Zoological Transactions.

Osteological Contributions to the Natural History of the Chimpanzees (Troglodytes), & Orangs (Pithecus).

No V. Comparison of the lower jaw & vertebral column of the Troglodytes Gorilla, Pithecus Satyrus, and different varieties of the Human Race.

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Read September, 1832.

The lower jaw (mandibula) of the Troglodytes Gorilla is one bone in the adult by confluence of the two halves at the symphysis, as in all Quadrumana. Each half or ramus shows the usual horizontal and vertical portions: the former gradually augmenting in depth as they approach the latter, where the breadth of the bone suddenly increases. The rami diverge from each other according to lines touching the outer side of the condyles and the back of the sockets of the canines, at an angle of The length of the jaw, in a straight line from the back part of the condyle to the fore-part of the symphysis is 7 inches 4 lines. From the outer side of one condyle to that of the other 5 inches 5 lines. The vertical extent of the rising ramus from the summit of the coronoid process to 6 inches 6 lines, the antero-posterior diameter of the same ramus is 2 inches 9 lines. The extent of the alveolar series from the last molar to the canine inclusive 3 inches 8 lines: the incisive alveoli are

This part of the series is longitudinal, almost straight, with a very slight bend inwards, and is parallel with the same part on the opposite side. The incisive alveoli are at right angles to the above & unite them together,

across

across the fore part of the jaw. The number of the alveoli correspond of course with those of the teeth described in a former memoir *: * Vol iii, p. 396

The socket of the canine is the largest & deepest depression. Those of the molars and anterior premolar are nearly equal: that of the posterior premolar is much smaller; & those of the incisors the smallest of all.

The symphysis arises from the incisive alveoli downward and backward with a gentle convexity to the lower border of the jaw. Its external surface is flat and convex; slightly more prominent near the middle of its lower part, but devoid of vertical or transverse ridges or tuberosities. There are slight depressions opposite the interspaces of the sockets of the incisor & canine teeth: the outer walls of these sockets are a little prominent, chiefly so in the canines, and also where the anterior root of the first premolar is implanted. A thin "head" or ridge of bone extends along the outer side of the "openings" of the molar sockets, beneath which there is a shallow longitudinal channel which inwardly passes below into the ~~outer~~ flat surface of the bone which becomes convex towards the lower border.

A little behind & below the prominent part of the first premolar alveolus, & a little nearer the lower than the upper border of the bone is the "foramen mentale" it is double on the right side, the smaller division being in advance of the chief opening: two or three much smaller foramina ~~are entire~~ open behind this.

There is a low tuberous rising near the lower border of the bone below the beginning of the pre + outer part of the rising ramus. This part or ridge commences in front by a platform of bone which extends outwards beyond the alveolus of the last molar; a strong ridge, continued from the back part of that alveolus, inclines, as it rises, towards the outer

ridge

ridge which it joins, after it has ~~en~~ bounded the
fore part of the coronoid depression
The lower border of the horizontal ramus is to the
under border of the vertical ramus by a pretty
regular convex curve, without an angle: the
outer part of this curve forms a low rather sharp
ridge: the inner part presents four or five tuberosities
bounding intermediate concavities (R. fig. 2
The outer surface of the rising ramus is nearly flat
there is a feeble middle ring & a shallow depression
anterior to this. The anterior border rises nearly
vertically and straight for two thirds of its extent
then curves gently backwards to the summit of the
coronoid process. This summit is pointed & is
divided from the
condyle by a deep & pretty regular concavity, formed
by the upper border of the ascending ramus, which
terminates near the outer side of the condyle.
The condyle is convex, sub-ovate, with its long axis
transverse, & its larger end inward: the fore part
of its articular surface terminates by a well defined
line or ridge, the back part curves downward, & is
insensibly lost on the neck of the condyle: there is
a rough protuberance below the outer end of
the condyle; and a more extensive rough surface
below the inner end, which overhangs the rising
ramus. The smooth broad convex ~~ridge~~ rising
which bounds the lower part of the coronoid fossa
terminates at the fore and inner part of the condyle
The inner side of the symphysis presents at its
lower posterior part a rough oval shallow depression
traversed by a right median vertical ridge, which terminates
in the rough transverse broader ridge bounding the
depression below. The inner surface of the

horizontal

horizontal ramus is smooth; a sudden but slight sinking marks the beginning of the inner surface of the ascending ramus. This surface is divided by the ridge leading to the condyle into an upper & lower part: the upper & smaller depression receives the insertion of the crotaphite muscle: the lower one is pierced by the dental canal, from which hole a canal is continued downwards & forwards. The hole is in the middle of the ascending ramus.

Compared with the mandible of the Human species even of the lowest variety, the Australian, e.g., the first & chief Distinction is the absence of the chin; and which is as well marked in the black as in the white ~~varieties~~ races of the Human kind. The entire jaw is much shorter in proportion to the intercondyloid space, in Man: for then in Europeans; the angle of the jaw is usually more rounded off in the Australians, is round as in the fig. 2, but always less rounded & better marked in a less degree than in the Gorilla. The distance between the condyles is as great in most adult male jaws as in the Gorilla & the same it is greater: whilst the ordinary length of the lower jaw measured as in Gorilla is only 5 inches.

The parabolic or elliptic curve of the alveolar arch (fig. 3), and the progressively diminishing size of the sockets from the molars to the incisors, and the thin sharp wall between each alveolus, are also well-marked characteristics of the human jaw in this comparison.

Of the generally developed vertical ridge or 'tubercle maxillare,' at the lower & fore part of the Symphysis in the human jaw, there is no trace in the Gorilla; and the tubercles sometimes developed in a transverse pair, or three in number, at the back surface of the symphysis are equally wanting in the Gorilla. The outer surface of the jaw beneath the outer & anterior origin of the ascending ramus, is more protuberant in Man. As to the absence of the 'external oblique ridge' attributed by some anthropotomists as a normal character of the lower jaw, the very frequent absence of any such ridge in the Human subject, renders the like absence in the jaw of the

of the Gorilla of little moment in this comparison

The foramen mentale which is below the first premolar in the Gorilla is below the second premolar in Man, as it is also in the Chimpanzee and Orang. The inner & anterior ridge of the ascending ramus converges more regularly (or directly as it ascends) to the outer one in Man & has not the angular deflection which it shows in the Gorilla. The horizontal ramus gradually and slightly diminishes in vertical extent as it approaches the ascending ramus: the contrary is the case in the Gorilla. The highest & most prominent part of the condyle is nearest the middle of that joint in Man. The point of the coronoid is on the same vertical line with the fore part of the base of the ascending ramus: in the Gorilla it is bent more backwards The interval between the coronoid & condyloid processes is relatively wider & more shallow.

The ridge which extends from that angle of the condyle in the Gorilla, above the foramen dentale is more feebly marked, or is wanting, in Man.

The inner wall of the molar alveoli overhangs the subjacent part of the jaw more & more abruptly in Man than in the Gorilla: the frequent development of the internal oblique ridge extending from behind the socket of the last molar forwards & downwards & beneath the first molar, or a little further, is a characteristic of the human jaw as compared with that of the Gorilla and other Anthropoid apes. There is only a slightly roughened longitudinal tract beneath the inner wall of the alveoli of the last two molars in the Gorilla.

The foramen of the dentary canal is relatively larger

larger, in the white varieties of the Human, than in the Gorilla; & the inner boundary of that foramen is more produced. The coronoid process is less depressed & less marked in man.

The condyle is more compressed from before backward in man; and its articular surface is better defined.

The outer surface of the angle of the jaw has neither the tuberosity nor the vascular groove present in some human jaws.

In comparison with the lower jaw of the Troglodytes niger, that of the Gorilla is chiefly distinguished by the superior height & expanse of its ascending ramus. The rounded part of the angle is less extensive in the Chimpanzee: that angle is consequently better marked, and both in this respect, and in the minor vertical extent of the horizontal ramus beneath the last molar tooth, the Chimpanzee approaches nearer the human subject; though both differences seem to be due to its inferior strength as compared with the Gorilla, are not particularly characteristic of Man. The symphysis is accordingly relatively deeper in the Chimpanzee; and though sloping backward as it descends it is rather more prominent at its lower part than in the Gorilla. The mental foramen besides being placed below the socket of the second premolar, is nearer the

the lower border of the ramus there is the Gorilla, & in so far differs more from man

The antero-internal ridge of the ascending ramus is more behind, & more distant from, the antero-external ridge than in man; but it rises, without the angular bend shown in the Gorilla, & the coronoid depression is relatively smaller, & its lip less deflected than in the Gorilla. The ridge continued from the middle of the antero-internal ridge to the condyle, (which, rounded,) is not so well marked in the old male Chimpanzee.

