ART. XXI. — *On the Skeleton of the Great Chimpanzée, Troglodytes gorilla.* Read before the Boston Society of Natural History, April 21st, 1852. By S. KNEELAND, Jr., M. D. Boston.

THE Society has recently received a most valuable addition to its Cabinet, in a nearly complete skeleton of the Troglodytes gorilla, presented by the American Board of Commissioners for Foreign Missions. It consists of a fine skull, with lower jaw, with the teeth complete; all the vertebræ except the atlas; the pelvis complete; both scapulæ and clavicles; the entire humerus, radius, and ulna of left side, the ulna of the right side with the humerus and radius broken; the femur and tibia of right side, and the head and upper portion of shaft of the left femur; all the ribs, a few bones of the hand, and the manubrium of the sternum.

The cranium is of great size and strength; the internal capacity is only twenty-seven cubic inches, while that of another specimen belonging to the Society is thirty-five cubic inches. Prof. Wyman gave the measurement of the last as half an inch less; this trifling difference may be owing to my using smaller shot, and perhaps pressing them down a little more closely. From the capacity, from the great development of the sagittal and lateral crests, and the massive character of all the bones, this is undoubtedly a male; the appearance of the jaws, the complete development and worn surfaces of the teeth indicate an adult, if not an old animal. The sutures are hardly discernible, as usual; the superciliary ridges and crests are exceedingly well developed. The specific characters pointed out by Professor Agassiz, in the decreasing depth of the infra-orbitar canal from before backwards, and the projection outwardly of the inner walls of the orbits, are well seen on this specimen. There are two infra-orbitar foramina on each side. The nasal bones are united together, in the lower half presenting traces of a median suture, in the upper half a prominent ridge; the portion of the bone between the

inner orbitar angles of the frontals seems to confirm Dr. Wyman's opinion, that it is an independent piece, having its own centre of ossification; the foramen existing midway between the incisive foramen of each side and the edge of the alveolus, on the left side is replaced by two, as in the Chimpanzée. The zygomatic arches are exceedingly strong, much more so than in our other specimen, inclosing temporal muscles which might easily account for the tremendous strength of the jaws. The other anatomical peculiarities of the cranium and face have been sufficiently detailed by Dr. J. Wyman in the fifth volume of the Society's Journal, (p. 426.) The following points are interesting: — The dental formula is the same as in man; the median upper incisors are twice the size of the lateral, the reverse of which is the case in the lower jaw; they are also respectively longer, giving to the upper incisors a convex edge, and to the lower a concave one; in the upper jaw there is an interval of two or three lines between the incisors and canines, and no interval between the latter and the premolars, the reverse being the case in the lower jaw, in which, however, the interval is less; the upper canines extend from the alveolus one inch and a half, the part within the alveolus being at least two inches; they are an inch broad and three fourths of an inch thick; the upper canines are worn anteriorly by the lower, and posteriorly by the first lower premolar, giving to the tooth a triangular shape, with an anterior, a posterior, and an internal cutting edge; the action of the lower premolar on the upper canine, and of the latter on the lower canine, produces a distinct *talon*, or heel, at the base of these teeth; the two grooves, mentioned by Dr. Wyman as occurring on the inner face, are not seen in these canines, probably from the extent of the worn surface; there is the lower portion of a single groove, however, which is lost in the worn surface beyond. To produce these surfaces there must be some lateral motion of the jaw, which would not be expected from the great length of these teeth. The premolars and molars agree with Owen's description in

the Cyclopedia of Anatomy and Physiology (Art. Teeth); in the upper molars the anterior inner cusp is seen to be united to the posterior outer cusp by an oblique ridge; the first lower premolar is much larger than the second, the anterior cusp being so strongly developed that the tooth resembles an enlarged human canine; all the lower molars have three cusps on the outside and two on the inside. The lower jaw, as will be seen by the measurements, is of great size and strength; the ramus being at right angles with the body of the bone; the condyle is one inch and three fourths wide, and five eighths of an inch thick, projecting much internally; the coronoid process is higher than the condyle. The external face of the ramus is deeply concave for the masseter muscle, which is nearly three inches wide; the ramus inclines very much outwardly at its lower portion, and is grooved internally for the internal pterygoid muscle. The body of the jaw is one and three fourths inches high, and nearly an inch thick; the height at the symphysis, and width is two inches; the thickness one and one fourth inches; the chin is convex and retreating, its convexity measuring three and one fourth inches.

