

WEEKLY EVENING MEETING,

Friday, February 9.

WILLIAM POLE, Esq. M.A. F.R.S. Treasurer and Vice-President,
in the Chair.

PROFESSOR OWEN, F.R.S.

On the Anthropoid Apes, and their relations to Man.

IN this discourse, the structure, more especially of the bones and teeth, of the most highly organised Apes—the Orang-utans and Chimpanzees—was compared with that of the Human Subject, in reference to the hypothesis that specific characters can be so far modified by external influences, operating on successive generations, as to produce a new and higher species of animal, and that thus there had been a gradual progression from the monad up to man.

The conditions under which an active monad might be developed from dead mucus, or other organic matter in an infusion, or those that might influence and attend the transmutation of one recognised species into another—say of a polype into a medusa—were legitimate and important subjects of physiological research. But, hitherto, the results of such researches had not favoured the hypothesis of the coming in of species by spontaneous generation and transmutation.

The last link in the chain of changes—from *Quadrumania* to *Bimana*—according to the latter old notion, the speaker had found alluded to by Henry More in his philosophical “*Conjectura Cabalistica* ;” and in reference to that, and other works of the same period, in which creative forces and the nature and origin of animal species were treated of, the equal spirit, vigorous intellect, profound learning, and laborious research of such men as Cudworth, More, and Grew, contrasted most favourably with the opposite characteristics of some works of the same kind of the present day.

True it was that the old authors referred to exemplified the prevalent belief of their age in witches and apparitions. But has not our age its clairvoyants and spirit-rappers? Two centuries ago it was believed that a long round piece of wood, if bestridden by a person properly “possessed,” would, under such influence, move against gravity, rise from the ground, and transport itself and its rider through the air. In our time it has been and may be still believed, that a flat circular piece of wood, on legs, can be made,

by the imposition of hands of believers, to move against gravity, tilt up, and dance about. We know that this belief had become so scandalously prevalent, as to make our excellent friend, the Fullerian Professor, deem it worth his while to deal it a crushing blow of his intellectual sledge-hammer.

The present age may be more knowing, but can it truly flatter itself as being wiser, more logical, and less credulous than that of Cudworth and More? As numerous and respectable eye-witnesses, in the seventeenth century, vouched for the transit of witches on broomsticks through the air; as, in the nineteenth, have testified to table-tilting and table-turning! And whether the occult influence over-ruling the law of gravitation charges a discoid or cylindrical substance—oozes from the palm of the hand, or emanates from another part of the body—matters not.

We ignore Satanic influences now-a-days, as a general rule. An impulse, said to be uncontrollable because uncontrolled, and a "black-cloud" over the mind, form grounds for acquitting the adulterous prolicide: of old, it would have been referred, in good earnest, to "the instigation of the devil," and an exemplary judgment would have followed the belief. It may be doubted whether the fearfully increasing number of acquittals, and of "merciful recommendations" of murderers, be a sign of the superior wisdom and humanity of our times.

But, returning to the sphere of that "lower wisdom, which rests in the contemplation of natural causes and dimensions," seeing that notions, refuted and repudiated centuries ago, are, in our day, revived and popularised, with a semblance of support from the later acquisitions of science, it is meet that they should be brought to the test of the exact results of modern inquiry: and this was the aim the Professor had in view in treating of the organical characters of the highest of the brute creation and their relations to those of the human species.

For about two centuries, naturalists have been cognizant of a small ape, tailless, without cheek-pouches, and without the ischial callosities, clothed with black hair, with a facial angle of about 60° , and of a physiognomy milder and more human-like than in the ordinary race of monkeys, less capricious, less impulsive in its habits, more staid and docile. This species, brought from the West Coast of Africa, is that which our anatomist, Tyson, dissected: he described the main features of its organisation in his work published in 1699. He called it the *Homo Sylvestris*, or pigmy. It is noted by Linnæus, in some editions of his *Systema Naturæ*, as the *Homo Troglodytes*. Blumenbach, giving a truer value to the condition of the innermost digit of the hind foot, which was like a thumb, called it the *Simia Troglodytes*; it afterwards became more commonly known as the "Chimpanzee."

At a later period, naturalists became acquainted with a similar kind of ape, of quiet docile disposition, with the same sad, human-

like expression of features. It was brought from Borneo or Sumatra ; where it is known by the name of *Orang*, which, in the language of the natives of Borneo, signifies "man," with the distinctive addition of *Outan*, meaning "Wood-man," or "Wild Man of the Woods." This creature differed from the pigmy, or *Simia Troglodytes* of Africa, by being covered with hair of a reddish-brown colour, and by having the anterior, or upper limbs, much longer in proportion, and the thumb upon the hind feet somewhat less. It was entered in the zoological catalogue as the *Simia Satyrus*. A governor of Batavia, Baron Wurmb, had transmitted to Holland, in 1780, the skeleton of a large kind of ape, tailless, like this small species from Borneo, but with a much-developed face, and large canine teeth, and bearing thick callosities upon the cheeks, giving it, upon the whole, a very baboon-like physiognomy ; and he called it the *Pongo*.