The breadth of the symphysis is almost equal to that in the Gorilla, as is shown in pl fig. 3, and is consequently relatively greater, compared with the length of the jaw than in the Gorilla

The entry of the dental canal is nearer the antero-internal ridge, and relatively lower, in the Chimpanzee than in the Gorilla, which in the more central position of that foramen more nearly approaches man. At the lower & back part of the symphysis there is a fossa bounded below by a transverse crescentic ridge, or backward continuation of the under surface of the centrum

The coronoid process agrees with that in the Gorilla in its shape and the backward curve of its apex. The condyle resembles in shape that of the Gorilla, but the articular surface does not extend so far downwards behind, and is better defined there. The two lower pairs

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of those adult specimens of Chimpanzee the development of the ridges on the inner & back part of the rising ramus is the most developed, as is shown in fig. 5. The form of the posterior margin of that ramus is shown in Man (pl. fig. 4, in the Gorilla, pl. fig. 2 & in the Chimpanzee ib. fig. 5.

In the Orang-utan (Pithecus Satyrus, var Wurmbii) the first difference is the lower & more obtuse coronoid process: the more full elliptical form of the condyle due to its greater antero-posterior breadth. The larger development & lower origin of the antero-external ridge; and the greater breadth of the channel dividing it from the antero internal ridge: this ridge rises straight to join the external one at the fore part of the coronoid process: Behind it the retroplatic depression is deeper but narrower than in the Gorilla. The external retroplatic depression is also better marked.

The dental foramen by its relatively higher position than in the Chimpanzee, corresponds closer with that in Man: Behind and below it one or two "myloglossi" foramina stand in the direction of the canal. The mental foramen is nearer the lower border of the jaw than in the Gorilla: it is below the second molar tooth.

The symphysis is broader & flatter, & less sloping at its upper half: below this it is convex & receding as in the Gorilla. There is a slight prominence at its under part,

on

on each side of which a rough tract extends outwards for nearly two inches.

A pit is bounded below by a rough crest or ridge characterizes the inner & back part of the symphysis. A narrow linear ridge extends from behind the last alveolus forward & downwards — a feeble trace of the internal oblique ridge in man.

Five or six rough ridges on the inner side & back part of the ascending ramus, with intervening depressions, indicate the attachment of the pterygoid, as in the Gorilla.

The angle of the jaw is better marked in the Orang.

The alveolar part of the jaw is shorter in proportion to the rami in the orang. and the same characteristic distinguishes man is shown by the straightness & parallelism of molar series.

In the lower jaw of a female Pithecus Satyrus the anterior & posterior borders of the ascending rami are nearly straight & parallel.

The vertebral column of the Gorilla in the Gorilla differs from that of Man in having but one gentle curve, with the concavity forward, from the sacrum to the cervical series, which is straight when extended. It differs also in the more uniform transverse diameter of the bodies of the ~~lumbar~~ dorsal & lumbar vertebræ, the latter not expanding in the same degree as they approach the sacrum, as ~~the dorsal are~~ they do in the Human Subject. These general differences in the relative position & proportions of the true vertebræ are repeated, and are rather more strongly marked in the Chimpanzee & Orang.

The comparison is restricted, throughout, with the Australian variety of the Human Species - a variety of which the skeleton, & the bones, have not hitherto been described and figured.

The cervical vertebræ of the Gorilla are the same in number as in the class Mammalia generally viz. 7.

The number

The number of dorsal vertebræ, or those bearing moveable ribs, is 13; that of the lumbar vertebræ 4; that of the sacral vertebræ 5; the total number of true vertebræ being the same

as in Man, only the ribs which answer to the transverse processes of the first lumbar in Man retain their distinctness with a greater length.

Cervical Vertebræ.—Of the true vertebræ the cervical series departs most from the Human type in the extraordinary length of the spines of the last five vertebræ; that of the fourth cervical being not less than three inches and a half; those of the third and fifth are nearly of the same length, but are thicker, and have a slight curvature in opposite directions, away from the fourth, the third forwards and the fourth backwards, in a very slight degree; the spines of the sixth and seventh cervicals gradually decrease in length and increase in thickness: the spine of the dentata is trihedral, the surfaces being divided by produced sharp ridges. The canal for the vertebral artery decreases in diameter from the sixth forward to the atlas. The bodies of these vertebræ are longer in proportion to their breadth than in Man, and the lower (pleurapophysial) part of the transverse process of the sixth is more suddenly increased in length and breadth, and diverges more from the upper division of the same process. The atlas is narrower than in Man, with a wider neural canal, especially between the condyles, which are smaller than in Man. An obtuse process is developed backwards from the part representing the body, which is broader than in Man; the perforation of the transverse process is smaller, and that process is narrower, especially vertically; the groove behind the upper articular processes is deeper and narrower. The axis or dentata differs chiefly in the greater size of the neural canal, and in the greater length and less breadth of the neural spine; the zygapophyses are smaller, the transverse processes are more directly perforated by the arterial foramina, and the diapophyses are more produced, and more remote from the posterior zygapophyses.

The bodies of the succeeding cervical vertebræ are longer in proportion to their breadth; the basis of the neurapophysis ascends to embrace the hinder half of the antecedent vertebra as in Man. The difference observable in the dentata is manifested in excess in the third cervical vertebra, the spinous process of which more than doubles the vertical diameter of the rest of the vertebra; the neural canal also exceeds that of Man in the same diameter; the zygapophyses are smaller than in Man: the arterial canal is transversely elliptic, not circular; the transverse process is longer, more slender and more simple; the pleurapophysial not projecting distinctly from the diapophysial part; the diapophysis is more remote from the zygapophysis; the neurapophyses are much thicker and stronger; the long neural spine becomes subcompressed and slightly dilated at its extremity, which is not bifurcate. The same general differences, and especially the very striking one in the length of the neural spine, are manifested in the fourth cervical vertebra, but the pleurapophysial part of the transverse process is now distinctly developed as a triangular depressed plate produced forwards and a little downwards; the lower part of the centrum is proportionally less than in Man, and the smaller size of the zygapophysis is the more remarkable in contrast with the larger proportions of almost all the rest of the vertebræ. In the fifth cervical vertebra the zygapophyses equal in size those of the corresponding vertebra in Man; the pleurapophysial part of the transverse process is less developed than it is in the fourth: the arterial canal is wider, the anterior and posterior zygapophyses are more nearly upon the same plane, and the neural arch has a greater antero-posterior extent; the superior thickness of the neurapophysis above these processes is very striking; the arterial canal of the transverse process increases in a greater degree in the Chimpanzee, Gorilla; the pleurapophysial part of that process diverges more from the diapophysis, and broader and more produced than in Man; the zygapophyses are now larger in the Chimpanzee and Gorilla, but the centrum is still narrower; the neural spine is still very long and very strong, but is somewhat shorter than in the antecedent vertebra, 5.

The atlas of the Orang (Pithecus Wurmbii) departs in the same way from the Human type, but in a greater degree than that of the Gorilla: the transverse diameter being still less in proportion to the fore-and-aft diameter, and the transverse processes being less developed: the neural arch, n, is more bowed and slender. The vertebra is applied to the whole of the compound part marked d, p & pl, in fig. 1, 3; d being the diapophysis, p the parapophysis, and pl the pleurapophysis.

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In the atlas of the ~~Chimpanzee (Troglodytes niger)~~ ~~Orang Utan (Simia satyrus, var. Wurmbii)~~ generally (pl. , figs. 1 & 4) the proportions are almost the same as in the Gorilla (pl. , figs. 2 & 3): and the difference of form from that in Man (figs. 8 & 9), consequently as great: the neural arch is ~~more extended and less angular~~ of the whole vertebra.

