho.

MATERIAL AND METHODS

The Astragalus and Calcaneus bones which have been examined at Gordion belong to the Roman people who lived there in the third and fourth centuries A. D. Two series, comprising 26 astragalei and 23 calcanei of children from five months to seventeen years, and 76 astragalei and 76 calcanei from adult individuals, form the subject of this article.

Martin's technique (1928) was closely followed in taking the measurements of the astragalus and calcaneus. [38] From these measurements on adult individuals, minima and maxima, averages, standard deviations and coefficients of variability, with all their probable errors, were calculated, without taking into account sex differences and the differences between right and left. To obtain these figures the data was classified once again. [39]

MORPHOLOGICAL AND BIOMETRICAL EXAMINATION OF THE ASTRAGALUS OF THE ROMAN PEOPLE OF GORDION

The surface of the trochlea from five months to eighteen years develops from a triangular shape to a square and oblong type. [40] The development of the tibiale and fibiale sides of the trochlea follows the same development as the height of these two parts. From

[33] Grünwald, 1925. pp. 261-274.
[34] Barnett and Napier, 1952. pp. 1-9.
[35] Barnett, 1955. pp. 225-230.
[36] Getz, 1957. pp. 189-201.
[37] Lisowski, Ashton and Ormerod, 1957. pp. 136-143.
[38] Martin, 1928. pp. 1053-1057; 1058-1060.
[39] More detailed tables of measurements will be attached to the full report to be published shortly.
[40] Volkov, 1903. p. 697.

five months to six years tibiale height increases more, while after seven to eight years, the increase in fibiale height is greater. This may be one reason why the feet of children at certain ages turn inwards. In adults sex differences are important, and the height of both sides is greater in men. Although in adults there is not a very great difference between tibiale and fibiale height averages, there is a tendency in favour of the latter. Whereas in modern Europeans the tibiale side is higher, in anthropoids fibiale height is always greater [41].

Trochlea depth shows three periods of growth. After the age of five months, the surface of the trochlea is convex, but after four-five years it becomes flattened. This condition is observed very rarely in the adult population of Gordion, as it is regarded as a primitive characteristic. In the third period the surface of the trochlea becomes concave, and in adults this concavity is more pronounced. In both sexes trochlea depth is greater on the right foot. In men the trochlea is relatively longer and narrower, and compared with Europeans, the trochlea of the Roman adults of Gordion shows a shorter and wider shape, which is a backward characteristic.

In the childhood period the collum tali is very long compared with the body of the astragalus. In the five months' individual, the collum tali forms 57 % of the entire length, whereas in adults it is 32 %. In primates also the collum tali is long as compared with the full length. In the human astragalus this characteristic repeats philogeny in ontogeny. The percentage established in the Roman people of, Gordion is the same as that of Europeans. From this point of view, the astragalus shows, as in Europeans, a well-developed construction.

In the children's series of the Roman people of Gordion, the angle of the collum tali is similar to that of newborn Europeans. The adult individuals show great variations and the average angle of the collum tali is close to that of Japanese, Peruvians and Europeans. The angle of separation of the neck is observed to decrease from childhood to maturity. This characteristic repeats philogeny in the course of growth.

In the children's series, squatting facets can be observed after the age of seven. Squatting facets are found in 55. 25 % of the adults.

[41] McCown and Keith, 1939. pp. 22, 23.

In individuals possessing facets on the collum tali, the facies maleolaris medialis is seen to extend far forwards. The great majority of individuals show this characteristic.

In the course of growth the width of the caput tali increases relatively more than length. The length and width measurements are greater in men, while in women the caput tali is relatively wider and more rounded than in men. The caput torsion angle increases from childhood to maturity. On the astragalus the caput tali is the first part to complete its growth, [42] and on account of this, the caput torsion angle exhibits adult characteristics from about eleven/twelve years.

The width of the astragalus increases relatively more than the length.[43] The width-length index and height-length index increase in the course of growth. The astragalus is flat during the childhood years, but towards adulthood it gains in height. In the course of ontogeny the height develops relatively more than the length. Length, width and height averages are greater in men. In women the astragalus is relatively shorter, while in men it is relatively higher. Compared with the Ancient Egyptians, the astragalus of the Gordion Roman people is relatively wider and it is both wider and higher than that of the Jericho group. [44]

In the course of growth, trochlea length increases relatively more than astragalus length. In men, the trochlea is relatively longer than the talus.

BIOMETRICAL AND MORPHOLOGICAL DEVELOPMENT AND CHANGES OBSERVED IN THE CALCANEUS OF THE ROMAN PEOPLE OF GORDION

The proportions of the calcaneus change considerably during the growing period. Up to six years the centre of the facies articularis cuboides protrudes forwards to form a swollen and rounded shape.

[42] Bostanci, 1955. pp. 92, 97, 99, 100. The development of the foot is completed at an earlier age than growth in sitting height, stature, hips and limbs. It can also be observed that the anterior part of the astragalus is the first to complete its development and that the posterior side is the last to finish its growth.

[43] Straus, 1927. p. 108.