At the time when Cuvier revised his summary of our knowledge of the animal kingdom, in his second edition of the *Règne Animal*, 1829, the knowledge of the anthropoid apes was limited to these three forms. It had been suspected that the pongo might be the adult form of the orang ; but Cuvier, pointing to its distinctive character, suggested that it could hardly be the same species. The facial angle of the small red orang of Borneo, and of the small black chimpanzee of Africa, brought them, from the predominant cranium, and small size of the jaws and small teeth, nearer than any other known mammalian animal to the human species, particularly to the lower, or negro forms. It was evident, from the examination of these small chimpanzees and orangs, that they were the immature of some large species of ape. The small size and number of their teeth, (there being in some of the smaller specimens, only twenty, like the number of deciduous teeth in the human species,) and the intervals between those teeth, all showed them to be of the first or deciduous series. Professor Owen had availed himself of the rich materials in regard to these animals collected about that time by the Zoological Society, to investigate the state of dentition, and the state of the teeth—the permanent teeth—that might be hidden in the substance of the jaws, of both the immature orang-outang and the chimpanzee, and had found, that the germs of those teeth in the orang-outang agreed in size with the permanent teeth that were developed in the jaws of a species of pongo of Wurmb, which Sir Stamford Raffles had presented to the museum of the College of Surgeons some years before. Specimens of orangs since acquired, of an intermediate age, have shown the progressive change of the dentition. The skull of one of these was exhibited, showing the huge anterior incisors co-existing with the small milk canines.

In the substance of the jaw are found the germs of the great canines, germs of large bicuspid teeth, showing the changes that must take place when the jaw is sufficiently enlarged to receive permanent teeth of this kind ; and when the rest of the cranium is

modified, as it must be, concomitantly for the attachment of muscles to work the jaw so armed, that all these changes must result in the acquisition of characters such as are presented by the skulls of the large pongo, or Bornean baboon-like ape. The specific identity of the pongo, with certain of the young orang-outangs, was thus satisfactorily made out, and is now admitted by all naturalists. With regard to the chimpanzee, the germs of similarly proportioned large teeth were also discovered in the jaws, likewise indicating that it must be the young of a much larger species of ape.

The principal osteological characters of the chimpanzee and orang, commencing from the vertebral column, were as follows:—The vertebral column describes only one curve, inclining forwards, where it supports the head with its large jaws and teeth. The vertebræ in the neck, seven in number as usual in the mammalia, are chiefly remarkable for the great length of the simple spinous processes developed more than in most of the inferior apes, in relation to the necessities of the muscular masses that are to sustain and balance the head that preponderates so much forward on the neck. The vertebræ maintain a much closer correspondence in size, from the cervical to the dorsal and lumbar region, than in the human skeleton. With regard to the dorsal vertebræ, or those to which moveable ribs are articulated, there are twelve pairs in the orang; seven of them send cartilages to join the sternum, which is more like the sternum in man than in any of the inferior quadrumana: it is shorter and broader. In the smaller long-armed apes (*Hylobates*), which make the first step in the transition from the ordinary quadrumana to the man-like apes, the sternum is remarkably broad and short. The lumbar vertebræ are five in number in this adult orang. The sacrum is broader than in the lower quadrumana, but it is still narrow in comparison with its proportions in man. The pelvis is longer. The iliac bones are more expanded than in the lower quadrumana, but are more expanded on the same plane, and are flattened and long. The tuberosities of the ischia are remarkably developed, and project outwards. All these conditions of the vertebral column indicate an animal capable only of a semi-erect position, and present a modification of the trunk much better adapted for a creature destined for a life in trees, than one that is to walk habitually erect upon the surface of the ground. But that adaptation of the skeleton is still more strikingly shown in the unusual development of the upper prehensile extremities. The scapula is broad, with a well-developed spine and acromion; there is a complete clavicle; the bone of the arm (*humerus*) is of remarkable length, in proportion to the trunk; the radius and the ulna are also very long, and unusually diverging, to give increased surface of attachment to muscles; the hand is remarkable for the length of the metacarpus, and of the phalanges, which are slightly bent towards the palm; the thumb is less developed than the corresponding digit in the foot; the whole hand is admirably adapted