(after perforating) The transverse process, ~~is perforated lengthwise by~~ the vertebral artery, ~~which afterwards~~ slightly grooves the neural arch. ~~The sutures between this arch and the~~ bony bar (hypapophysis) by which holds the place of the centrum, ~~are still distinct.~~ The transverse extent of the ~~bar~~, in proportion to the antero-posterior extent, is greater than in Man: the flattened posterior articular ~~processes~~ (fig. 14, z') are reniform, not subcircular as in Man, and the vertebral foramina, are relatively less. (sub-elliptic or)

In the dentata of the ~~Chimpanzee~~ Orang the short transverse process ~~is~~ perforated, ~~but~~ and it is not bifurcate: the neural spine is pointed, the posterior articular surface of the centrum is convex transversely, slightly concave vertically. The odontoid (true centrum of the atlas) is longer, in proportion to its thickness than in Man; the anterior articular surfaces are narrower, the lower surface of the centrum is flatter, the spine is longer and more pointed, and the perforation in the transverse process relatively smaller than in Man. The transverse convexity of the posterior surface of the centrum is greater, and the vertical concavity less than in Man. (resembles that of the Gorilla in being)

The third cervical vertebra, in the ~~Chimpanzee~~ Orang as in the Gorilla, ~~It~~ is chiefly distinguished from the corresponding Human vertebra by the length and slenderness of its simple spinous process. The transverse process has a short oblique pleurapophysial plate. In

~~The~~ the fourth cervical vertebra, ~~The~~ the angles of the oblique lamelliform transverse process begin to be produced. In the fifth cervical

In ~~this~~ the diapophysial and ~~para~~pleurapophysial portions project distinctly from each transverse process. In the sixth,

~~In this~~ the pleurapophysis or rudimental rib completing the perforated transverse process has not coalesced with the parapophysis; and it has either not been ossified, or is lost, in the adult skeleton examined. In the seventh cervical vertebra the transverse process is represented as in the Gorilla, by the diapophysis only, which is not perforated.

The spinous process of the last five cervical vertebrae, markedly differ, like those of the Gorilla, from the corresponding parts in Man: only they are ~~less~~ proportionally less developed than in the Gorilla.

In the atlas of the Chimpanzee (Troglodytes niger),

~~There~~ there is a short process from the back part of the hypapophysis: the vertebral artery ~~pierces~~ (by) after traversing the transverse process ~~lengthwise and then~~ also perforates the neural arch, but this may be an individual variety: the costal part of the left transverse process has not been ossified: that process is represented by a short parapophysis and a long diapophysis, the vertebral foramen being, nevertheless, complete. A small ridge represents the neural spine. In comparison with the Orang, the breadth of the atlas exceeds its antero-posterior diameter chiefly by the length of the diapophysial part of the transverse process: it thus, as in the Gorilla, more nearly resembles that of Man in its general shape. It likewise resembles it more in the minor breadth and greater length of the part representing the body, in the larger and more definite surface on the upper part for the articulation with the odontoid process, and in the greater breadth and more produced margins of the hinder articular processes. In all these approximations it agrees with the atlas of the Gorilla.

In the dentata

~~The axis~~ In the dentata of the Chimpanzee

~~The~~ transverse processes are short and terminate simply and obtusely: the neural spine is trifid, having an anterior ridge and two terminal tuberosities directed outwards and a little backwards. The body is deeper behind in proportion to its breadth than in the Orang, and the vertical concavity equals the transverse convexity of that articular surface: the neural canal is less contracted above: the anterior zygapophyses are larger and better defined. In all these respects the Chimpanzee approaches nearer to Man than the Orang does.

like the Gorilla

In

The third cervical vertebra,

~~The~~ fore part of the bases of the neurapophyses are produced forwards beyond the centrum and complete the transverse concavity for the reception of the backwardly produced body of the axis. This surface is deeper in proportion to its breadth than in the Orang, and in this respect approaches nearer to that of Man. The vertebral arterial foramina are larger, the neural canal wider, and the anterior zygapophyses better defined, than in the Orang. The body of the vertebra is longer in proportion to its breadth than in the Orang, and the vertical concavity of the hinder surface is deeper. The costal portion of the transverse process is compressed and slightly produced downwards, forming an obtuse angle distinct from the more acute diapophysis which is prolonged outwards and backwards. The neural spine is subtrihedral, slender, obtusely pointed, and ~~of equal vertical extent~~ with the neural canal.

its base is coextensive

The fourth cervical vertebra of the Chimpanzee,

~~This vertebra,~~ in the greater depth and minor breadth of the body, and in the larger relative size of the neural canal and of the vertebral arterial foramina, repeats the same differences from that of the Orang, and the same resemblances to that in Man, as the foregoing vertebra does. The neurapophyses still form the sides of the anterior concavity of the body. The costal ridge is equally distinct; the diapophysis is longer and the neural spine is a little longer than in the preceding vertebra.

The same differences, as compared with the fifth cervical in the Orang are repeated in this vertebra of the Chimpanzee. The costal portion of the transverse process is more produced. The neural spine is both longer & stronger. The diapophyses are somewhat less.

The sixth cervical differs from the foregoing in a slight increase of breadth & prominence of the pleurapophysis & in a diminution of the diapophysis: the centrum is more expanded posteriorly, the neural spine is longer & ~~stronger~~ thicker than in the Orang; but is proportionally less developed than in the Gorilla. In

C 9

The seventh cervical vertebra,

~~The~~ costal portions of the transverse process are reduced to an osseous filament, which completes the lower boundary of the vertebral arterial canal. The diapophysis is much longer and thicker than in the sixth. The transverse extent of the centrum continues to increase, as also the antero-posterior breadth of the neurapophyses. The neural spine increases in breadth and slightly in length.

In the atlas of the male Australian (pl. , figs. 8 & 9) there

the fore part of the (by)

There is a tubercle from the hypapophysis representing the body, and a rough surface on the neural arch in place of a spine. The vertebral artery perforates the transverse process ~~lengthwise, and afterwards~~ grooves the neural arch behind the produced angles of the ~~ante-~~ ~~rior~~ zygapophysis. The body is longer and deeper in proportion to its breadth than in the Chimpanzee. The surface for the odontoid is more nearly circular and better defined. The cavities for the condyles ~~are~~ relatively larger, deeper, with the margins more produced. The pleurapophysial boundary of the vertebral arterial foramen is much thicker than the diapophysial one: they are equal in the ~~Chimpanzee~~: the arterial foramina are relatively larger and the posterior zygapophyses are relatively much larger than in the ~~Chimpanzee~~.

the back part of the upper Gorilla or Orang. occipital Gorilla Gorilla

proceps, or true body of the atlas,

These differences chiefly relate to the more secure articulation and support of the vertically sustained head, and to the larger size of the cerebral organ in part nourished by the vertebral arteries in the Human species. The development of the zygapophyses gives a greater antero-posterior extent to those parts of the atlas, and the transverse processes are thicker in proportion to their length.

~~The axis.~~ body of the dentata (fig. 10) its

hinder border is more rounded.

The ~~lower~~ surface of the ~~centrum~~ is less flattened than in the Chimpanzee, the middle line being produced almost into a ridge. The transverse process is thicker and more obtuse in proportion to its length: both the anterior and posterior zygapophyses are relatively larger: the neural canal is relatively wider transversely: the neural spine is much less developed. In fact, what is usually described as the bifurcated spine of the axis seems rather to be the upper slightly produced extremities of the not completely coalesced neurapophyses of that vertebra in Man.

Lines drawn parallel with the transverse plane of the anterior zygapophyses would meet at a right angle in the Chimpanzee, but at a more open angle in Man, especially in the White races.

~~The~~ third cervical vertebra (fig. 7, 8)

~~The~~ upper ~~anterior~~ angle of the base of each neurapophysis is produced forwards beyond the centrum, and assists in forming, but in a less proportion than in the Chimpanzee, the transverse concavity for the ~~backwardly~~ produced body of the axis. The centrum is larger in proportion to the rest of the vertebra than in the Chimpanzee, save in its ~~antero-posterior dimension.~~ The pleurapophysial part of the transverse process forms a distinct obtuse angle from the diapophysial part, which is shorter, thicker, and more obtuse than in the Chimpanzee. The same difference is here repeated in the greater relative size of the zygapophyses, particularly the anterior ones. The transverse diameter of the neural canal is relatively greater. The neural spine is much shorter ~~and thicker.~~

Gorilla or lengths.

~~The~~ fourth cervical vertebra (fig. 11) of the body

~~The~~ upper ~~anterior~~ concavity are still formed by the neurapophyses, which are less produced than in the preceding vertebræ, or than in the corresponding vertebræ of the ~~Chimpanzee.~~ The diapophyses ~~and neural spine~~ are shorter than in the Chimpanzee; ~~especially the latter.~~ The zygapophyses are relatively larger. The pleurapophysial and diapophysial parts of the transverse process are nearly equally developed, and are bent ~~forwards~~ upwards on the sides of the groove which impresses the ~~fore~~ upper part of the transverse process. The pleurapophysial boundary for the canal for the vertebral artery is here much thinner than the diapophysial one.

Gorilla. the neural spine is considerably shorter than in the Gorilla.