[44] Sewell, 1904, pp. 234, 235, Lisowski, Ashton, Ormerod, 1957. p. 149, Table 11

On account of this, the greatest length is the same as the physiological length. After seven years, the depth of the facies articularis begins to increase and in adulthood exhibits certain variations. The length of the posterior part of the corpus calcaneus (between the facies articularis calcanea posterior and the back edge of the heel) gains in ontogeny. The shortening of the corpus is a characteristic of a primitive foot type.[45] In women the posterior length of the corpus calcaneus is shorter, and the physiological length averages are greater. The concavity of the posterior part of the heel increases in ontogeny and is connected with development in length of this part.

It can be observed that in the course of growth the shape of the facies articularis medialis shows simian characters. During growth, the sustentaculum becomes united with the facies articularis cuboides and the facies articularis calcanea posterior. In the adult individual the medial and anterior facets are inclined further outwards. This inclination decreases in ontogeny and in adulthood these facets slope not outwards but upwards. In children the medial facet forms an angle of 45°, while in adults it is 90°.[46] This is further evidence that ontogeny repeats philogeny.

In the calcaneus the width from the sustentaculum is greater in men, and the sustentaculum tali is more massive. In children the calcaneus is very short and wide, but towards maturity this character weakens and is transformed into a narrower and longer shape. The width-length percentages show a great similarity to Japanese.[47]

In the course of growth, the height-length and width-height indices change rapidly. After nine years the percentages approach

[45] Straus, 1927. pp. 112.
The corpus calcanei length was taken as the distance between the rear edge of the facies articularis calcanea posterior and the upper edge of the posterior surface of the heel. An examination of the length of the corpus calcanei is of importance because of the very interesting changes this part has undergone in the course of evolution.

[46] Morton, 1926b. p. 310, Fig. 2.
The angle of inclination of the facies articularis talaris is small in the gorilla; in Neandertal man it is almost vertical and in modern man it is 90°. In the same way this angle gradually increases after birth towards adulthood. The type found in Neandertal man can be observed in a few of the Gordion Roman individuals.

[47] Adachi and Adachi, 1905. p. 320.

those of adults. The calcaneus is relatively higher in women and in the Gordion Roman adults it is flatter than Europeans'.[48] It can be understood that from this point of view, the Roman people of Gordion possess a foot type near to that of Negroes, Melanesians, Bushmen and Hottentots. In the Gordion Romans, the men have a relatively wider calcaneus.

It can be observed that the facies articularis talaris posterior and cuboides exhibit simian characteristics in the growing period. Although the cuboides length diameter in the five months' child is more or less parallel to a horizontal surface, in adults the greatest diameter is vertical. In this way, in the human calcaneus, philogeny is repeated in ontogeny.

The angle of torsion in the calcaneus displays wide variations in the course of growth. In the children of the Gordion Romans, the angle of torsion varies from 8° - 45°, and up to eight years it is high. After this age the average is 28°. Between eight and seventeen years the average angle of torsion is 12° and from childhood to maturity it decreases.[49]

The angle of inclination of the posterior face of the heel, when the calcaneus is resting on a flat surface, is the angle which is produced by the Achilles tendon surface joining with the vertical surface of the posterior part of the heel. This angle is greatest in human beings, as it is a characteristic which has been acquired during evolution. This angle (the angle of inclination of the posterior face of the heel) increases from childhood to adulthood and repeats philogeny in ontogeny. On this account it is important. The smallness of this angle is a primitive characteristic and is related to the arch of the foot.

The talo-calcanea angle was established in 71 individuals. In the Gordion Roman adults it was observed that this angle varied between +11° and —12°. Without taking into account sex differences the average obtained was - 4. 90° ± 0.220. Getz found that this

[48] According to Volkov (1904) pp. 25, 30, 31, the calcaneus is flat in prosimians and relatively high in anthropoids. In the human groups the height-length percentages are greater and among them Europeans have the highest calcaneus.

[49] The angle of torsion is large in primates and small in human beings. As regards European Neandertal man, the angle of torsion is of a degree intermediate between the anthropoids and modern Europeans. (Boule, 1912. p.179.

angle in Lapps was $-3.7° \pm 1.2$ in men and $-2.4° \pm 1.2$ in women[50]. In respect of the talo-calcanea angle, the construction of the Gordion Roman foot is intermediate between that of the Bantu and the Hottentots. [51]

CONCLUSION AND SUMMARY

In the human foot bones there are many simian characters in the first periods of development, which decrease towards adulthood. In prehistoric man and historical races there are many more primitive characters compared with modern races. Among the adult Romans of Gordion, one can come across some individuals who have retained the primitive characters which are observed in the childhood period. In Europeans the great majority of the simian characters which are seen in foetal life are lost before birth or shortly after, whereas it is observed that the simian characters in the majority of the Roman children of Gordion continue in postnatal life during the growing period and persist until adulthood in some cases, although in a less characteristic form.

The astragalus and calcaneus show ethnic differences from the point of view of both biometrical and morphological characters. Keeping these points in view, research must be undertaken by always classifying population groups separately. The examination of the biometrical and morphological characters of the astragalus and calcaneus gives valuable knowledge about variations in the muscles, structure and mechanism of the foot and at the same time helps to clarify problems connected with the biogenetics, ontogenetical development and philogeny of the foot.

