

XXVII. *On the Osteological relations observable among a few Species of the Bovine Family.**By* WALTER ADAM, M.D. *Communicated by* ROBERT BROWN, Esq., V.P.L.S.

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IN a communication formerly submitted to the Linnean Society\*, an attempt was made to trace throughout one large animal the identities and variations of osteological dimension characteristic of a species. The animal selected for that inquiry was the Camel of Bactria.

It is now intended, by an osteological comparison of some species in a cognate group of animals, to exemplify the more striking resemblances and deviations in form which are exhibited among the components of a zoological family. The indulgence of access to the British Museum has enabled the writer to examine at leisure nine osteological specimens contained there, of the Mammalian family of Bovines; three pairs, male and female:—the *Bos Bantiger* of Java, the *Bibos Gaurus* of Nepal, and the *Bison* of North America; along with three separate males,—the *Aurochs* (*Bison*) of Lithuania, the *Caffre Buffalo* of the Cape of Good Hope, and the *Short-horned Buffalo* of the Gambia, the last a young animal. The Bovines, equally with the Camel, seemed deserving of study, on account of their value to Man.

As a standard of measurement within the animal itself, the basilar length of the cranium was found to be most eligible in the Camel; the same dimension, similarly divided into 72 parts, has been continued in the Bovines. Though no single dimension can be assumed to be invariable, the basilar length of the cranium, notwithstanding its rostral termination in the intermaxillaries, will admit of preference in many other animals.

The breadths of the head in the Camel occupy three sets of distances from the mesial plane, ending with the greatest breadth—the orbital. Subsequent to those three dimensions of breadth there are four cranial lengths, beginning with the shortest—the palatal. Thus placed in order, the seven dimensions of the head in the Camel are by six equal decrements successively reduced from the greatest length. Bovine species being numerous, with a corresponding scale of diversity, indications of a fixed normal type could not in Bovines, as a family, be so decided as in the almost solitary Camel. Bovine osteological dimensions will be seen to vary not a little. From size of parts—not always greater in the male—the male and the female bones might even be thought to belong to animals quite distinct. Still the cranial lengths of the Bovines, without such regular progression as in the Camel, show a degree of similarity. In all, the length of the head approaches, in the Gour it attains, the cranial extreme of the Camel. The very different character of

\* Linnean Transactions, vol. xvi. p. 525.

profile in the Camel is owing to the backward position of the nostrils. In the Gour the fulness of the inion brings the corono-nasal length almost to an equality with the basilar; so that the lengths of the cranium, beginning with the coronal, which in the Camel are 5.7.6, may in the Gour be stated to be 6.7.6. In general, among the other Bovines, especially the males, the basilar length of the cranium, as in the Camel, is intermediate to the elongation of the muzzle and the recedence of the nasal bones; the palatal length also reaches nearly two-thirds of the basilar length.

Continuing the profile: Bovines have no prevailing height of cranium. In the vaulted crania of the Aurochs and the North American Bison the inion is even lower than the nasal bones are over the palate. The inial elevation of the other species may be stated to be one-third more than the palatal. Compared with the lengths of the cranium, the tendency of the palatal height in Bovines is to be one-third of the basilar length. While the vaulted crania, as has been already noticed, sink in, the crania of Bovines, which are flattened over the palate, rise to an inial elevation of one half the basilar length. In the male Bantiger the inial height is half the corono-nasal length.

The greatest similarity of wideness in Bovine crania seems to be at the zygomatic arches, where the span of the cranium is exactly, or very nearly, half the basilar length. The muzzles also have a strong resemblance in breadth, that dimension being in all of them more than one-sixth of the basilar length. The broadest muzzle, that of the Cape Buffalo, is exactly a fourth of the basilar length; thus in identity with the cerebral transverse of the cranium. The Aurochs is most conspicuous for wideness of cranium. Next to the Aurochs are the North American Bisons, male and female. In these two species the greater breadth seems to compensate for the smaller height. While in the other Bovines the tendency is to an orbital breadth half the basilar length, the orbits of the Aurochs reach laterally beyond two-thirds of the basilar length, and their expansion is not much less in the North American Bisons.

The horns even show a determinate correspondence with the rest of the osteological structure. The capacious circuit that surmounts the head of the Gour, spreads out, in the fully-developed male, to twice the basilar length of the cranium.

The mesial extent of the Bovine vertebræ, from the occipital condyles to the root of the tail, closely approaches four times the cranial basilar length. It is accurately so in the Aurochs, the North American Bisons, and the female Bantiger. Of all the nine Bovines, the Aurochs and the North American Bisons have the greatest extension of the dorsal vertebræ, as there is of the cervicals in the female Bantiger. The vertebral growth of the under-aged Gambian Buffalo had been with the sacrals, lumbar and dorsals, in the progression 2.4.8.