for retaining a firm grasp of the boughs of trees. In the structure of the carpus, there is a well-marked difference from the human subject, and a retention of the character met with in the lower quadrumana; the scaphoid bone being divided in the orang-outang. In the chimpanzee the bones of the carpus are eight, as in the human subject, but differ somewhat in form. If the upper extremities are so extraordinary for their disproportionate length, the lower ones are equally remarkable for their disproportionate smallness in comparison with the trunk, in the orang. The femur is short and straight, and the neck of the thigh-bone comparatively short. The head of the thigh-bone in this animal, which requires the use of these lower prehensile organs to grasp the branches of trees, and to move freely in many directions, is free from that ligament which strengthens the hip-joint in man; the head of the femur in the orang is quite smooth, without any indication of that attachment. Here, again, the chimpanzee manifests a nearer approach to man, for the *ligamentum teres* is present in it, in accordance with the stronger and better development of the whole hind-limb. This approximation, also, is more especially marked in the larger development of the innermost of the five digits of the foot in the chimpanzee, which is associated with a tendency to move more frequently upon the ground, to maintain a more erect position than the orang-outang, and to walk further without the assistance of a stick. The foot, in both these species of anthropoid orangs, is characterised by the backward position of the ankle-joint, presented by the astragalus to the tibia, which serves for the transference of the superincumbent weight upon the foot; by the comparatively feeble development of the backward projecting process of the calcaneum; by the obliquity of the articular surface of the astragalus, which tends to incline the foot a little inwards, taking away from the plantigrade character of the creatures and from their capacity to support themselves in an erect position, and giving them an equivalent power of applying their prehensile feet to the branches of the trees in which they live.

With reference to the chimpanzee, it was further observed, that, although the number of the true vertebræ is the same as in the orang, yet there is an additional pair of ribs developed; but, as there are thirteen dorsal vertebræ, we find only four lumbar ones. The modifications of the pelvis are a close repetition of those of the orang-outang. The chief differences in the skeleton of the chimpanzee are, a shortening and strengthening of the upper extremities, an approach towards the characteristic proportions of those parts in man; the presence of the *ligamentum teres* of the hip-joint; and the greater development of the innermost toe in the foot. In both the orang and chimpanzee the skull is articulated by condyles, which are placed far back on its under surface. The cranium is small, characterised by well-developed occipital and sagittal ridges; the occipital ridges in reference to the muscles sustaining

the head ; and the sagittal ones in reference to an increased extent of the temporal muscles. The zygomatic arches are strong, and well arched outwards. The lower jaw is of great depth, and has powerful ascending rami, but the chin is wanting. The facial angle is about 50° to 55° in the full-grown *simia satyrus*, and 55° to 60° in the *troglydites niger*. The difference in the facial angle between the young and adult apes, (which, in the young chimpanzee, approaches 60° to 65° .) depends upon those changes consequent upon the shedding of the deciduous teeth and the concomitant development of the jaws and intermuscular processes of the cranium.

But the knowledge of the species of these anthropoid apes has been further increased since the acquisition of a distinct and precise cognisance of the characters of the adults of the orang and chimpanzee. First, in reference to the orangs of Borneo, specimens have reached this country which show that there is a smaller species in that island, the *Simia Morio*, in which the canines are less developed, in which the bony *cristæ* are never raised above the level of the ordinary convexity of the cranium, and in which the callosities upon the cheeks are absent, associated with other characteristics plainly indicating a specific distinction. The Rajah Brooke has confirmed the fact of the existence in the island of Borneo of two distinct species of red orangs ; one of a smaller size and somewhat more anthropoid ; and the larger species presenting the baboon-like cranium.

In reference to the black chimpanzee of Africa also, another very important addition has been made to our knowledge of those forms of highly developed quadrumana. In 1847 Professor Owen received a letter from Dr. Savage, a church-missionary at Gaboon, enclosing sketches of the crania of an ape, which he described as much larger than the chimpanzee, ferocious in its habits, and dreaded by the negro natives more than they dread the lion or any other wild beast of the forest. These sketches showed plainly one cranial characteristic by which the chimpanzee differs in a marked degree from the orangs ; viz. that produced by the prominence of the supra-orbital ridge, which is wanting in the adult and immature of the orangs. That ridge was strongly marked in the sketches transmitted. At a later period in the same year, Mr. Stuchbury transmitted to the Professor from Bristol two skulls of the same large species of chimpanzee, received from the same locality in Africa, bringing clearly to light evidence of the existence in Africa of a second larger and more powerful ape,—the *troglydites gorilla*. This species presents the characters of the cranium which are seen in the immense development of the occipital and parietal *cristæ* in relation to the muscles of the neck and jaws,—repeating, and even exaggerating, the prominence of the supra-orbital ridges of the chimpanzee, and showing the same characteristic inequality in the development of the teeth, particularly in the exaggerated size of the canine teeth, as in the great pongo of Wurmb. But the gorilla differs from the orang, and resembles man, first in the minor develop-