In the astragalus, the length of the collum tali, the caput torsion angle, the angle of the collum tali, tibiale and fibiale height, the facies maleolaris medialis, and in the calcaneus the upper length of the

[50] In the Gordion Roman adults the range of variation of the talo-calcaneo angle is smaller in women, but sex differences between the averages, as in Lapps, are not important. The average in men is -5.844° and in women -5.961°. The same angle in Senois is +12°, in Australians +7°, in Tyroleans -7.0° and in Germans -8.8°. (Reicher 1913, p. 125).

[51] The talo-calcaneo angle in Bantus is -3.6°, in Hottentots -6.3° and Bushmen -7.8°. (Wells, 1931. p. 233). In Tibetans it is +1.4°. (Martin, 1928. p. 1175).

corpus (between the posterior edge of the facies articularis calcanea and the upper edge of the back part of the Achilles tendon surface), the heel torsion angle, the angle of inclination of the sustentaculum tali, and the form of the facies cuboides, all repeat philogeny in ontogeny.

In various groups the investigation of the astragalus has cleared up certain ethnological problems. In the Roman inhabitants of Gordion, as in other primitive people, we have established that the squatting habit is very common, because in the astragalus of the Gordion Romans the medial and lateral facets of the trochlea and the facies articularis maleolaris extend forwards towards the neck and on the upper part of the collum tali extra facets can be observed. All these characteristics are connected with the habit of squatting.

In the astragalus and calcaneus sex differences are important. In the astragalus and calcaneus of the women the morphological and biometrical characters exhibit a more perfect form than the men's. The diameters on the astragalus and calcaneus in the women are smaller. As a general rule, the measurements of the right side are greater in both sexes than the left.

In civilised groups, the proportion percentages and morphological characters in the structure of the astragalus and calcaneus show a more perfect form than in backward tribes and historical and prehistoric groups. All these investigations lead one to conclude that the human foot has not yet completely got rid of its primitive characters.

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TABLE I

Measurements taken on the Astragalus of the Roman people of Gordion. Number of individuals, minima and maxima of measurements, averages and standard deviations, co-efficient of variability with all their probable errors.

	No. ♂+♀	Min. Max. mm.	M±PE ♂+♀ mm.	SD±PE ♂+♀	V±PE ♂+♀
Talus length	76	43-56	50.09±0.227	2.95±0.160	5.88 ±0.321
Talus width	76	36–47	41.01±0.226	2.93±0.159	7.14 ±0.390
Talus height	76	26.5–36	30.02±0.184	2.39±0.130	7.96 ±0.435
Trochlea width	76	25–35	29.31±0.175	2.27±0.124	7.79 ±0.423
Trochlea length	76	28–38	32.46±0.181	2.35±0.128	7.231±0.395
Caput Tali length	76	27–37	32.23±0.182	2.37±0.129	7.35 ±0.401
Caput Tali width	76	19–32	22.82±0.167	2.17±0.118	9.50 ±0.519
Fac. Art. Cal. Post. length	76	27–37	31.60±0.206	2.68±0.146	8.48±0.468
Fac. Art. Cal. Post. width	76	18–24	21.00±0.133	1.72±0.094	8.19±0.448
Fac. Art. Cal. Post. depth	76	4–9	6.03±0.070	0.91±0.049	0.15±0.008
Collum-Caput length	74	16–25	19.77±0.166	2.13±0.117	10.77±0.597
Trochlea depth	77	0.5–3	1.33±0.108	1.42±0.076	1.05±0.056
Maximum length	76	46–62	55.82±0.462	5.98±0.327	10.71±0.586
Collum tali length	75	12–21	16.06±0.182	2.35±0.129	14.63±0.805
Collum tali width	76	21–31	26.34±0.181	2.35±0.128	8.92±0.487
Tibiale height	76	27–35	31.11±0.149	1.93±0.105	6.20±0.339
Fibiale height	76	26.5–36	31.32±0.171	2.31±0.125	7.37±0.403
Collum tali angle	76	7°–30°	18°30±0.429	5.55±0.303	30.32±0.165
Caput Torsion angle	76	25°–46°	33°88±0.354	4.59±0.250	13.54±0.741

TABLE II

Measurements taken on the Calcaneus of the Roman people of Gordion. Number of individuals, minima and maxima of measurements, averages and standard deviations, co-efficient of variability with all their probable errors.