Trunk. Of the vertebræ, only the atlas is wanting. The odontoid process of the axis, instead of being almost perpendicular as in man, inclines backwards at an angle of about 50°; the spinous process is an inch long, spreading at its apex to nearly the same width, with an evident disposition to fork as in the human type; it is also somewhat concave at the end of its under surface. The bodies of all the *cervical* vertebræ are higher, but narrower than in man, and received deeply one in the other. The spinous processes are horizontal, long, and, excepting the third, which is sharp-pointed, are swelled or club-shaped at the end; the fourth is the longest, the third the shortest; their lengths are, from the posterior face of the spinal canal, as follows: — the third, two and one eighth inches; the fourth, three and three fourths inches; the fifth, three and five eighths inches; the sixth,

three and one eighth inches; the seventh, three and one fourth inches. The use of these long spinous processes is sufficiently obvious, being required for the attachment of the ligamentum nuchæ, which must be very strong in these creatures; from the posterior situation of the occipital foramen, the head must have a great tendency to fall forward, and its immense weight requires a corresponding strength in this ligament. The transverse processes are very long, the posterior an inch in length; the anterior, or cervical ribs, begin to be seen at the fourth, increasing to the sixth and seventh, which last are of equal size; there being, as a general rule, no cervical ribs to the seventh vertebra of the mammal neck. All the cervical vertebræ are pierced for the vertebral artery on each side; the transverse processes are directed obliquely downwards.

The *dorsal* vertebræ are *fourteen* in number, (as in the Chimpanzée, according to Cuvier); they much resemble the human in shape and size; the last two are rather larger, and more like the human lumbar vertebræ; the spinous and transverse processes are much more developed; the spinous process of the first is like the cervical, and two and seven eighths inches long; the spinal canal is less in this and the remainder of the column; the spinous processes of the second and third dorsals are compressed laterally at the end, and are two and a half inches long. At the fourth, the spinous processes begin to descend, as in man, to the ninth; below this they resemble the lumbar spines, though pointing more downwards. The last dorsal has its rib on the right side firmly anchylosed to the body.

The *lumbar* vertebræ are only *three* in number, fewer than in any of the higher Mammals; the bodies are larger and thicker than in man; the vertical diameter is less anteriorly than posteriorly, making this region concave anteriorly, and showing that the erect position is as unnatural for it as for the other Quadrumana. Possibly one of the lumbar vertebræ may be missing; though from the manner in which they fit into each other, and into the last dorsal and first sacral, it seems hardly

probable; adding the fourteen dorsals, the whole number is the same as in man.

The *sacrum*, which has a slight lateral deviation to the left, consists of *eight* bones, firmly joined together, the intervertebral spaces being obliterated, excepting between the first and second. The first bone resembles very much a lumbar vertebra, and on one side its transverse process, though bearing the upper portion of the articulating surface for the right ilium, is not connected with the lateral portion of the sacral wing below; on the left side, the bony union is complete, and the spinous process is continuous without interruption or foramen with the median sacral crest; this crest, at its upper portion, is two inches in height, gradually decreasing, and lost entirely on the sixth bone, where also the sacral canal terminates. The sacrum is long and narrow, having a very decided concavity anteriorly. The articulating surface for the ilium is confined to the first three vertebræ. Whether or not any coccygeal vertebræ are anchylosed in the sacrum, it is not easy to say; from the uncommonly large number of sacral vertebræ, namely, eight, it would seem probable that these also include the coccyx; the terminal bone ends in a rounded projection, which has somewhat the appearance of an articulating surface.[1]

The bodies of the second and third cervical vertebræ incline backwards; the direction becomes perpendicular in the fourth, and in the last three a little inclined forwards; at the upper dorsal region the spine is slightly convex, in the lower dorsals and lumbar concave; at the last lumbar and first sacral it is again convex, and in the lowest portion again concave. The whole number of vertebræ is thirty-two, and possibly thirty-three; the length of the cervical, dorsal, and lumbar vertebræ is twenty-two inches; from this it would appear that the spinal column is very nearly as long as the

[1] In Dr. W. Lewis's description of a Gibbon (Vol. I. of this Journal, p. 35,) it is stated that the coccyx consisted of one bone; in our specimen this single rudimentary coccyx may have been attached to the sacral terminal surface.

human, to which it also comes nearer, in its curves, than to that of any of the Quadrumana.