~~5190.~~ The fifth cervical vertebra (fig. 5 and fig. 12)

Gorilla or

~~The~~ upper ~~anterior~~ concavity of the body is less deep than in the Chimpanzee. The ~~antero-posterior extent~~ of the centrum is absolutely less and relatively much less in breadth. The costal portion is now more developed than the diapophysial portions of the transverse process, ~~which appears to~~ form a short broad plate with the angles bent ~~forwards~~ outwards. The zygapophyses are relatively ~~much~~ larger than in the Chimpanzee: the antero-posterior extent of the neural arch is greater: the neural spine is much shorter, thicker, and is ~~not~~ bifurcate. The ~~anterior~~ upper margin of the neural arch is sharper than in the Chimpanzee.

lengths and parapophysial

15 Australian

The sixth cervical vertebra (fig. 7, 6, and fig. 11)

The Human characteristics of this vertebra are shown in the greater relative increase in the size of the centrum, especially transversely, with the minor degree of the anterior concavity and posterior transverse convexity of the centrum. The pleurapophysial part of the transverse process is more produced outwards in proportion to the diapophysial part; the zygapophyses continue to present their characteristic superiority of size; and the neural spine, although here of greater length, is inferior in this respect to that in the Chimpanzee. The antero-posterior extent of the neurapophyses is greater in Man, and their anterior border is sharper, than in the Gorilla or Chimpanzee.

(pl) (d) than in the preceding cer. vicals, than in the fifth cervical, is vastly / Gorilla, Orang, or /

The seventh cervical vertebra (fig. 7, 7)

The increase of breadth in the centrum, the increase of the antero-posterior vertical extent of the neural arch, and in the length and thickness of the neural spine, is somewhat greater in this vertebra, as compared with the sixth cervical, than in the Chimpanzee. The costal part of the transverse process, completing the arterial foramen, is thicker than in the Chimpanzee: the diapophysis is shorter, but much thicker.

Gorilla or /

(but it is much less developed than in the Gorilla (fig. 1, 6, + fig. 6, pl). the arterial canal, v, is less than in the Gorilla (fig. 6, v).)

In both the Human subject and the great anthropoid apes the aspect of the articular surfaces of the zygapophyses are, in the upper pair, upward & backward; a little outward, and the reverse in the lower ones. The metapophysial tuberosities, m, are better marked in the last three cervical vertebrae of the Australian than in the Gorilla.

The differences between the cervical vertebrae of the Australian & the Gorilla, which are prominently exemplified in the figures of pl: especially in the contrast of the fifth cervical vertebra, fig. 5, with that of Man, fig. 12, and of the fifth cervical vertebra, fig. 6, with fig. 11, gradually decrease as we pass from the first to the lower or succeeding dorsal vertebrae: pl.

~~Dorsal Vertebræ~~ The dorsal vertebræ besides their increase of number—the thirteenth however answering to the first lumbar in Man, with the pleurapophysis retained as distinct elements—differ in the greater length of the spines of the first five vertebræ, which progressively decrease to the length they present in the Human subject, but with greater thickness, and in the last three with greater ~~antero-posterior~~ vertical extent. The bodies of the middle dorsal vertebræ are shorter in proportion to their breadth; the diapophyses are thicker, stand more directly outwards, and the costal surfaces are more concave and oblong; the metapophysis which projects distinctly in the eleventh vertebra in Man, does not so appear until the twelfth in the Gorilla (pl. fgs. 2 p, m) / (ib. fgs. 1, 12, m).

In the first dorsal the centrum is larger ~~vertically~~ from before backwards, and the spine is twice the length of that in Man; the zygapophyses are larger than in Man; the costal surface is more produced ~~on~~ in the side of the body: but the chief difference is in the position and direction of the diapophysis, which in the Gorilla projects directly outwards below the level of the anterior zygapophysis; the fore part of the base of the neurapophysis is less deeply grooved in the Gorilla. and is set inclined downwards.

The tenth dorsal vertebra of the Gorilla (pl. , fgs. 3, 5 & 7,) contrasts in corresponding views with that of Man (ib. fgs. 4, 6. & 8). The under surface of the body, c, is somewhat smaller in the Gorilla, & the surfaces, pl, for the ribs are better marked: a slight difference in the aspect of the zygapophyses allows more of their articular surface to be seen in fg. 3, at z': the greater difference in the direction of the diapophyses, d, is also well shown. The somewhat thicker diapophyses and stouter neck of the spine are shown in fg. 5, as compared with fg. 6: and the more prominent upper zygapophyses in Man are exemplified in both figures 6 & 8.

The same general differences may be noticed in the ~~three~~ succeeding dorsal vertebræ, except that the spine becomes shorter and the centrum larger in the Gorilla; the neural arch rises more abruptly beyond the ~~anterior~~ upper zygapophysis.

In the sixth dorsal vertebra the neural spine is reduced to the same length as the corresponding spine in Man; the centrum is larger, the neural canal of the same size, the posterior costal pits are longer, the diapophyses still stand out more transversely.

~~In the Chimpanzee the proportionate increase of the centrum is greater than in Man,~~ the neural spine is less obliquely bent backwards, and is thicker ~~antero-posteriorly~~, though not longer; the ~~anterior~~ upper zygapophyses are more produced; the diapophyses are broader and somewhat shorter.

~~spine~~ vertically

In the eleventh dorsal the neural spine is much expanded at its extremity.

In the twelfth there are distinct and well developed metapophyses (m) projecting from the ~~fore~~ upper part of the diapophyses ~~behind~~ beyond the ~~anterior~~ upper zygapophyses. This vertebra corresponds in this character with the eleventh of the human subject. The neural spine is broader vertically, and thicker especially superiorly. There is but one costal surface on each side of the base of the neurapophysis. The diapophyses are reduced in size, the metapophyses equalling them ~~in~~ ~~body and neural spine increasing~~ in

In the last dorsal vertebra of the Gorilla (pl. 1, fig. 1, 13) (pl. 1, fig. 2, 1) which answers to the first lumbar in Man, the chief difference is the articular surface, p, for the free rib-element.

The increase in the size of the centrum is more in the antero-posterior than in the transverse diameter; and in the size of the spine it is more in the vertical diameter than in length.

The dorsal vertebræ of the Chimpanzee accord very closely, except in size, with those of the Gorilla, and manifest the same general distinctions from those of Man.

In the first dorsal

~~The~~ bases of the neurapophyses, instead of being produced ~~forwards~~ upwards, have those angles as it were truncated, to form the articulation with the heads of the first pair of ribs. The breadth of the centrum is augmented, and also, in a more especial degree, that of the diapophysis, which is excavated below for articulation with the tubercle of the rib. The neural spine is increased in ~~antero-posterior~~ vertical extent, ~~but not in length, nor~~ and is as long as that of the last cervical: it is consequently longer than in Man.

In the second dorsal the centrum is larger than in the first: the upper zygapophyses are more approximate & distinct from the diapophyses, which thereby appear to be longer: the neural spine is somewhat longer than in the first dorsal.

The third differs from the second dorsal in its narrower upper neural emargination, in the somewhat shorter diapophyses & longer neural spine. In the ninth dorsal the centrum presents a marked increase of size: the spine is thicker transversely and more expanded at its end.

In the tenth dorsal there is an increase in the size of the body and of the neural spine: and the inferior costal surface is replaced by a more articular tubercle: that surface is retained & well marked in the corresponding vertebra of the Gorilla, pl. , fig. 1, p'.

In the twelfth dorsal the metapophysis projects distinctly upward from the diapophysis

In its principal characters it resembles the last ~~dorsal~~ thirteenth dorsal of Man; for instance, in the distinct and well-developed metapophyses, which are thicker and longer in the Chimpanzee; also in the narrower and longer ~~posterior~~ lower part of the neural arch, concomitant with the change of position of the ~~posterior~~ lower zygapophyses. The diapophysis still shows, in the Chimpanzee, an articular surface for the tubercle of the thirteenth rib. The neural spine is longer and larger than in Man, especially in its ~~antero-posterior~~ vertical extent.

Although the Orang in some resembles Man more than does either the Gorilla & Chimpanzee in the number of dorsal vertebræ, or those characterised by moveable ribs, yet the individual vertebræ do not offer so close a similarity to the corresponding human ones as they do in the Chimpanzee. The Spines of the first & second dorsals are equally characterised by their superior length.

The spine of the third dorsal has an ~~anterior~~ upper and ~~posterior~~ lower prominence: the succeeding spines gradually diminish in length, but increase in breadth and ~~antero-posterior~~ vertical extent to the penultimate lumbar.