ment of the intermaxillary bone—that part being more produced in the orang-outang, giving it a less open facial angle; it differs also in the form of the orbits, which in the orang-outang are a full oval, but in the gorilla square-shaped, more nearly approaching those in the human species; it differs likewise in significant modifications of the base of the skull, as, for example, in the greater depth of the glenoid cavity, which joint, instead of being defended by merely the post-glenoid process in the inferior quadrumana, is now defended by a ridge developed from the tympanic bone, which ridge corresponds with the vaginal process in the human subject. In the conformation of the grinding surface of the teeth there is also a marked difference, which brings this great ape of Africa more nearly to the human subject, in reference to that character, than any other known species of the quadrumanous order. The characteristic of the grinding surface of the molar teeth in man, as may be seen in almost all varieties of the human species, is, that the four tubercles on the grinding surface are united by a ridge describing a strong sigmoid curvature. This is repeated in the gorilla, which also presents another important approach to the human subject in the commencement of a projection of the nasal bone. Like the chimpanzee, the superior extremities are longer than the lower ones; and the innermost digit of the foot is converted into a powerful thumb.

Having premised this account of the mature characters of the different species of oranges and chimpanzees, the lecturer next proceeded to contrast their structure with that of man. With regard to the dentition of these anthropoid apes, the number and kinds of the teeth, like those of all the quadrumana of the old world, correspond with those in the human subject; but all these apes differ in the larger proportionate size of the canine teeth, which necessitates a certain break in the series, in order that the prolonged points of the canine teeth may pass into their place when the mouth is completely closed. In addition to the larger proportionate size of the incisors and canines, the bicuspid in both jaws are implanted by three distinct fangs—two external and one internal: in the human species, the bicuspid are implanted by one external and one internal fang: in the highest races of man these two fangs are often connate; very rarely is the external fang divided, as it constantly is in all the species of the orang and the chimpanzee.

With regard to the catarrhine, or old-world quadrumana, the number of milk teeth is twenty, as in the human subject. But both chimpanzees and oranges differ from man in the order of development of the permanent series of teeth: the second true molar comes into place before either of the bicuspid have cut the gum, and the last molar is acquired before the permanent canine. We may well suppose that the larger grinders are earlier required by the frugivorous apes than by the omnivorous human race; and one condition of the earlier development of the canines and bicuspid in man, may be their smaller relative size as compared

with the apes. The great difference is the predominant development of the permanent canine teeth, at least in the males of the orangs and chimpanzees; for this is a sexual distinction, the canines in the females never presenting the same large proportion. In man, the dental system, although the formula is the same as in the apes, is peculiar for the equal length of the teeth, arranged in an uninterrupted series, and shows no sexual distinctions. The characteristics of man are exhibited in a still more important degree in the parts of the skeleton. His whole framework proclaims his destiny to carry himself erect; the anterior extremities are liberated from any service in the mere act of locomotion, and are perfected to be the fitting instruments of the rational mind and free will with which he is endowed. The speaker proceeded to trace these modifications from the foundation upwards.

With regard to the foot, it had been shown in a former discourse "On the Nature of Limbs," that in tracing the manifold and progressive changes of the feet in the mammalian series, in those forms where it is normally composed of five digits, the middle is usually the largest; and this is the most constant one. The modifications in the hind foot, in reference to the number of digits, are, first, the reduction and then the removal, of the innermost one; then the corresponding reduction and removal of the outer one; next, of the second and fourth digits, until it is reduced to the middle digit, as in the horse.

The innermost toe, the first to dwindle and disappear in the brute series, is, in man, developed to a maximum of size, becoming emphatically the "great toe," one of the most essential characteristics of the modifications of the human frame. It is made the powerful fulcrum for that lever of the second kind, which has its resistance in the tibio-astragalar joint, and the power applied to the projecting heel-bone: the superincumbent weight is carried further forwards upon the foot, by the more advanced position of the astragalus, than in the ape tribe; and the heel-bone is much stronger, and projects more backwards.