Of Bovine ribs, the longest fully attains, or somewhat exceeds, the extreme cranial length. In like manner, the first rib corresponds with the palatal length, slightly exceeding it in those robust species, the Aurochs and the Cape Buffalo.

In no Bovine was there found a perfect identity of dimension between the scapula and the pelvis, except in the female of the North American Bison. The Aurochs and the North American Bisons, both male and female, have the longest scapulæ. The scapulæ,

in their length, seem to be referable more to the basilar than to the extreme of the cranium. On the other hand, the length of the pelvic bones does correspond with the cranial extreme.

In its transverse dimensions the enclosure of the pelvic cavity has no marked identity with the transverses of the cranium. The ischial transverse has some relation to the coronal, or to the extreme, lengths of the head. At the same time, the ischial transverse dimension is very nearly the same as the acetabular, the slight excess of the ischial over the acetabular in the males being reversed in the females. In the young Gambian Buffalo the acetabular development had been more rapid than the ischial.

There is a considerable diversity in length of limb among Bovines, as much in regard to the atlantal limbs compared with the sacral, as to the separate bones of the limbs compared with each other. Except in the male Bantiger and the Gambian Buffalo, the humerus is in a small degree shorter than the radius; while there is more excess of length in the femur over the tibia. The male and the female Bantiger show a difference almost beyond what is specific. In Bovines generally the atlantal extremities are curtailed of the proportion of the longer sacral bones by from a third to a half of the basilar length of the cranium.

	<i>Aurochs.</i>	<i>Bos Bantiger.</i>		<i>Bibos Gaurus.</i>		<i>American Bison.</i>		<i>Bubalus Caffer.</i>	<i>Bubalus Brachyceros.</i>
		Male.	Female.	Male.	Female.	Male.	Female.		
Actual basilar length of cranium, in inches . . . . .	18.55	17.80	17.35	19.80	17.90	18.90	17.75	18.60	15.80
Corono-nasal length of cranium, in proportional parts*	65	65	61	71	70	65	62	65	63
Extreme length of cranium . .	80	82	78	83	84	79	78	79 to occipital cond.	76
Intermaxillaries to inial of palate . . . . .	44	45	abest	47	46	44	45	45	44
Intermaxillaries to basilar of spinal foramen . . . . .	72	72	72	72	72	72	72	72	72
Height from inial of palate . .	26	25	22	24	25	28	24	24	22
Height from basilar of spinal foramen . . . . .	25	32	36	38	36	25	23	34	30
Intermaxillary transverse . . . .	14	13	13	15	14	14	13	18	13
Orbital transverse . . . . .	50	35	31	40	36	46	41	38	32
Zygomatic transverse . . . . .	36	33	32	37	34	35	32	36	34
Auditory transverse . . . . .	34	32	30	35	32	34	30	32	30
Temporal transverse . . . . . between horns and occiput	38	31	26	36	33	40	33	37	no sinus
Cornual transverse . . . . .	98	114	39	144 horns	84	88 horns 84 tips of corn. bones	78 tips of corn. bones	130 ext. bdth. of horns	69 horns
Cerebral transverse . . . . .	21	18	18	17	18	21	19	18	19

\* The basilar length of the cranium being taken as 72 parts, all the following measurements are in proportional parts.