	No.	Min. Max.	M ± PE mm.	SD ± PE	V ± PE
	♂+♀	mm.	♂+♀	♂+♀	♂+♀
Maximum length	75	64–92	77.64±0.569	5.97±0.328	7.68±0.423
Physiological length	75	59-85	72.29±0.541	5.68±0.390	7.85±0.432
Minimum width	75	21–33	26.88±0.718	9.21±0.507	34.76±1.887
Greatest width	75	25–41.5	30.84±0.271	3.49±0.191	11.31±0.622
Width from sustentaculum tali	75	34.5–51	41.41±0.243	3.13±0.172	7.55±0.415
Height	75	36–52	44.05±0.333	4.28±0.235	9.716±0.793
Minimum height	75	30–45	37.45±0.246	3.16±0.174	8.43±0.464
Projected height	75	34–49	41.97±0.269	3.54±0.188	8.43±0.450
Sulcus Calcanei height	75	17–29	23.37±0.183	2.34±0.129	10.01±0.551
Corpus Calcanei length	72	16–25	20.30±0.182	2.30±0.129	11.33±0.636
Corpus Calcanei depth	76	1–6.5	3.77±0.075	0.98±0.053	25.54±1.397
Facies Art. Post. width	75	18–33	22.88±0.197	2.55±0.139	11.14±0.613
Facies Art. Post. length	75	24–36	30.00±0.231	2.97±0.163	9.90±0.544
Facies Art. Cuboid width	75	19–28	23.36±0.163	2.10±0.115	8.98±0.494
Facies Art. Cuboid length	75	21–34	25.09±0.217	2.80±0.153	11.15±0.641
Sustentaculum tali length	73	19–34	25.91±0.261	3.31±0.184	12.77±0.656
Tuber Calcanei width	75	28–44	34.01±0.239	3.07±0.169	9.02±0.496
Post. surface angle of the heel	75	15°–37°	24.°98∓0.375	4°.82±0.265	19°29±1.062
Angle of Torsion	74	0°–30°	9°.06±0.506	6°.47±0.358	7°.14±0.395
Talo-Calcanea Angle	71	+11°-12°	4°.90±0.220	−2.77±0.156	56.53±3.200

TABLE III

Some indices of the Astragalus of the Roman people of Gordion. Averages and standard deviations, co-efficient of variability with all their probable errors.

Indices	Right+Left ♂+♀ M ± PE	Right+Left ♂+♀ SD ± PE	Right+Left ♂+♀ V ± PE
Talus Width × 100 / Talus Length	81.02±0.282	3.65±0.282	4.50±0.199
Talus Height × 100 / Talus Length	59.78±0.238	3.09±0.168	5.16±0.282
Trochlea Length × 100 / Talus Length	64.09±0.235	3.05±0.166	4.75±0.259
Trochlea width × 100 / Talus Width	70.94±0.297	3.84±0.210	5.41±0.295
Trochlea width × 100 / Trochlea length	89.74±0.442	5.71±0.463	6.36±0.347
Fac. Art. Cal. Post. Width × 100 / Fa.Art.Cal. Post. Length	66.03±0.401	5.20±0.422	7.87±0.638
Caput Tali Width × 100 / Caput Tali Length	71.02±0.701	9.07±0.495	12.77±0.698

TABLE IV

Some indices of the Calcaneus of the Roman people of Gordion. Averages and standard deviations, co-efficient of variability with all their probable errors

Indices	Right+Left ♂+♀ M ± PE	Right+Left ♂+♀ SD ± PE	Right+Left ♂+♀ V ± PE
Minimum width × 100 / Maximum Length	34.35±0.204	2.62±0.144	7.62±0.421
Minimum height × 100 / Maximum length	47.95±0.267	3.42±0.189	7.13±0.394
Minimum width × 100 / Minimum height	71.44±0.476	6.09±0.337	8.52±0.472
Width from sustentac. × 100 / Maximum length	53.08±0.238	3.05±0.168	5.74±0.318
Projected height × 100 / Physiological length	57.87±0.383	3.42±0.271	5.90±0.326
Fac.Art.Post.Width × 100 / Fac. Art. Post. Length	75.38±0.447	5.71±0.316	7.57±0.419
Facies Art. Cuboid. Wid. × 100 / Facies Art. Cuboid Length	93.50±0.650	8.36±0.549	8.94±0.492

EXPLANATION OF THE FIGURES

(Scale is in cm.)

Series No. 1. From the left: the smallest astragalus, five months; three years, four years, six years and six-and-a-half years old astragalei seen from above. No. 2: The same astragalei seen from below.

Series No. 3. From the left: 6.5 years, 7 years, 11/12 years old astragalei seen from above. No. 4: The same astragalei seen from below.

Series No. 5. From the left: 15/16, years, 14/15 years and 16/17 years old astragalei seen from above. No. 6: the same astragalei seen from below.

Series No. 7. The astragalus of two male individuals seen from above. No. 8. The same astragalei seen from below.

Series No. 9. From the left: 3 years, 4 years, 6 - 6.5 years, 6 - 6.5 years old calcanei seen from above. No. 10; the same calcanei seen from below: No. 11, from inside and No. 12, from outside.