The arrangement of the powerfully-developed tarsal and metatarsal bones is such as to form a bony arch, of which the two piers rest upon the proximal joint of the great toe and the end of the heel. Well-developed cuneiform bones combine with the cuboid to form a second arch, transverse to the first. There are no such modifications in the orangs, in which the arch, or rather the bend of the long and narrow sole, extends to the extreme end of the long and curved digits, indicating a capacity for grasping. Upon these two arches the superincumbent weight of man is solidly and sufficiently maintained, as upon a low dome, with this further advantage, that the different joints, cartilages, coverings, and synovial membranes, give a certain elasticity to the dome, so that in leaping, running, or dropping from a height, the jar is diffused and broken before it can be transmitted to affect the enormous

brain-expanded cranium. The hind limbs in man are longer in proportion to the trunk than in any other known mammalian animal. The kangaroo might seem to be an exception, but if the hind limbs of the kangaroo are measured in relation to the trunk, they are shorter than in the human subject. In no animal is the femur so long in proportion to the leg as in man. In none does the tibia expand so much at its upper end. Here it presents two broad, shallow cavities, for the reception of the condyles of the femur. Of these condyles, in man only is the innermost longer than the outermost; so that the shaft of the bone inclines a little outwards to its upper end, and joins a "neck" longer than in other animals, and set on at a very open angle. The weight of the body, received by the round heads of the thigh bones, is thus transferred to a broader base, and its support in the upright posture facilitated. There is also the collateral advantage of giving more space to those powerful adductor muscles that assist in fixing the pelvis and trunk upon the hind limbs. With regard to the form of the pelvis, you could not fully appreciate its peculiar modifications unless you saw it, as here displayed, in contradistinction to the form of the pelvis in the highest organised quadrumana. The short and broad ilium bends forwards, the better to receive and sustain the abdominal viscera, and is expanded behind to give adequate attachment to the powerful glutei muscles, which are developed to a maximum in the human species, in order to give a firm hold of the trunk upon the limbs, and a corresponding power of moving the limbs upon the trunk. The tuberosities of the ischium are rounded, not angular, and not inclined outwards, as in the ape tribe. The symphysis pubis is shorter than in the apes. The tail is reduced to three or four stunted vertebræ, ankylosed to form the bone called "os coccygis." The true vertebræ, as they are called in human anatomy, correspond in number with those of the chimpanzee and the orang, and in their divisions with the latter species, there being twelve thoracic, five lumbar, and seven cervical. This movable part of the column is distinguished by a beautiful series of sigmoid curves, convex forwards in the loins, concave in the back, and again slightly convex forwards in the neck. The cervical vertebræ, instead of having long spinous processes, have short processes, usually more or less bifurcated. The bodies of the true vertebræ increase in size from the upper dorsal to the last lumbar, which rests upon the base of the broad wedge-shaped sacrum, fixed obliquely between the sacro-iliac articulations. All these curves of the vertebral column, and the interposed elastic cushions, have relation to the libration of the head and upper limbs, and the diffusion and the prevention of the ill effects from shocks in many modes of locomotion which man, thus organised for an erect position, is capable of performing. The arms of man are brought into more symmetrical proportions with the lower limbs; and their bony framework shows all the perfections that have been superinduced upon it in the mammalian

series, viz., a complete clavicle, the antibrachial bones so adjusted as to permit the rotatory movements of pronation and supination, as well as of flexion and extension; manifesting those characters which adapt them for the manifold application of that most perfect and beautiful of prehensile instruments, the hand. The scapula is broad, with the glenoid articulation turned outwards; the clavicles are bent in a slight sigmoid flexure; the humerus exceeds in length the bones of the fore-arm. The carpal bones are eight in number. The thumb is developed far beyond any degree exhibited by the highest quadrumana, and is the most perfect opposing digit in the animal creation. The skull is distinguished by the enormous expansion of the brain case; by the restricted growth of the bones of the face, especially of the jaws, in relation to the small, equally-developed teeth; and by the early obliteration of the maxillo-intermaxillary suture. To balance the head upon the neck-bone, we find the condyles of the occiput brought forward almost to the centre of the base of the skull, resting upon the two cups of the atlas, so that there is but a slight tendency to incline forwards when the balancing action of the muscle ceases, as when the head nods during sleep, in an upright posture. Instead of the strongly developed occipital crest, we find a great development of true mastoid processes advanced nearer to the middle of the sides of the basis cranii, and of which there is only the rudiment in the gorilla. The upper convexity of the cranium is not interrupted by any sagittal or parietal cristæ. The departure from the archetype, in the human skull, is most conspicuous, in the vast expanse of the neural spines of the three chief cranial vertebræ, viz., occipital, parietal, and frontal.