The *pelvis* of the *T. gorilla* departs widely from that of the Chimpanzée and Orang, and approaches that of man in the greater spread of the ilium, — its deep anterior cavity, and corresponding posterior convexity, on which a well-marked longitudinal ridge indicates the origin of the glutæus maximus, — and a fainter semicircular line, extending from the sciatic notch to near the rudimentary anterior inferior spinous process, about two and a half inches above the acetabulum, the probable origin of the glutæus minimus; the anterior superior spinous processes are fully six inches in advance of the plane of the sacrum. The sacrum extends only to the spine of the ischium, about four inches from the tuberosities of this bone, so that the pelvis has somewhat of the lengthened narrow form peculiar to the Quadrumana, though it projects far more from the line of the spine than in the other members of the group. The superior aperture has not the narrow, elongated shape of the Orang's, the antero-posterior diameter being only half an inch greater than the transverse, these being respectively six and a half and six inches; in the female, according to Dr. Wyman's measurements, the difference is greater, being three inches. The tuberosities of the ischia are very thick and broad, and the rami of the pubes very wide; the whole lower portion indicates great strength and solidity. It is the portion of the pelvis between the acetabulum and the lower edge of the sacro-iliac articulation, which is so much shorter in this animal than in the Chimpanzée, and which gives to the pelvis its more human aspect.

At first sight the *scapula* has the appearance of the human, having very much its shape, but somewhat enlarged; the measurements given at the end of the article show it to have belonged to a larger specimen than the one described by Dr. Wyman. It more nearly resembles that of the Orang than that of the Chimpanzée, but is more like that of Man

than either, in its more equilateral form. The spine is placed nearly in the middle of the bone, making the supra spinous nearly equal to the infra spinous fossa; after about one third of its length it ceases to have the broad thick edge of the human spine, reaching nearly to the posterior border, but is continued by a sharp well-marked ridge quite to the edge, as in the Orang; the spine is also more perpendicular to the plane of the dorsum than in man, and its direction more that of the axis of the trunk. The acromion process is longer, and less curved than in man, and wants the strong angle on its posterior surface a little in advance of the plane of the glenoid cavity; its arch over this cavity belongs also to a much larger circle. The coracoid process has a greater inclination downwards than in man and the Chimpanzée; this direction, in the Orang, Vrolik considers a sign of inferiority. The glenoid cavity is much the same as in man, the upper half being less narrow in proportion. The subscapular fossa is very deep, and divided by prominent ridges into five or six smaller depressions. There is no deep supra-scapular notch as in the human scapula; but there is a decided concavity at the base of the coracoid process, without the narrowness of a notch, contrasting strongly with the nearly straight line of the upper border of the bone in the Orang.

The *clavicles* are shorter and stronger than in man, and less curved; the edges are more angular; their length, in a straight line, is six and one fourth inches; their circumference in the middle two inches, thence increasing to each end; the subclavian ridge is well marked.

The *sternum*, at its upper portion, is four inches wide, and about half an inch thick; there is a decided semilunar notch, but less than in man; the lower portions are wanting. There is no sign of division into lateral halves in this upper portion, which is three and three fourths inches long. The articular surface for the clavicles is less curved and more horizontal than in man.

The *ribs* are fourteen pairs; of these two are wanting on

the left side, at about the middle of the series. They much resemble those of man, and form a very capacious thorax; they are, however, longer and thicker, and the curves less complicated. Some of them, like other bones, bear marks of old injuries. The angles of the ribs are extremely well marked; even the last is united both to the body and to the transverse process of a single vertebra.

The *humerus* is about three inches longer than that of man, and two inches greater in circumference at the middle, the latter measurement being five inches; around the middle of the head, horizontally, eight and one fourth inches; greatest width at lower extremity four and one fourth inches. The bone is of very compact structure, and very heavy. It resembles that of man, but it is less twisted on itself; the bicipital groove is quite deep and wide, having on its sides very large tuberosities for the insertion of the powerful muscles indicated by the immense scapular surface of origin; the ridges for the attachment of the pectoralis major, latissimus dorsi, and teres major attest also the great strength of these muscles; unlike those of Dr. Wyman's specimen, these bones have the deltoid insertion well marked, and the anterior face rather convex than concave, even more so than in man. Both the condyles, and the condyloid ridges are more developed than in man; the trochlear portion is less excavated, and the internal ridge less prominent; there is a deep groove between the trochlea and the surface for the head of the radius, which is very slight in man. The lower extremity is perforated in the right humeris, but not in the left; the cavity for the olecranon is an inch in width and half an inch deep, while that for the coronoid process on the anterior surface is hardly sunk beneath the level of the bone; this difference is much less in man.