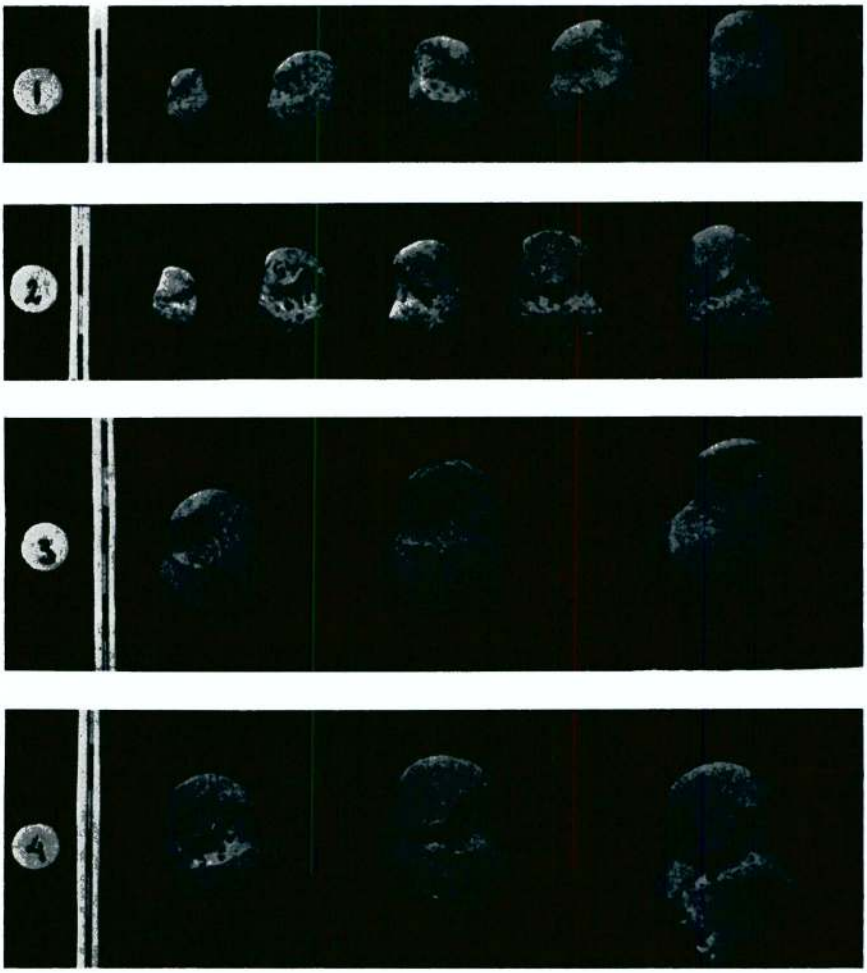
Series No. 13. Fram the left: 6 years, 6 years, 15/16 years old calcanei seen from above No. 14: the same calcanei seen from below. No. 15, from inside and No. 16 from outside.

Series No. 17. From the left: calcaneus of 11 years old individual; two 16/17 years old youths and one adult male. No. 18; the same calcanei seen from below. No. 19, from inside and No. 20, from outside.

Series No. 21. The calcaneus of two adult male individuals seen from above. No. 22: the same calcanei seen from below; No. 23, from inside and No. 24, from outside.

Series No. 54. The calcaneus and astragalus belonging to a young gorilla, seen from above No. 55, seen from below.