The Professor next entered upon the question, "To what extent does man depart from the typical character of his species?" With regard to the kind and amount of variety in mankind, we find, propagable and characteristic of race, a difference of stature, a difference in regard to colour, difference in both colour and texture of the hair, and certain differences in the osseous framework. With regard to stature, the Bushmen of South Africa and the natives of Lapland exhibit the extreme of diminution, ranging from four to five feet. Some of the Germanic races and the Patagonian Indians exhibit the opposite extreme, ranging from six to seven feet. The medium size prevails generally throughout the races of mankind. With reference to the characteristics of colour, which are extreme, we have now opportunities of knowing how much that character is the result of the influence of climate. We know it more particularly by that most valuable mode of testing such influences which we have from the peculiarity of the Jewish race. For 1800 years that race has been dispersed into different latitudes and climates, and they have preserved themselves most distinct from any intermixture with the other races of mankind. There are some Jews still lingering in the valleys of the Jordan, having been oppressed

by the successive conquerors of Syria for ages,—a low race of people, and described by trustworthy travellers as being as black as any of the Ethiopian races. Others of the Jewish people, participating in European civilization, and dwelling in the northern nations, show instances of the light complexion, blue eyes, and light hair of the Scandinavian families. The condition of the Hebrews, since their dispersion, has not been such as to admit of much admixture by the proselytism of household slaves. We see, then, how to account for the differences in colour, without having to refer them to original or specific distinctions. As to the difference in size in mankind, it is slight in comparison with what we observe in the races of the domestic dog, where the extremes of size are much greater than can be found in any races of the human species. With reference to the modifications of the bony structure, as characteristic of the races of mankind, they are almost confined to the pelvis and the cranium. In the pelvis the difference is a slight, yet apparently a constant one. The pelvis of the adult negro may sometimes be distinguished from that of the European by the greater proportional length and less proportional breadth of the iliac bones; but how trifling is this difference compared with that marked distinction in the pelvis which the orang-outang presents!

With regard to the cranial differences, the Professor selected for comparison three extreme specimens of skulls characteristic of race: one of an aboriginal of Van Diemen's Land (the lowest of the Melanian or dark-coloured family), a well-marked Mongolian, and a well-formed European skull. The differences were described to be chiefly these. In the low, uneducated, uncivilised races, the brain is smaller than in the higher, more civilised, and more educated races; consequently the cranium rises and expands in a less degree. Concomitant with this contraction of the brain-case is a greater projection of the fore-part of the face; whether it may be from a longer exercise of the practice of suckling, or a more habitual application of the teeth in the inter-maxillary part of the jaw, and in the corresponding part of the lower jaw, in biting and gnawing tough, raw, uncooked substances,—the anterior alveolar part of the jaws does project more in those lower races; but still to an insignificant degree compared with the prominence of that part of the skull in the large apes. And while alluding to them, the speaker again adverted to the distinction between them and the lowest of the human races, which is afforded by the inter-maxillary bone, already referred to. In the young orang-outang, even when the change of dentition has begun, the suture between that bone and the maxillary is present; and it is not until the large canine teeth are developed, that the stimulus of the vascular system, in the concomitant expansion and growth of the alveoli, tends to obliterate the suture. In the young chimpanzee, the maxillary suture disappears earlier, at least on the facial surface of the upper jaw. In

the human subject those traces disappear still earlier, and in regard to the exterior alveolar plates, the inter-maxillary and maxillary bones are connate. But there may be always traced in the human foetus the indications of the palatal and nasal portions of the maxillo-intermaxillary suture, of which the poet Goëthe was the first to appreciate the full significance.

In the Mongolian skull there is a peculiar development of the cheek-bones, giving great breadth and flatness to the face, a broad cranium, with a low forehead, and often with the sides sloping away from the median sagittal tract, something like a roof; whereas, in the European, there is combined, with greater capacity of the cranium, a more regular and beautiful oval form, a loftier and more expanded brow, a minor prominence of the malars, and a less projection of the upper and lower jaws. All these characteristics necessarily occasion slight differences in the facial angle. On a comparison of the basis cranii, the strictly bimanous characteristics in the position of the foramen magnum and occipital condyles, and of the zygomatic arches, are as well displayed in the lowest as in the highest varieties of the human species.

With regard to the value to be assigned to the above defined distinctions of race:—in consequence of not any of these differences being equivalent to those characteristics of the skeleton, or other parts of the frame, upon which specific differences are founded by naturalists in reference to the rest of the animal creation, the Professor came to the conclusion that man forms one species, and that these differences are but indicative of varieties. As to the number of these varieties:—from the very well marked and natural character of the species, just as in the case of the similarly natural and circumscribed class of birds, scarcely any two ethnologists agree as to number of the divisions, or as to the characters upon which those varieties are to be defined and circumscribed. In the subdivision of the class of birds, the ornithological systems vary from two orders to thirty orders; so with man there are classifications of races varying from *thirty* to the *three* predominant ones which Blumenbach first clearly pointed out,—the Ethiopian, the Mongolian, and the Caucasian or Indo-European. These varieties merge into one another by easy gradations. The Malay and the Polynesian link the Mongolian and the Indian varieties; and the Indian is linked by the Esquimaux again to the Mongolian. The inhabitants of the Andaman Islands, New Caledonia, New Guinea, and Australia, in a minor degree seem to fill up the hiatus between the Malay and the Ethiopian varieties; and in no case can a well marked definite line be drawn between the physical characteristics of allied varieties, these merging more or less gradationally the one into the other.