In the dorsal ~~vertebræ~~ series of a half-grown Orang (Pithecus Wurmbii) I have ~~a~~ noticed that the metapophysis begins to project from the anterior angle of the diapophysis in the seventh vertebra, progressively increases in size in succeeding vertebræ, & ~~is~~ arrives at its maximum in position close to the upper zygapophysis in the last dorsal. In the adult male Skeleton in the College of Surgeons,

The metapophysis appears as a tubercle, near the base of the ~~anterior~~ upper zygapophysis of the twelfth dorsal: it is equally distinct on the first lumbar, but subsides to a slight eminence on the succeeding lumbar vertebræ. The anapophysis is only distinguishable from the diapophysis upon the first lumbar vertebra, where it serves to illustrate the true relation of the diapophysis of that vertebra to those of the antecedent dorsals and the succeeding lumbars.

In comparing the last dorsal vertebra with that of Man one may notice the smaller size of the body & the shorter neural Spine of the Orang: and that the neural arch of the Orang is entire below, not notched.

In the Negro and Australian Skeleton the body

The first dorsal vertebra (pl. , fig. 2, 1)

The body is relatively larger than in the Chimpanzee, particularly anteriorly: it is less convex below. The transverse processes are thicker and are more inclined ~~upwards~~ backwards and ~~for-~~ upwards: the spinous process is thicker and relatively shorter, & more inclined downwards

The second dorsal vertebra (ib. 2)

it is larger in proportion & the neural arch & its appendages than in the Gorilla

The centrum is increased in vertical and antero-posterior extent: the ~~anterior~~ upper zygapophyses are nearer to each other and are produced more ~~forwards~~ than in the first dorsal, whereby the ~~anterior~~ upper notch of the neural arch becomes deeper and narrower. The diapophyses are longer and thinner. The neural spine is also thinner, and the ~~posterior~~ lower zygapophyses are smaller. This vertebra differs from its homologue in the Chimpanzee in the more ~~upward~~ backward direction of the diapophyses and the more outward aspect of their articular surface. The ~~anterior~~ upper emargination of the neural arch is less deep: the neural spine is absolutely shorter and smaller. The body is relatively ~~as well as~~ absolutely larger, and the pedicles of the neural arch are ~~higher and~~ longer in conformity with the wider neural canal.

Gorilla and (larger than in the Gorilla and is) than in the Chimpanzee

The third dorsal vertebra (ib. 3)

~~This~~ differs from the second in a slight diminution in the transverse and increase in the ~~vertical~~ antero-posterior extent of the centrum: the diapophysis and neural spine are somewhat thicker: the ~~anterior~~ upper neural emargination is narrower. It differs from that of the Chimpanzee in the minor length of the neural spine, the greater relative breadth of the centrum, the greater length of the pedicles and concomitant expanse of the neural canal. The accessory tubercle is less distinctly developed upon the diapophysis, than it is in the Chimpanzee

Gorilla &

The fourth dorsal vertebra (ib. 4)

The same general differences, in comparison with the Chimpanzee, are repeated ~~in this vertebra~~ with a greater development of the diapophysis ~~upwards~~ backwards and an increased size of the accessory tubercle.

The seventh dorsal vertebra (ib. 7)

The progressive increase in the size of the centrum is greater, and the ~~anterior~~ upper and ~~posterior~~ lower costal surfaces are less equal and less approximated than in the Chimpanzee.

The eighth ~~dorsal vertebra.~~

The neural spines of ~~this~~ and the preceding dorsal vertebræ are shorter than in the Chimpanzee, are thicker transversely and less extended in the axis of the spine, especially at their extremities, which are tuberous, not truncate as in the Chimpanzee.

The ninth dorsal vertebra (ib. 9)

The centrum is relatively larger, and the accessory tubercle above the diapophysis is more produced.

The tenth dorsal vertebra (ib. 10 & figs. 4, 6 & 8.)

~~This~~ chiefly differs from the preceding in the absence of the ~~posterior~~ lower costal surface on each side, as at pl. fig. 4. in which it agrees with

with the tenth dorsal of the Chimpanzee & differs from that in the Gorilla.

In Australian

The eleventh dorsal vertebra

The metapophysial tubercle which was slightly indicated in the preceding vertebra becomes more distinct. The centrum continues to increase in size. In

The twelfth dorsal vertebra (fig. 2, 12)

The centrum continues to enlarge, and the neural spine to gain in ~~antero-posterior~~ vertical extent. The metapophyses are well developed: the anapophyses may be recognized distinctly: the diapophyses are reduced to smooth tubercles without an articular facet. The neural arch of this vertebra contracts in breadth ~~posteriorly~~ below, concomitantly with the modified shape and direction of the ~~posterior~~ lower (2') zygapophyses, which are elongated and incline more obliquely outward than in the preceding vertebra. This modification does not characterize the corresponding vertebra in the Chimpanzee. The ~~anterior~~ upper emargination of the neural arch is wider in the twelfth dorsal, which is distinguishable from the eleventh not only by this character, but by the distinctness and greater length of the metapophyses, and by the greater length and minor breadth of the part of the neural arch supporting the ~~posterior~~ lower zygapophyses.

(3)

Gorilla or

Lumbar vertebræ

These in the Gorilla & Chimpanzee are four in number by reason of the retention of distinct or free pleurapophyses in the vertebra answering to the first lumbar in Man: they are, also, in some adults of both Gorilla & Chimpanzee portion reduced by the modification of the vertebra, answering to the last lumbar in Man, by which it assumes the characters of a sacral vertebra.

In the full grown but not old Gorilla compared by me the four lumbar vertebræ are distinct. - They are figured in pl. . fig. 1; and ~~They~~ have longer

~~Lumbar Vertebræ, the centrum~~

~~between~~ Less long bodies in proportion to their breadth, their spines slope more ~~downwards~~ backwards, the metapophyses (m) continue more distinct and prominent, ~~& the spines~~ are more expanded at their extremity and in all but the last are subbifid, in the Gorilla.

(from in Mom:)

When naturally articulated together they form a straight line, without any tendency to convexity forwards as in Man; and in the Gorilla the whole series of the vertebræ form but one curvature which is slightly concave ~~in the~~ forwards, especially in the dorsal region —

~~o o~~

[redacted] between the normal Lumbar [redacted] exemplified [redacted] of the great [redacted] the 3d [redacted] Negro [redacted] of the [redacted] in backwards [redacted] of the [redacted] production [redacted] giving greater distinctness to the metapophyses m: the rhomboidal form and downward inclination of the neural spine: the base of which extends further above the lower zygapophyses z', which is more distinct & prominent, and with it articular surface more everted in Mom (fig. 5, 3).

The contracted calibre of the neural canal in the lumbar vertebræ of the Gorilla, as exemplified in figure 4 is an interesting & important deviation in its relations to the minor development of the lower limbs in that great Anthropoid ape. The superior capacity

Lumbar Vertebræ. The lumbar vertebræ have longer bodies in proportion to their breadth than in Man: their spines slope more downwards: the metapophyses (m) continue more distinct and prominent: the spines are more expanded at their extremity and in all but the last are subbifid, in the Gorilla.

When naturally articulated together they form a straight line, without any tendency to convexity forwards as in Man, and in the Gorilla the whole series of true vertebræ present one curvature which is slightly concave forwards, especially in the dorsal region —

The chief differences between the normal lumbar vertebræ of the Gorilla & Man are exemplified in the 4 views of the 2d lumbar vertebra of the great Ape, pl. : figs 3 & 4 and of its homologue the 3d lumbar vertebra of an adult male Negro at fig. 5. As to the greater length of the centrum: the greater inclination (and less inclination backwards) downwards of the diapophysis d: the more upward production of the anterior zygapophysis z, giving greater distinctness to the metapophysis m: the

(pl. figs. 1, 2)

In the first lumbar vertebra the metapophysis (m) is still large and distinct; the upper zygapophysis becomes more convex and oblique in position; the diapophysis is suddenly elongated, as compared with that of the corresponding Human vertebra; the chief difference is seen in the smaller size of the neural canal which relates to the inferior development of the lower extremities, and in the greater length and terminal expanse of the neural spine. The same difference obtains in the second lumbar vertebra; the diapophyses are broader and more depressed in the Gorilla; the upper zygapophyses are more convex in part, not wholly concave as in Man; a fossa divides them from the metapophyses; the centrum is as broad as in Man, but is deeper and longer; the neural spine extends more obliquely downwards, and its expanded apex is bifid. In the last lumbar vertebra the difference is very striking in the minor expanse of the centrum in the Gorilla, especially behind, in the much smaller and more depressed form of the neural canal, in the shorter and broader diapophysis, the more distinct metapophysis, in the convex anterior and more approximated posterior zygapophysis, and in the greater length of the centrum. The

(text on verso of flap)

capacity of that canal in the corresponding human vertebra, pl. 5, relates to the enlargement of the myelonal centre of the supply of nerves influencing the characteristically developed & modified lower limbs of Man, in relation to his privileged upright posture. This difference demands or occasions a greater length in the crura or bases of the neural arch in ~~Man~~ the human lumbar vertebræ.