Series No. 45. Reading from the scale: left and right calcaneus and astragalus belonging to a young Pan Trogleates; 963a, left calcaneus and astragalus belonging to a Hylobates Hooloch; left calcaneus and astrogalus belonging to a young Pan Trogleates No. 46: the same astragalei and calcanei seen from below.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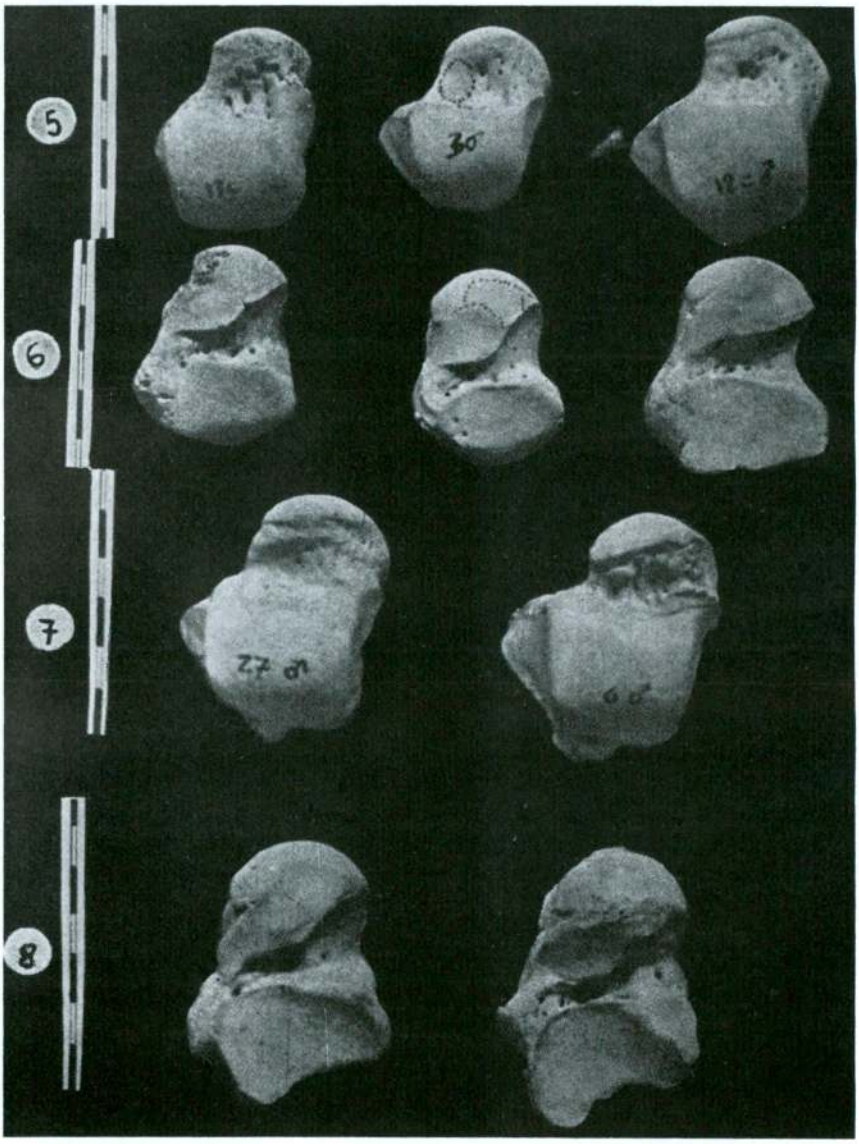
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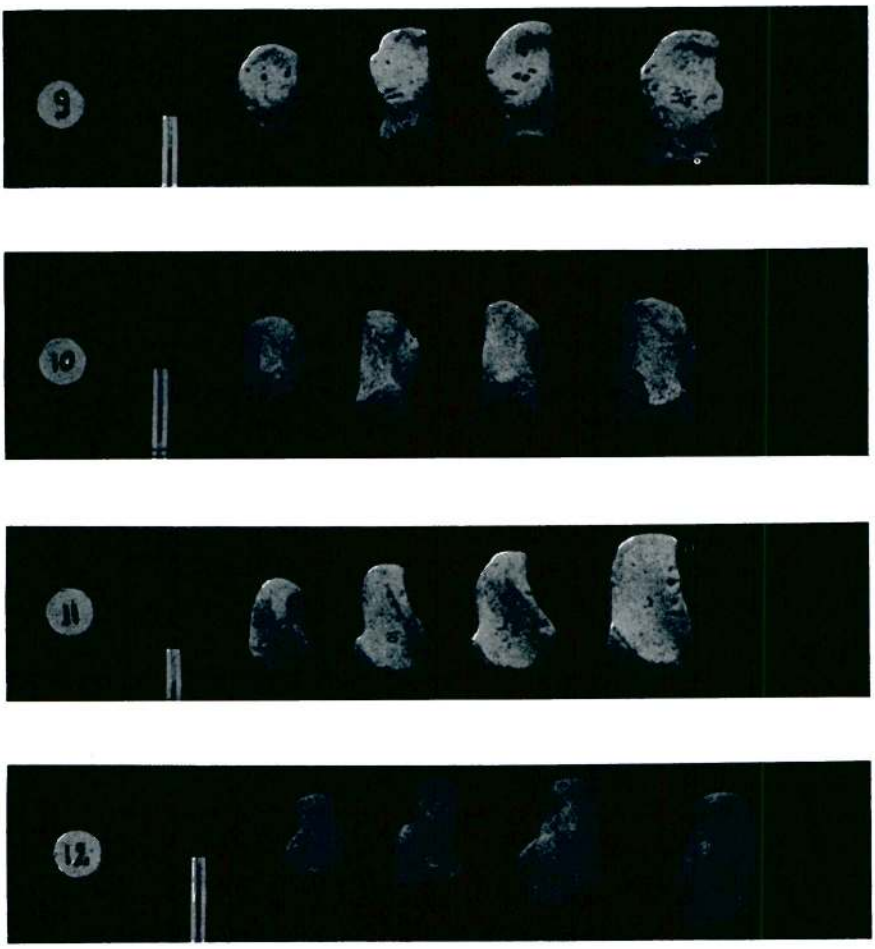
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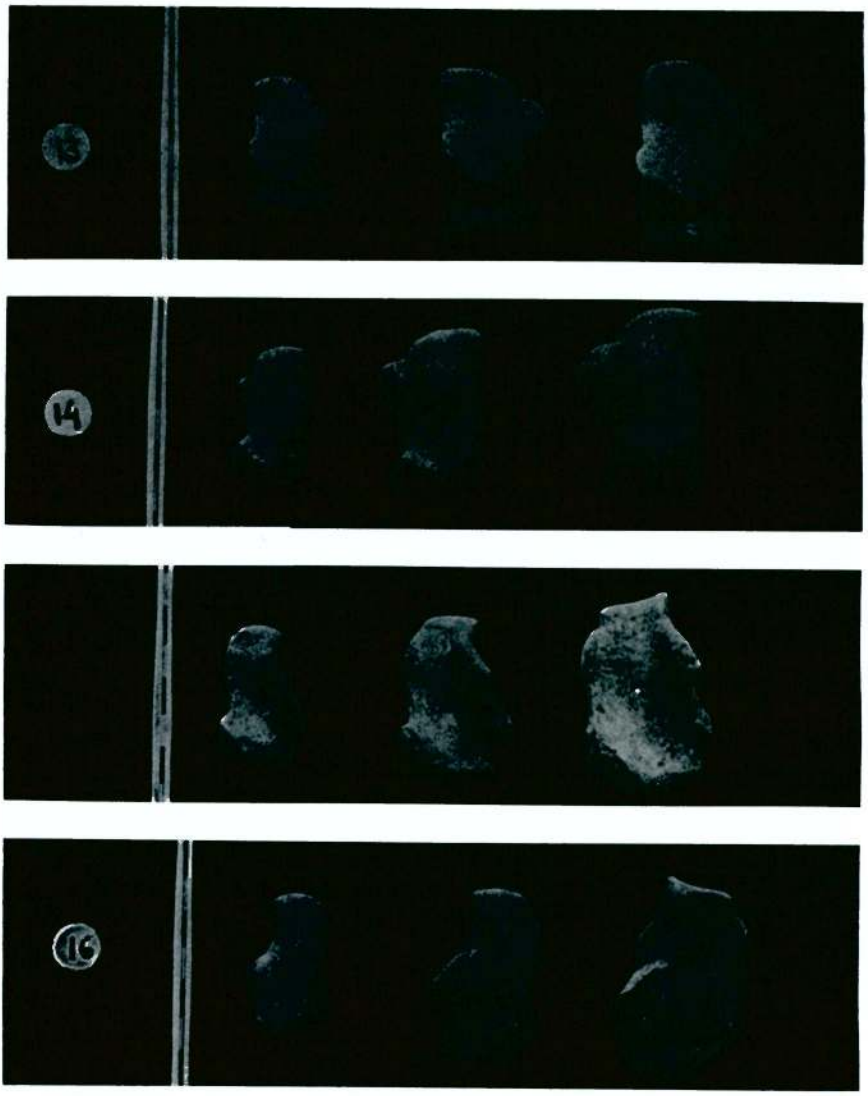