In considering the import and value of the osteological differences between the gorilla—the most anthropoid of all known brutes—and man, in reference to the hypothesis of the origination of

species of animals by gradual transmutation of specific characters, and that in the ascending direction, Professor Owen admitted that the skeleton may be modified to a certain extent by the action of the muscles to which it is subservient, and that in domesticated races the size of the animal may be brought to deviate in both directions from the specific standard. By the development of the processes, ridges, and crests, and also by the general proportions of the bones themselves, especially those of the limbs, the human anatomist judges of the muscular power of the individual to whom a skeleton under comparison has ascertained.

The influence of muscular actions in the growth of bone is more strikingly displayed in the change of form which the cranium of the young carnivore or the sternum of the young bird undergoes in the progress to maturity; not more so, however, than is manifested in the progress of the development of the cranium of the gorilla itself, which results in a change of character so great, as almost to be called a metamorphosis.

In some of the races of the domestic dog, the tendency to the development of parietal and occipital cristæ is lost, and the cranial dome continues smooth and round from one generation of the smaller spaniel, or dwarf pug, *e. g.* to another; while, in the large deerhound, those bony cristæ are as strongly developed as in the wolf. Such modifications, however, are unaccompanied by any change in the connexions, that is, in the disposition of the sutures of the cranial bones; they are due chiefly to arrests of development, to retention of more or less of the characters of immaturity: even the large proportional size of the brain in the smaller varieties of house-dog is in a great degree due to the rapid acquisition by the cerebral organ of its specific size, agreeably with the general law of its development, but which is attended in the varieties cited by an arrest of the general growth of the body, as well as of the particular developments of the skull in relation to the muscles of the jaws.

No species of animal has been subject to such decisive experiments, continued through so many generations, as to the influence of different degrees of exercise of the muscular system, difference in regard to food, association with man, and the concomitant stimulus to the development of intelligence, as the dog; and no domestic animal manifests so great a range of variety in regard to general size, to the colour and character of the hair, and to the form of the head, as it is affected by different proportions of the cranium and face, and by the intermuscular crests superadded to the cranial parietes. Yet, under the extremest mask of variety so superinduced, the naturalist detects in the dental formula and in the construction of the cranium the unmistakable generic and specific characters of the *canis familiaris*. This and every other analogy applicable to the present question justifies the conclusion that the range of variety allotted to the chimpanzee under the operation of external circum-

stances favourable to its higher development would be restricted to differences of size, of colour, and other characters of the hair, and of the shape of the head, in so far as this is influenced by the arrest of general growth after the acquisition by the brain of its mature proportions, and by the development, or otherwise, of processes, crests, and ridges for the attachment of muscles. The most striking deviations from the form of the human cranium which that part presents in the great orangs and chimpanzees result from the latter acknowledged modifiable characters, and might be similarly produced; but not every deviation from the cranial structure of man, nor any of the important ones upon which the naturalist relies for the determination of the genera *troglydytes* and *pithecus*, have such an origin or dependent relation. The great chimpanzee, indeed, differs specifically from both the orang and man in one cranial character, which no difference of diet, habit, or muscular exertion can be conceived to affect.

The prominent superorbital ridge, for example, is not the consequence or concomitant of muscular development; there are no muscles attached to it that could have excited its growth. It is a characteristic of the cranium of the genus *troglydytes* from the time of birth to extreme old age; by the prominent superorbital ridge, for example, the skull of the young chimpanzee with deciduous teeth may be distinguished at a glance from the skull of an orang at the same immature age; the genus *pithecus*, Geoffr., being as well recognised by the absence, as the genus *troglydytes* is by the presence, of this character. We have no grounds, from observation or experiment, to believe the absence or the presence of a prominent superorbital ridge to be a modifiable character, or one to be gained or lost through the operations of external causes, inducing particular habits through successive generations of a species. It may be concluded, therefore, that such feeble indication of the superorbital ridge, aided by the expansion of the frontal sinuses, as exists in man, is as much a specific peculiarity of the human skull, in the present comparison, as the exaggeration of this ridge is characteristic of the chimpanzees and its suppression of the orangs.

The equable length of the human teeth, and the concomitant absence of any diastema or break in the series, and of any sexual difference in the development of particular teeth, are to be viewed by the light of actual knowledge, as being primitive and unalterable specific peculiarities of man.