	<i>Aurochs.</i>	<i>Bos Bantiger.</i>		<i>Bibos Gaurus.</i>		<i>American Bison.</i>		<i>Bubalus Caffer.</i>	<i>Bubalus Brachyceros.</i>
		Male.	Female.	Male.	Female.	Male.	Female.		
Vertebrae:—									
Atlas, length, dorsad . . . . .	18	9	10	8	9	9	7	10	8
„ transversely . . . . .	32	36	25	32	27	29	24	36	25
Dentata, length, sternad . . . .	19	15	16	17	15	13	15	16	11
„ transversely, rostrad . . . .	17	17	16	18	17	16	17	17 29 caudad	15
„ height, caudad . . . . .	26	23	21	26	23	24	20	26	19
Cervicals, mesial extent, sternad . . . . .	69	71	80	67	70	67 <sup>so</sup> 7th cartilage off	70	70	56
Dorsals . . . . .	128 Fourteen	114 Thirteen	112	114 Thirteen	114	133 Fourteen at articular centres	134	121 Thirteen	96 Thirteen
Lumbar . . . . .	52 Five	58 Six	58	59 Six	59	53 Five	51	60 Six	48 Six
Sacral . . . . .	39 Five	27 Four	38	34 Four	40 Five	34 Five	36	27 Four	23 Four
	288	270	288	274	288	287	291	278	223
Greatest sterno-dorsal of dorsals . . . . .	78 2nd	53 2nd	50 4th	63 3rd	57 4th	75 1st & 2nd	64 1st & 2nd	61 3rd	40 2nd, 3rd & 4th
Greatest transverse of lumbar . . . . .	57 3rd	62 4th	49 5th	50 5th	50 5th	51 4th	51 4th	56 6th	40 4th
Length of first rib . . . . .	52	45	48	47	50	42	45	51	38
Length of longest rib . . . . .	82 9th	82 9th	80 9th	86 8th, 9th & 10th	82 8th, 9th & 10th	88 9th & 10th	85 9th & 10th	84	76 9th & 10th
Breadth of broadest rib . . . . .	..	9 7th	9 7th	8 8th	8 8th	5 7th	6 7th	14	9 7th & 8th
Scapula, greatest length along ridge . . . . .	84 with cartilage	62	57	76	70	76	72	65	57
„ greatest expanse, dorsad . . . . .	45	38	32	41	37	35	36	39	31
„ smallest breadth toward glenoid . . . . .	11	10	8	11	10	10	10	11	9
Pelvic bones, rostro-caudal extent of each . . . . .	89	78	79	82	82 76 broken	73	72	79	67
„ mesio-lateral expanse of ditto . . . . .	40	44	36 <sup>so</sup>	39	36	33	35	41	36
„ compression toward acetabulum . . . . .	8	8	9	10	8	7	7	9	7
Lumbar transverse of whole pelvis . . . . .	71	81	69	67	68	66	68	83	67
Acetabular . . . . .	40	41	42	38	41	39	41	42	39
Ischial . . . . .	44	42	39	39	39	38	37	39	29
Humerus, extreme length . . . . .	61	51	55	60	56	55	52	54	50
Ulna „ „ . . . . .	72	59	63	74	66	65	61	66	64
Femur „ „ . . . . .	72	68	70	73	69	63	60	64	61
Tibia „ „ . . . . .	69	65	65	68	65	62	60	62	62
	274	243	253	275	256	245	233	246	237

	<i>Aurochs.</i>	<i>Bos Bantiger.</i>		<i>Bibos Gaurus.</i>		<i>American Bison.</i>		<i>Bubalus Caffer.</i>	<i>Bubalus Brachyceros.</i>
		Male.	Female.	Male.	Female.	Male.	Female.		
Humerus, articular length ..	53	42	48	54	50	49	48	47	44
Radius „ „ ....	51	45	48	52	49	48	47	45	48
Metacarpus „ „ ....	29	27	38 <sup>so</sup>	38	37	29	32 <sup>so</sup>	28	32
	$\frac{133}{133}$	$\frac{114}{114}$	$\frac{134}{134}$	$\frac{144}{144}$	$\frac{136}{136}$	$\frac{126}{126}$	$\frac{127}{127}$	$\frac{120}{120}$	$\frac{124}{124}$
Femur „ „ ....	67	64	65	68	65	62	58	62	57
Tibia „ „ ....	65	56	55	59	58	55	53	56	56
Metatarsus „ „ ....	36	40	42	41	41	36	39	33	37
	$\frac{168}{168}$	$\frac{160}{160}$	$\frac{162}{162}$	$\frac{168}{168}$	$\frac{164}{164}$	$\frac{153}{153}$	$\frac{150}{150}$	$\frac{151}{151}$	$\frac{150}{150}$
Humerus, proximal transverse	14	16	17	20	18	17	17	19	15
Radius „ „	15	14	14	15	15	14	14	16	14
Metacarpus „ „	13	11	10	11	10	11	11	12	11
Femur „ „	22	22	21	23	22	22	20	24	20
Tibia „ „	18	18	18	21	19	18	17	19	17
Metatarsus „ „	9	8	9	9	9	9	8	10	9
Humerus, smallest transverse.	7	6	6	9	9	7	6	8	6
Cubitus „ „	8	7	7	9	8	8	7	8	7
Metacarpus „ „	7	6	5	7	5	7	6	7	6
Femur „ „	7	6	7	8	6	7	6	7	7
Tibia „ „	8	7	7	9	7	7	6	7	7
Metatarsus „ „	7	5	5	6	5	5	4	6	5
Humerus, distal transverse ..	14	14	13	14	13	14	14	14	13
Cubitus „ „ ..	14	14	11	13	13	14	13	14	13
Metacarpus „ „ ..	10	12	9	10	10	11	11	12	11
Femur „ „ ..	18	17	17	20	18	16	16	19	17
Tibia „ „ ..	9	11	10	12	11	11	11	12	11
Metatarsus „ „ ..	9	11	9	10	9	10	10	10	10

N.B. Dr. Adam's Paper was accompanied by a series of Tables, in which the more important Dimensions of the Bactrian Camel, as given in the sixteenth volume of the Linnean Transactions, and those of the nine Bovine Skeletons, as given above, are represented by proportional lines instead of figures. These Tables are deposited in the Archives of the Society.—SECR.

# LEADING OSTEOLOGICAL DIMENSIONS OF THE CRANIUM AND TRUNK IN THE BACTRIAN CAMEL.