The first lumbar ~~vertebra~~ of the Chimpanzee (pl. , fig. 6)

~~This~~ vertebra, which answers to the second lumbar vertebra in the Orang and Man, differs from both in the superior length and size of the neural spine. The metapophyses project from the ~~upper~~ hinder and outer part of the ~~anterior~~ upper zygapophyses, from which they are separated by a narrow groove. There is a feeble rudiment of anapophysis from the ~~back~~ lower part of the long and depressed diapophysis.

~~The~~ second lumbar vertebra

The metapophyses still continue to be separated by a groove from the anterior zygapophyses. The neural spine is more expanded at its broad flattened termination. The centrum is somewhat augmented in size.

~~The~~ third lumbar ~~vertebra~~

In ~~this~~ vertebra the diapophysis is shorter and thicker, and the anapophysial tubercle larger and more distinct at its ~~back~~ lower part. There is a slight increase in the size of the centrum. The neural canal which, in the first lumbar vertebra, is relatively narrower than in Man, becomes gradually more contracted as it approaches the sacrum. The fourth lumbar has both diapophysial elements modified for articulation with the iliac bones, & functionally forms the beginning of the sacral series. in the adult Chimpanzee examined by me,

In proceeding with the ~~comparison~~ examination of the ~~lumbar of Man as far~~ vertebral column in the ~~Negro~~ Ethiopian & Australian varieties of the human race, ~~we find that, as compared with the dorsal series,~~ the in reference to the present comparison, we see that the lumbar vertebræ, 5 in number, (pl. fig. 2) are so arranged, when in their easy & natural co-articulation, as to form a slight curve with the convexity forwards: and owing to the less length of the bodies, these five vertebræ do not exceed by more than half a vertebra the length of the four lumbar vertebræ in the Gorilla. Compared with the dorsal vertebræ of the same skeleton

skeleton previously described & compared

The first lumbar vertebra (ib. fig. 2, 1) has its

~~The~~ centrum is much increased in size, and the neural spine in extent. The metapophysial tubercles (m) are also enlarged, but do not project so freely, by reason of the extension of the articular surfaces of the ~~anterior~~ upper zygapophyses upon the inner sides of their base. The diapophyses are much increased in length. The anapophysial tubercles are still distinct. The ~~hinder~~ lower half of the neural arch is more contracted than in the last dorsal, and the ~~posterior~~ zygapophyses are turned directly outwards. This outward direction is much less in the Gorilla & Chimpanzee.

The second lumbar vertebra (ib. fig. 2, 2)

~~This~~ chiefly differs from the first by a slight increase in the size of the centrum and in the length of the diapophysis. The ~~anterior~~ upper zygapophyses are larger and look more directly inwards. Both metapophysial and anapophysial tubercles are distinct. This vertebra differs from its homologue, the first lumbar vertebra, of the ~~Chimpanzee~~ Gorilla, in the greater size of the ~~body and~~ neural arch, in the greater size of the zygapophyses as compared with the diapophyses, ~~and more especially in the greater size~~ of the neural spine. The anapophysial tubercles are better developed in the Human vertebræ, and are situated at the upper, and not at the hinder part of the base of the diapophysis. The ~~backward~~ downward production of the ~~posterior~~ lower zygapophyses occasioning the deep ~~posterior~~ inferior emargination of the neural arch is also a characteristic distinction of the Human lumbar vertebræ.

from that of the Chimpanzee it differs also in the greater size of the centrum and

D. 17

The third lumbar vertebra (ib. fig. 2, 3 & fig. 5)

Both metapophysial (m) and anapophysial tubercles continue distinct ~~on this vertebra~~. The ~~posterior~~ margin of the neural spine projects distinctly ~~behind~~ between two oblique ridges which diverge from the sides of that spine upon the ~~posterior~~ lower zygapophyses (z'). ~~This differs~~ this character adds to the other differences pointed out in the preceding lumbar vertebræ. Gorilla &

The fourth lumbar vertebra (ib. fig. 2, 4) Gorilla &

~~This~~ shows, like the corresponding vertebra in the Chimpanzee, a decrease in the length of the diapophysis, but it likewise shows a marked diminution in the ~~antero-posterior~~ vertical extent of the neural arch, occasioned principally by a diminished length and increased breadth of the ~~posterior~~ lower zygapophysis. The anapophysial tubercles are distinctly developed. The body of the vertebra, though much broader, is not longer than that of its homologue, the third lumbar, in the Chimpanzee, and it is shorter than the corresponding vertebra in the Gorilla.

The fifth lumbar vertebra (ib. fig. 2, 5) especially breadth,

~~This~~ is characterized not only by its superior size, but by the great transverse expansion of the ~~hinder~~ lower part of the neural arch concomitant upon the superior development and outward ~~expansion~~ extension of the ~~posterior~~ lower zygapophyses. The diapophyses and neural spine are shortened: the anapophyses appear like a part of the upper border of the base of the diapophysis pinched up and produced ~~backwards~~ downwards. The metapophysial tubercles are separated by a groove from the anterior zygapophyses.

As we recede from the thoracic or central region of the vertebral column the differences from the Human type become greater & the specific peculiarities of the ape become more marked. Even the differences of race begin to be more clearly indicated in the osseous structure of the vertebræ when we come to the sacrum; which has indeed one of constant characters that one in a European with the sacrum of an Australian of similar the same age & sex.

In the Gorilla the

Sacrum

(pl. , figs. 1 & 2)

The sacrum departs in a greater and more instructive degree from the Human type; it consists of five anchylosed vertebræ, but they are longer and narrower than in Man, and present a very slight curve, with the concavity forwards; the neural foramina are much smaller, the neural spines much more developed; they coalesce to form a single strong bony ridge, extended over and gradually subsiding on the last sacral vertebra, the neural arch of which is entire; the articular surface of the first sacral vertebra is one-third smaller than in Man; the zygapophyses are smaller, but the metapophyses are present and well developed; the iliac surface extends to the upper half of the third vertebra, is narrower than in Man, but owing to the greater length of the first and second vertebræ, it is longer. The posterior outlets of the nervous canals are very small, and the whole neural canal is much more contracted.

(n.s) (figs 2, n.s) of the body (figs. 2) (figs. 6 & 8)

sacrum of the , which consist of five vertebræ.

In the Orang (Pithecus Wurmbii) the confluent spines form a lower ridge with projections corresponding to the three upper vertebræ, of which the last third prominence is the thickest; & then it ceases. The sacro-iliac synchondrosis is restricted to the first & second vertebræ & a small part of the third. The neural arch is open in the last two vertebræ. The entire sacrum is relatively shorter, and broader above than in the Gorilla.

In the Chimpanzee the sacrum more resembles in its general form & proportions, that of the Gorilla: it also consists of five vertebræ.

The neural arch is complete in each, and the spinous process is developed from all but the last, the four posterior spines being confluent. The metapophyses are developed from the four anterior sacrals: the three anterior ones join the iliac bones.

The sacrum of the male Australian figured in pl. figs 5 & 6.

(as in the Human species generally)

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Chimpanzee by their greate

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In both

figure of the last

obtuse angle d

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sides of the

In the Anthropomorphous apes, as in Man, the tail is reduced to three more or less stunted vertebræ, which being usually anchylosed together in the Human adult are the bone called 'coccyx'. This is shorter, and broader

+ 00

The characteristic peculiarities of the first sacral vertebra in Man, e.g. the greater relative capacity of the neural canal (n.s) the larger size, especially in the antero-posterior direction, of the articular surface of the centrum c; the greater length of the coalesced pleural apophyses pl; and the less length of the neural spine, — are shown in figures 4, 6, 2 & 4.

outlets of the nervous canals are very small, and the whole neural canal is much more contracted.

sacrum of the
In the Orang (Pithecus Wurmbii), which consist of five vertebræ,
the confluent spines form a lower ridge
with projections corresponding to the three upper vertebræ, of which
the last third prominence is the thickest; + there it ceases
The sacro-iliac symphysis
is restricted to the first + second vertebræ + a small part of the third.
The Neural arch is open
is incomplete in the last two vertebræ. The
entire sacrum is relatively shorter, and broader above
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In the Chimpanzee the sacrum more resembles in its
general form & proportions, that of the Gorilla: it also
consists of five vertebræ. The neural arch is complete in each, and the spinous process is developed from all but the last, the four posterior spines being confluent. The metapophyses are developed from the four anterior sacrals: the three anterior ones join the iliac bones.