Teeth, at least such as consist of the ordinary dentine of mammals, are not organised so as to be influenced in their growth by the action of neighbouring muscles; pressure upon their bony sockets may affect the direction of their growth after they are protruded, but not the specific proportions and forms of the crowns of teeth of limited and determinate growth. The crown of the great canine tooth of the male *troglydytes gorilla* began to be calcified when its diet was precisely the same as in the female, when both

sexes derived their sustenance from the mother's milk. Its growth proceeded and was almost completed before the sexual development had advanced so as to establish those differences of habits, of force, of muscular exercises, which afterwards characterise the two sexes. The whole crown of the great canine is, in fact, calcified before it cuts the gum or displaces its small deciduous predecessor; the weapon is prepared prior to the development of the forces by which it is to be wielded; it is therefore a structure fore-ordained, a predetermined character of the chimpanzee, by which it is made physically superior to man; and one can as little conceive its development to be a result of external stimulus, or as being influenced by the muscular actions, as the development of the stomach, the testes, or the ovaria.

The two external divergent fangs of the premolar teeth, and the slighter modifications of the crowns of the molars and premolars, appear likewise from the actual results of observation to be equally predetermined and non-modifiable characters.

No known cause of change productive of varieties of mammalian species could operate in altering the size, the shape, or the connexions of the premaxillary bones, which so remarkably distinguish the great *troglydytes gorilla*, not from man only, but from all other anthropoid apes. We know as little the conditions which protract the period of the obliteration of the sutures of the premaxillary bones in the *tr. gorilla* beyond the period at which they disappear in the *tr. niger*, as we do those that cause them to disappear in man earlier than they do even in the smaller species of chimpanzee.

There is not, in fact, any other character than those founded upon the developments of bone for the attachment of muscles, which is known to be subject to change through the operation of external causes; nine-tenths, therefore, of the differences, especially those very striking ones manifested by the pelvis and pelvic extremities, which the Professor had cited in memoirs on the subject, published in the "Zoological Transactions," as distinguishing the great chimpanzee from the human species, must stand in contravention of the hypothesis of transmutation and progressive development, until the supporters of that hypothesis are enabled to adduce the facts and cases which demonstrate the conditions of the modifications of such characters.

If the consideration of the cranial and dental characters of the *troglydytes gorilla* has led legitimately to the conclusion that it is specifically distinct from the *troglydytes niger*, the hiatus is still greater that divides it from the human species, between the extremest varieties of which there is no osteological and dental distinction which can be compared to that manifested by the shorter premaxillaries and larger incisors of the *troglydytes niger* as compared with the *tr. gorilla*.

The analogy which the establishment of the second and more formidable species of chimpanzee in Africa has brought to light

between the representation of the genus *troglydytes* in that continent, and that of the genus *pithecus* in the great islands of the Indian Archipelago, is very close and interesting. As the *troglydytes gorilla* parallels the *pithecus Wurmbii*, so the *troglydytes niger* parallels the *pithecus morio*, and an unexpected illustration has thus been gained of the soundness of the interpretation of the specific distinction of that smaller and more anthropoid orang.

It is not without interest to observe, that as the generic forms of the *quadrumana* approach the *bimanous* order, they are represented by fewer species. The gibbons (*hylobates*) scarcely number more than half-a-dozen species; the oranges (*pithecus*) have but two species, or at most three; the chimpanzees (*troglydytes*) are represented by two species.

The unity of the human species is demonstrated by the constancy of those osteological and dental characters to which the attention is more particularly directed in the investigation of the corresponding characters in the higher *quadrumana*.

Man is the sole species of his genus, the sole representative of his order; he has no nearer physical relations with the brute-kind than those which flow from the characters that link together the primary (unguiculate) division of the placental sub-class of mammalia.

Professor Owen trusted that he had furnished the confutation of the notion of a transformation of the ape into man, which had been anticipated by the old author to whom he had referred at the outset, and strongly recommending his writings to those of his hearers who might not be acquainted with them, he concluded by quoting the passage referred to.

“And of a truth, vile epicurism and sensuality will make the soul of man so degenerate and blind, that he will not only be content to slide into brutish immorality, but please himself in this very opinion that he is a real brute already, an ape, satyre or baboon; and that the best of men are no better, saving that civilizing of them and industrious education has made them appear in a more refined shape, and long inculcate precepts have been mistaken for connate principles of honesty and natural knowledge; otherwise there be no indispensable grounds of religion and vertue, but what has hapned to be taken up by *over-ruling* custom. Which things, I dare say, are as easily confutable, as any conclusion in mathematics is demonstrable. But as many as are thus sottish, let them enjoy their own wildness and ignorance; it is sufficient for a good man that he is conscious unto himself that he is more nobly descended, better bred and born, and more skilfully taught by the purged faculties of his own minde.”*

[R. O.]

* Henry More's "Conjectura Cabbalistica," fol. (1662)—p. 175.