The *ulna* is more curved than in man, as is also the *radius;* they curve in opposite directions, inclosing a wide space between them; the curve of the radius begins at the tubercle, while the ulna is curved its whole length. The articulating

surface for the humerus, on account of the less prominence of the inner ridge of the trochlea, differs from that of man in being proportionally wider, and in having a deep concave inner wall, which in the human ulna is not only wanting, but the edge of this border of the joint is worn into a deep notch corresponding with the long inner ridge of the human trochlea; at the bottom of this cavity is an irregular long bone, apparently wedged in, and perhaps having a separate centre of ossification; if the olecranon process were taken off through the suture here left open, the head of the ulna would very much resemble the head of the tibia, to which it corresponds in the lower extremity; this is seen on both sides. The articulating surface for the head of the radius is less perpendicular than in man; the coronoid process is also less prominent, in conformity with the small anterior concavity on the humerus; the styloid process, and the accompanying groove, occupy a greater proportion of the lower extremity. With the exception of stronger ridges, and sharper angles, the remaining portions of the ulna and radius resemble much the same bones in man, on a large scale. The proportion between the humerus and ulna brings this animal nearer to man than the Chimpanzée or Orang.

The *femur*, in its head and neck, is much like the human; it has a roughness, hardly a depression, for the ligamentum teres; the neck of the bone is proportionally shorter, and placed more obliquely with respect to the shaft; the trochanters, especially the great, are much stronger; the lesser trochanter also stands out enormously to receive the internal iliac muscle, situated in the immense iliac fossa, and principally concerned in flexing the thigh on the pelvis, as in the act of climbing; the space between the great trochanter and the head of the bone is less, and the concavity much deeper than in man; the neck of the bone is also more flattened and less round, supporting, as it does, less proportional weight. The whole bone is flatter, especially just above the condyles, and its shaft more curved. Though the inner condyle is so

much longer than the external as to give the lower part of the shaft an inclination outwards, as in man, the curve of the middle and upper portions restores its general direction nearly to the vertical, as in the Chimpanzée. The femur is about two inches shorter than the humerus; in this respect the *T. gorilla* recedes from the human type, while he approaches it in the relative lengths of the ulna and humerus.

The *tibia* also is considerably shorter than the human, and more curved both laterally and anteriorly, producing consequently a large interosseous space. The upper articulating surfaces, as observed by Dr. Wyman, are on different planes; the internal one being the lowest and concave, the outer one convex; as the lowest surface answers to the longest condyle of the femur, the axes of the bones are nearly in the same line. The right *astragalus* is preserved, somewhat resembling the human, but flatter and longer; the articular surface for the tibia is less convex, and narrower posteriorly; the surface for the scaphoid is more prominent, flatter, and with a better-marked constricted portion or neck; the lateral surface for the tibia is more quadrilateral and less vertical; the surface for the fibula is less triangular; the posterior portion is wider, with a less deep groove for the flexor longus pollicis; the surfaces for the os calcis, with the deep groove, are very much as in man. There are also some carpal, metacarpal, and phalangeal bones of the hand, and a few phalanges of the toes; the metacarpal bones are long and curved inwards, with large lower articulating surfaces; the bones of the fingers have their edges much turned under on the anterior surface, for the protection of the vessels, nerves, and tendons, as they grasp the limbs of trees in their usual swinging mode of progression; they may also serve for the insertion of the strong ligaments.

All the bones are exceedingly solid and heavy, indicating very great muscular force; many of them bear marks of fracture and bony growths, which indicate that this was a veteran male, who had seen many a hard fight; the skull, the lower

jaw, and many of the long bones show by their broken condition that he was killed only after a severe struggle, and with many a wound both from bullet and cutting instrument.