The sacrum of the male Australian figured in pl. figs 5 + 6.
as in the Human, spinis generally,
consists of five anchylosed vertebræ. They differ from the sacral vertebræ of the Chimpanzee by their greater breadth and by their anterior concavity both lengthwise and transversely. The nervous foramina are relatively much larger: the spinous processes are shorter and thicker. The two anterior sacrals and a small part of the third form the sacro-iliac joint. The neural arch of the last two sacral vertebræ is incomplete.

In both the Gorilla and Chimpanzee the diapophyses
Figure of the last sacral vertebra (5 5, d) terminate in an
obtuse angle divided by a notch from the side of
the body of the vertebra, down which they are continued
lower down in the Chimpanzee than in the Gorilla.
In Man they subside gradually upon the
sides of the last sacral vertebra.
In the Anthropoid apes, as in Man, the tail is
reduced to three more or less distinct vertebræ, which
being usually anchylosed together in the Human adult form
the bone called 'coccyx'. This is shorter, and
broader

and broader at its base in Man than in the Gorilla or Chimpanzee (fig. 3, c1, c2). In some rare instances the first caudal vertebra is anchylosed to the last sacral vertebra & modified like it, as in fig. 7, pl. , & the coccyx, c 2, is reduced to ~~two~~ vertebræ.

As the question of the degree of variety & which the portion of the skeleton described & compared in the preceding pages may be subject in the human species, is one of much interest in the ~~pre~~ actual state of Organic Philosophy the following results of comparison of a male Dyak (Borneo), a Skeleton of a male Eskimaux, and of a well formed European (Frenchman) may not be unacceptable:, ~~and~~

Vertebræ

Vertebræ of a male adult Eskimaux compared with those of an adult male Australian

The atlas

It differs from that of the male Australian (No. 5186), in the larger relative size of the zygapophyses.

The axis.

This is larger, has larger zygapophyses, and the under part of the centrum less compressed, than in the Australian. In both the neural spine is broad transversely, with its angles bent back.

The third cervical vertebra.

The posterior zygapophyses are larger, the diapophyses thicker and more produced, and the canal for the vertebral artery wider, than in the Australian.

The fourth cervical vertebra.

The vertical diameter of the centrum is much greater than in the Australian.

The first dorsal vertebra.

It differs chiefly in its longer and stronger proportions from that of the Australian.

The second to the sixth dorsal vertebræ.

The parapophysis (or articular surface for the head of the rib) increases in size and distinctness from the fourth to the sixth. These vertebræ differ chiefly from those of the Australian by the relatively greater size of the centrum and the stronger processes.

The seventh to the tenth dorsal vertebræ.

They differ chiefly in their relatively larger centrum from those of the Australian.

The eleventh dorsal vertebra.

It has a single surface for the head of the rib on each side, which has ascended from the body upon the neurapophysis. The diapophysis is very short and obtuse: a metapophysis of greater length extends from its upper and back part towards the zygapophysis. There is a short anapophysis.

The twelfth dorsal vertebra.

The costal surface has now wholly passed upon the extremity of the short and thick diapophysis: the metapophysis and anapophysis are distinct from this.

As compared with the twelfth dorsal of the Australian, besides a considerable inferiority of size, the costal surface is on the side of the neurapophysis, and has not ascended upon the tubercle which represents the diapophysis, as in No. 5204.

The first lumbar vertebra.

The anapophysis and metapophysis have subsided to tubercles, and the diapophysis is elongated by the extension of ossification into the fibro-cartilaginous basis of the pleurapophysis.

In the Australian the metapophysis is relatively longer, the diapophysis smaller, and the tubercles on the back of the posterior zygapophyses are less developed.

The second lumbar vertebra.

The third lumbar vertebra.

The upper part of the neural arch has been, probably after fracture, moveably articulated with its piers or bases. The anapophyses are well developed.

The fourth

The fourth lumbar vertebra.

That of the Australian differs in its much shorter diapophyses.

The fifth lumbar vertebra.

The shortened and much thickened diapophyses present an articular surface for the produced angles of the sacrum.

The sacrum.

It is larger and broader in proportion to its length than in the Australian (No. 5210); it is also more concave anteriorly. The neural arch is left open and incomplete in all the vertebræ, whilst in the Australian the neural arch of each of the three anterior sacral vertebræ is completed and supports a spine.

Vertebræ of a Male Dyak (Borneo) compared with those of

The atlas.

Compared with that of the Australian (No. 5186), the zygapophyses are smaller, the diapophyses are larger, and the sub-bifurcate neural spine is better developed. The canals for the vertebral arteries are larger, and they perforate the neural arch as well as the transverse process. The neural arch is likewise perforated by the first spinal nerve. The characters of age are manifested by the irregular ossification extending from the periphery of the odontoid articular surface.

The axis.

The diapophyses here are smaller, the bifid spine longer, and the transverse processes more widely perforated and more produced, than in the Australian (No. 5187).

The third cervical vertebra.

This, also, repeats the differences of the smaller zygapophyses, the larger articular canals, and, the spine being bifid, with the two divisions well produced.

The fourth cervical vertebra.

The fifth cervical vertebra.

The same differences are repeated in both these vertebræ as compared with those of the Australian.

The sixth cervical vertebra.

The body is proportionally larger and the costal part of the transverse process more produced than in the Australian. As an individual peculiarity, the neural arch and spine are slightly distorted towards the right side, and the vertebral arterial canal of the same side is contracted and divided by a transverse bony bar.

The seventh cervical vertebra.

Both transverse processes are perforated. All the foregoing vertebræ to the axis inclusive show characters of age by irregular ossifications extending into the anterior vertebral ligament.

The first dorsal vertebra.

The inequality of size in the zygapophyses is here less. The diapophyses are longer and stand more outwards, and the centrum is larger than in the Australian Negro.

The sixth dorsal vertebra.

In each of the preceding the diapophyses are less bent upwards than in the Australian.

The metapophyses are distinctly developed from the upper part of the base of the diapophyses of the eleventh vertebra.

The twelfth dorsal vertebra.

It is larger than in the Australian, has the neural spine more extended in the direction of the axis of the body, has a larger costal surface, and shows the anapophysis more distinct from the rudimental diapophysis.

The first lumbar vertebra.

In this the metapophyses, anapophyses and diapophyses are more produced and distinct than in the Australian. Although the vertebra is larger than in the Australian, the zygapophyses continue to be absolutely as well as relatively less.

The second lumbar vertebra.

Although the anterior zygapophyses in their change of position have ascended to the base of the metapophyses, both these and the anapophyses continue to be distinct from the progressively increasing diapophyses.

The third lumbar vertebra.

Here both metapophyses and anapophyses have subsided to tubercles. The zygapophyses equal those in the Australian, and the diapophyses are of the same length, but the body and neural spine of the vertebra are much larger.

The fourth lumbar vertebra.

This is individually remarkable for the ossific growths which have extended from the under part of its centrum into the ligamentous sheaths underlapping the contiguous vertebra before and behind.

The last lumbar vertebra, showing in a minor degree the same characteristics of age.

The sacrum, with the first coccygeal vertebra anchylosed.

It is relatively broader, especially across the third vertebra, and is less concave than in the Australian. The neural arch is completed over the first four vertebræ.

Vertebræ of an adult male Bushman, compared with

It is larger, particularly in the transverse diameter, than that of the Esquimaux or the Australian. As compared with the latter, the zygapophyses and arterial foramina are proportionally larger. The diapophyses are broader and less obliquely twisted.

The axis.

With the same superiority of size, it differs from that of the Esquimaux in the more backward inclination of the transverse processes and the deeper notch between these and the posterior zygapophyses. The spine is not so broad, but is higher. The notch between the post-zygapophysis and diapophysis is less deep in the Australian than in the Esquimaux.

The third cervical vertebra.

In this, the character of the deeper notch between the zygapophysis and diapophysis is repeated. The spine is longer and more slender.

The fourth cervical vertebra.

The notch between the diapophysis and zygapophysis is wider than in the Esquimaux and deeper than in the Australian. The spine is longer, and, as in the preceding vertebræ, is unsymmetrically bifurcate.

The seventh cervical vertebra.

This shows a marked superiority of size over that of the Esquimaux, and still more so over that of the Australian. The diapophyses are thicker and more produced: both, but especially the right, are perforated by smaller foramina than those of the preceding cervical vertebræ. Besides the increase of size, this vertebra differs from the preceding in the minor depth of the anterior articular surface of the centrum, in the increase of that part transversely, and the absence of any prominent plate from the costal part of the transverse process which now forms simply the lower boundary of the arterial foramen; in the greater length, breadth and thickness of the diapophysial part of the same process; and in the greater length and thickness of the spine, which terminates in an obtuse enlargement notched behind but not bifurcate. The posterior zygapophyses are also relatively larger.