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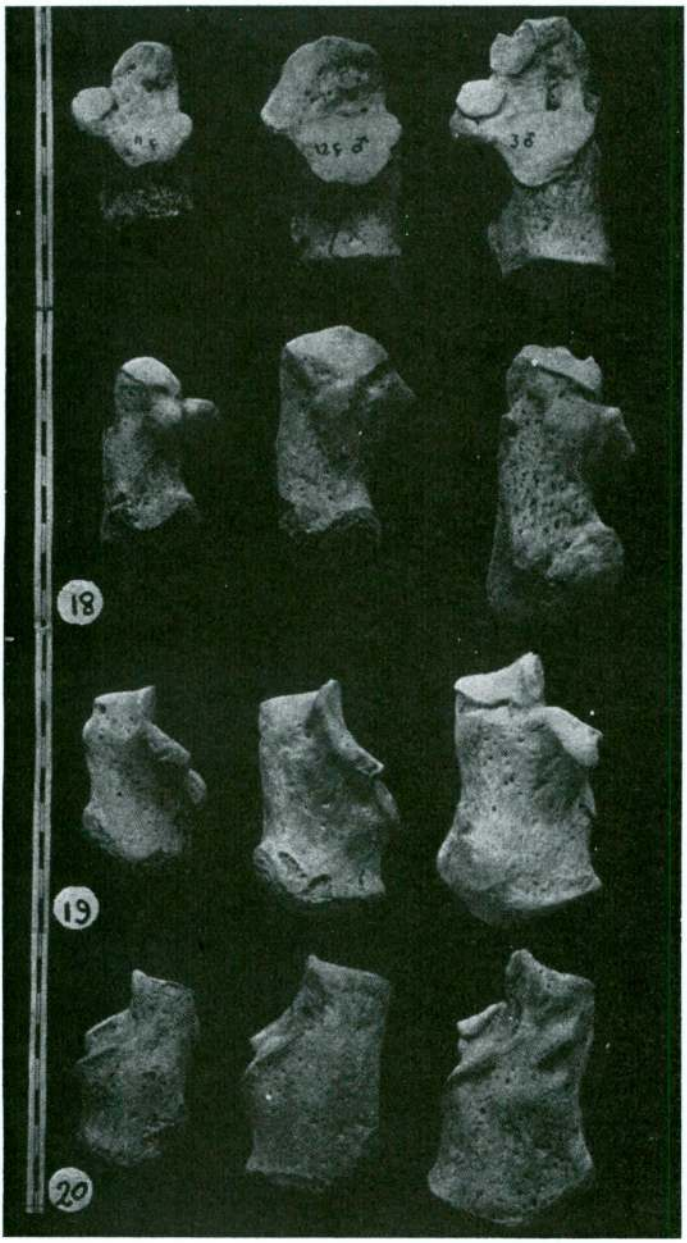
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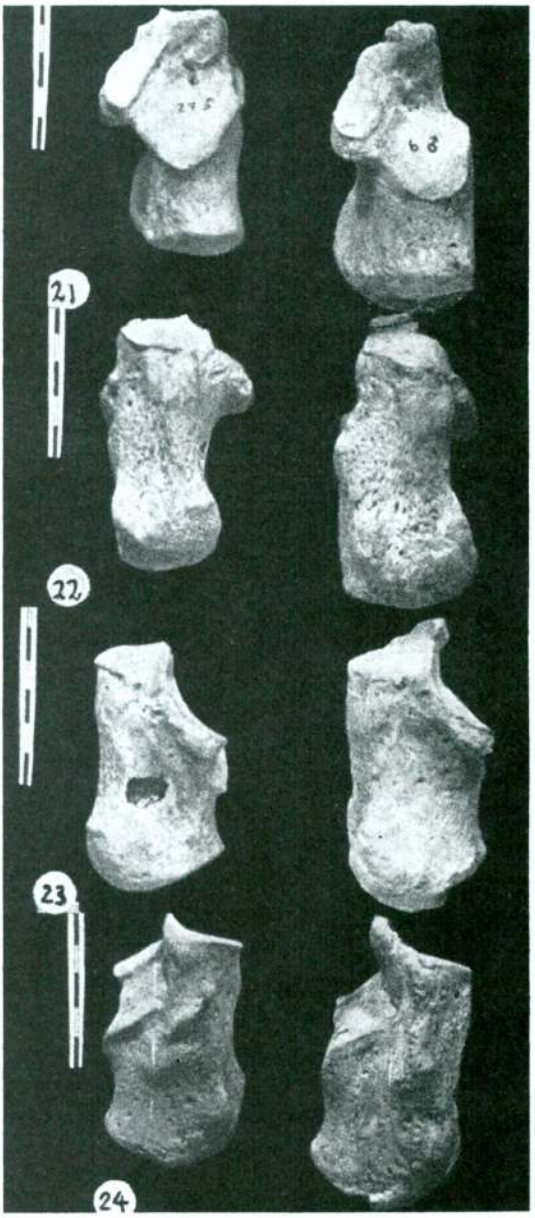
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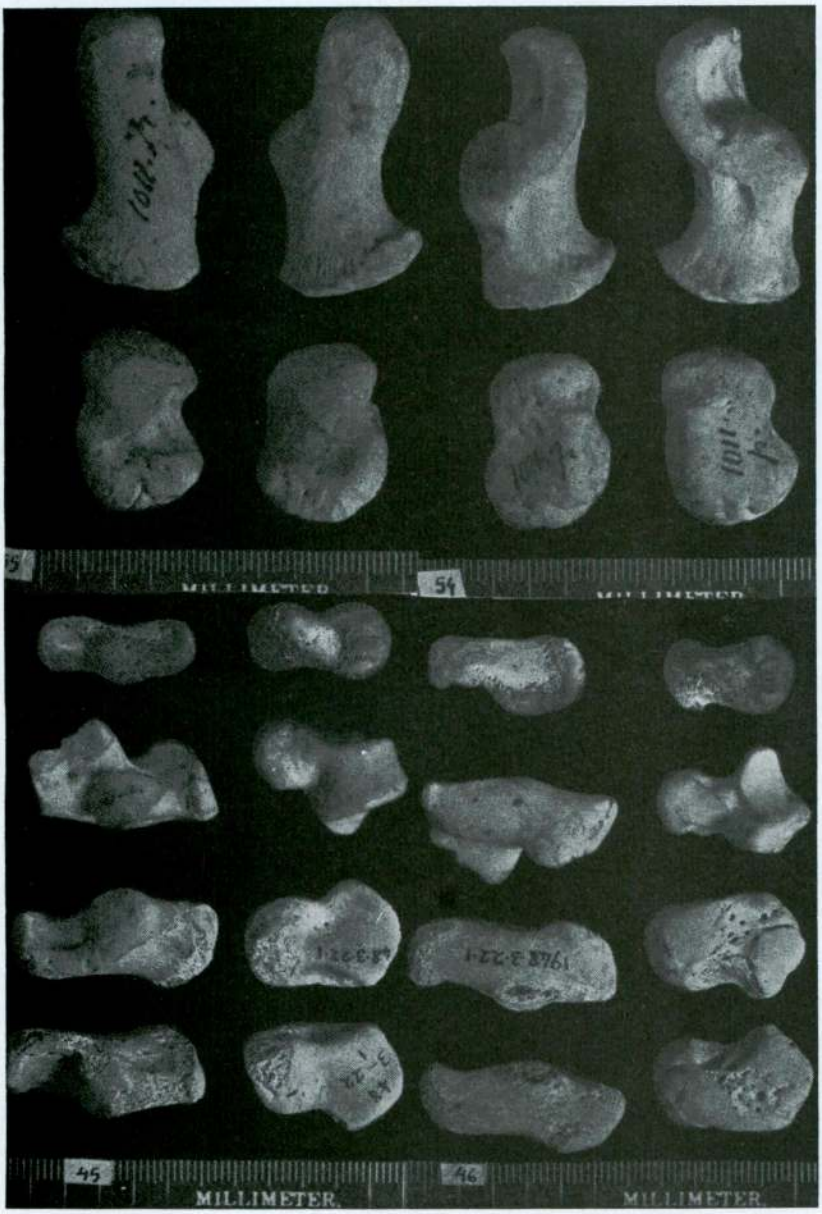
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