The height of this specimen must have been nearly five and a half feet, and the breadth of his shoulders, judging from the scapulæ and ribs, over two feet; the hands extend a little below the knees; the abdomen, judging from the iliac fossæ, must be nearly two feet wide; the lower extremities are strongly bowed. If we clothe this immense skeleton with its powerful muscles and its coarse hairy covering, we may have an idea of a monster which it would be more pleasant to read about and describe than to meet.

A table of measurements (in inches) has been added, comparing this specimen with those of Dr. Wyman; those belonging to the former occupying the first column, and the latter the other two.

| | Male. | Male. | Female. |
|---|---|---|---|
| **Head.** | | | |
| From the posterior plane of the occiput to margin of incisors, | 13.5 | 12. | 9.1 |
| Greatest lateral diameter of cranium at post-auditory ridges, | 6. | 6.1 | 5.2 |
| Smallest lateral diameter of cranium behind orbits | 2.5 | 2.5 | 2.5 |
| Diameter of face across zygomata, | 6.75 | 6.5 | 5.5 |
| Diameter of face outside of orbits, | 5.3 | 4.9 | 4.3 |
| From posterior plane of occiput to fronto-nasal suture, | 7.5 | 7.3 | 6.5 |
| From fronto-nasal suture to margin of incisors, | 6.5 | 4.8 | 4.5 |
| Breadth of zygomatic fossa, | 2. | 1.7 | 1.4 |
| Inter-orbitar space, | 1.3 | 1.1 | 1. |
| Lateral diameter of orbit, | 1.6 | 1.5 | 1.4 |
| Vertical diameter of orbit, | 1.75 | 1.6 | 1.4 |
| Length of bony palate, | 3.5 | 3.7 | 3.4 |
| **Lower Jaw.** | | | |
| Length from condyle to symphysis, | 7.5 | 7. | 6.5 |
| Length from angle to symphysis, (outside,) | 6. | | |
| From angle to condyle, | 5. | | |
| Breadth between angles, (inside,) | 5. | | |
| Breadth of ramus, | 2.9 | 2.9 | 2.45 |
| Height of ramus, | 5. | 4.6 | 4.3 |
| **Upper Extremity.** | | | |
| Length of scapula along base, | 10. | 9. | |
| Broadest part of scapula, | 7.25 | 6.5 | |

| | Male. | Male. | Female. |
|---|---|---|---|
| Posterior extremity of spine from upper angle, | 5.3 | 4.5 | |
| Humerus, | 16.5 | 17. | |
| Radius, | 13.5 | 13.5 | |
| Ulna, | 14.3 | 14.2 | |
| **Pelvis.** | | | |
| Length of sacrum, | 6.5 | 6. | |
| Breadth of sacrum, | 4. | 3.7 | 3.2 |
| Breadth of pelvis between spinous processes of ilia, | 16.5 | 15. | 15. |
| Breadth of ilium, | 9. | 8. | 7.5 |
| Length of os innominatum, | 14.5 | 14. | 12. |
| Antero-posterior diameter of pelvis | 6.5 | | 8. |
| Transverse diameter of pelvis, | 6. | | 5.1 |
| Length of symphysis, | 3.2 | 3. | 2 3 |
| Long diameter of obturator foramen, | 2.2 | 2.1 | 2.2 |
| Outside of one tuber ischii to the other | 7.15 | | 5.8 |
| **Lower Extremity.** | | | |
| Femur, | 14.3 | 14. | |
| Tibia, | 11.5 | 11.5 | |
| **Vertebræ. Last Dorsal.** | | | |
| Transverse diameter, | 1.7 | | 1.75 |
| Antero-posterior diameter, | 1.25 | | 1. |
| Vertical diameter of anterior face, | 1.1 | | .8 |
| " " posterior face, | 1.15 | | |
| **Second Lumbar.** | | | |
| Antero-posterior diameter, | 1.3 | | 1.15 |
| Transverse diameter, | 2. | | 1.7 |
| Vertical " anterior face, | 1. | | 1. |
| " " posterior face, | 1.4 | | 1. |
| **Second Dorsal.** | | | |
| Antero-posterior diameter, | .65 | | |
| Transverse diameter, | 1. | | |
| Vertical " anterior face, | .6 | | |
| " " posterior face, | .75 | | |
| **Fourth Cervical.** | | | |
| Antero-posterior diameter, | .7 | | |
| Transverse diameter, | .8 | | |