The first dorsal vertebra.

The diapophyses are longer, and less inclined upwards than in the Esquimaux or Australian, and the aspect of the costal surface upon them is more directly downwards. In the Australian it looks more outwards than in the Esquimaux. The ridge along the lower part of the same process, here strongly developed, is feebly marked in the Esquimaux and is not present in the Australian. The produced parts of the border of the anterior articular surface of the centrum formed by the neurapophyses are more restricted to the upper and outer parts than in the preceding vertebræ.

The second to the tenth dorsal vertebræ inclusive.

In each of these the aspect of the costal surface of the diapophysis is more directly downwards than in either the Esquimaux or Australian.

The eleventh dorsal vertebra.

This vertebra is characterized, as in the Esquimaux and Australian, by the development of well-marked metapophyses from the upper and fore part of the diapophyses, which are shorter and less thick than in the foregoing vertebræ. The surface for the head of the rib has passed upon the side of the neural arch. This differs from the preceding vertebra in the distinct development of the metapophyses, in the diminished size of the diapophyses, which now cease to show the well-defined articular surface, and in the diminished length with increased thickness of the spine.

The twelfth dorsal vertebra.

This differs from that of the Esquimaux in the articular surface for the rib being still confined to the side of the base of the neurapophysis and not transferred to the diapophysis, which is short and obtusely pointed. The neural spine has a less antero-posterior extent, and a more expanded summit. This vertebra differs from the eleventh dorsal in the superaddition of small but distinct anapophyses, in the increase of the metapophyses and diminution of the diapophyses. The posterior zygapophyses are smaller, and are convex, instead of flat or slightly concave, surfaces; and those surfaces are turned more obliquely outwards. The hinder half of the neural arch is narrower.

The first lumbar vertebra.

This differs from that of the Esquimaux in having the metapophysial tubercles larger and the anapophysial ones smaller: the diapophyses are shorter, but broader: the neural canal is wider in proportion to the size of the centrum. As compared with that of the Australian, besides the general superiority of size, the difference is chiefly marked in the much longer and larger diapophysis of the Frenchman's vertebra. As compared with the last dorsal vertebra, besides the usual difference of absence of the costal articular surface may be noted the diminution of the metapophysis and its approximation to the anterior zygapophysis, which has now a concave surface directed obliquely upwards and inwards. The two tubercles, which terminate the posterior ridge of the neural spine below in the tenth, eleventh and twelfth dorsal vertebræ, are here further apart and advanced upon the back part of the posterior zygapophyses.

The second lumbar vertebra.

The transverse processes of this vertebra are relatively longer than in the Australian, and the spine is higher in proportion to its antero-posterior extent. The tubercles behind the posterior zygapophyses are more distinctly developed. The anapophyses have subsided to mere ridges.

The third lumbar vertebra.

That of the Esquimaux differs from it chiefly in the retention of the anapophyses. The zygapophyses are less widely apart in the Esquimaux. The distance between the zygapophyses in each pair is the same in the Australian as in the European, although the vertebra itself is smaller in the Australian.

The fourth lumbar vertebra.

The zygapophyses are relatively larger than in the Esquimaux, and the whole neural arch with its processes are larger in proportion to the centrum than in the Australian; the spine more particularly is longer. This vertebra differs from the foregoing in the reappearance of the anapophysis upon the back part of the base of the diapophysis. Three ridges radiate from it; one to the diapophysis, another to the anterior zygapophysis, a third to the side of the neural arch.

The fifth lumbar vertebra.

The posterior zygapophyses are larger and wider apart than in the Esquimaux, and are larger but not wider apart than in the Australian: the spine is longer than in either of those varieties: the diapophyses are much thicker than in the Australian. The fifth differs from the fourth lumbar vertebra chiefly in the shortening and thickening of the diapophyses, at the back part of which the anapophyses are reduced to tubercles. The metapophyses now appear as simple thickenings upon the upper border of the anterior zygapophyses. The posterior zygapophyses are larger; their articular surface is concave, and looks more directly downwards. The neural spine is reduced, particularly in antero-posterior extent.

The sacrum

(and answering to the first caudal vertebra in the normal type of skeleton, in the present instance,) consists of six anchylosed vertebræ, the supplemental one being at the caudal extremity of the bone. The first vertebra of the coccyx has nevertheless its usual size and shape: the sacrum is consequently longer in proportion to its breadth than in the Esquimaux, and larger in all dimensions, with a deeper anterior concavity, than in the Australian. The so-called transverse processes of the first sacral vertebra slope more downwards from the anterior articular surface of the centrum than in the Esquimaux, the direction being more like that in the Australian. The anterior zygapophyses also resemble those of the Australian in being larger and more sessile than in the Esquimaux, and the tuberosity which extends outwards and forwards from their base is much less produced than in the Esquimaux. The articular surface for the ilium terminates on the same transverse line with the third sacral foramen, as in the Australian. In the Esquimaux it extends very little beyond the second sacral foramen. In the present sacrum the neural arch is completed over four vertebræ and supports a spine: in the last two sacral vertebræ the neurapophysis coalesces with its homotype of the contiguous vertebra, but not with its fellow in the same vertebra.

(of the first vertebra of the ordinary coccyx, like the sacrum of most male Europeans, this)

All the differences above noted, after a scrupulously detailed comparison of the bones of the different varieties of the human race, are much less degree and very inferior in importance to the proportions of distinction established in the present comparison between the skeleton of Man (lowest variety of) and that of the highest of the ape-tribe. //

Description of the plate.

All the figures are of the natural size. Plate

Plate

Mandibula or lower jaw.

Fig. 1. Side view of the lower jaw of an adult male Gorilla (Troglodytes Gorilla)
2. Ib. of an Australian.
3. Upper view of the lower jaw & teeth of adult male do.
4. Back view of the ascending ramus of the lower jaw of do.

Plate

Fig. 1. Upper view of the lower jaw & teeth of the Gorilla
2. Back view of the ascending ramus of the lower jaw of do.
3. Upper view of the lower jaw and teeth of (an adult male Chimpanzee (Troglodytes niger).
4. The grinding surface of the molar series of the right side of the jaw, with the crown of the canine, of an old male Chimpanzee.
5. Back view of the ascending ramus of the lower jaw of the Chimpanzee.

In all the figures c signifies the canine; p 3 & p 4 the premolars, indicative of their homology with the third & fourth of the typical series, as shown in the hog; & m 1, m 2, & m 3, the first, second & third true molars

Plate

Cervical vertebræ

Fig. 1 The cervical vertebræ of the Gorilla (Troglodytes Gorilla
(a part only of the 7th is indicated in outline)

2. Upper view of the atlas of the Gorilla

3. Under view of the atlas of do.

4 Under view of the dentate of do.

5 Under view of the fourth cervical vertebra of do

6 Upper view of the fifth cervical vertebra of do

7 The cervical vertebræ of an adult male Negro.

8 Upper view of the atlas of do.

9 Under view of the atlas of do.

10 Under view of the dentate of do

11 Upper view of the sixth cervical vertebra

12 Under view of the ~~fifth~~ fourth cervical vertebra.

13 Upper view of the atlas of the Ateles (Pithecia Satyrus).

14 Under view of the atlas of do.

Plate

Dorsal Vertebræ.

Fig. 1 The thirteen dorsal vertebræ of the Gorilla.

2 The twelve dorsal vertebræ of a Negro.

3 Lower view of the tenth dorsal vertebra of the Gorilla.

4 Lower view of the tenth dorsal vertebra of a Negro.

5 Hinder view of the tenth dorsal vertebra of the Gorilla.

6 Hinder view of the tenth dorsal vertebra of a Negro.

7 Front view of the tenth dorsal vertebra of a Gorilla.

8 Front view of the tenth dorsal vertebra of a Negro.

Plate.

Lumbar Vertebræ

Fig. 1. The five lumbar vertebræ of the Gorilla

Pl. 2. The five lumbar vertebræ of a Negro.
3. Side view of the second lumbar vertebra of the Gorilla.
4. Upper view of the second lumbar vertebra of do.
5. Side & upper views of the third lumbar vertebra of a Negro.
6. Upper view of the second lumbar vertebra of the Chimpanzee (Troglodytes niger).

Plate

The Sacrum.

Pl. 1 The sacrum of the Gorilla
2 Upper view of the sacrum of do.
3 The sacrum & coccyx of the Chimpanzee.
4 Upper view of the sacrum of do.
5 The sacrum of an adult male Australian
6 Upper view of the same sacrum.
7. The sacrum & coccyx of a Bushman
8. Upper view of the same sacrum.