XVIII. *Osteological Contributions to the Natural History of the Chimpanzees* (Troglodytes, *Geoffroy*), *including the description of the Skull of a large species* (Troglodytes Gorilla, *Savage*) *discovered by* Thomas S. Savage, *M.D., in the Gaboon country, West Africa. By Prof.* Owen, *F.R.S., F.Z.S. &c.*

Read February 22, 1848.

§ 1. *Introduction.*

THE principal additions, since the time of Cuvier, to the Natural History of the great Apes that make the nearest approach to Man, are to be found, I believe, in previous volumes of the 'Transactions of the Zoological Society of London,' and are chiefly due to the important aids which the Society has been able to render by its collections and its illustrated publications to those Members who are more immediately engaged in the advancement of its scientific objects.

But of these additions none exceed in interest and importance that to which the present memoir relates, and for the chief subject of which the obligations of naturalists are due to Dr. Thomas Savage, Corr. Member of the Boston Society of Natural History, U.S., and to Mr. Samuel Stutchbury, F.L.S. Before, however, commencing the account of the very remarkable crania which Mr. Stutchbury has obligingly transmitted for exhibition at the Meeting of the Society this evening, and liberally confided to me for description, and which establish the fact of the existence in the western parts of tropical Africa of a second and very large and formidable species of Chimpanzee, a few words may be premised on the principal steps by which the natural history of the Anthropoid Quadrumana has been advanced since the publication of the last edition of the 'Règne Animal*.'

In the first volume of this classical work Cuvier groups the Chimpanzee and the Orang, recognising only a single species of each, in the same subgeneric section of the Linnæan genus *Simia*, and he places the Orang (*Pithecus*, Geoffroy) next to Man, characterizing it as "of all animals that which most resembles Man in the form of the head, the expanse of the forehead (la grandeur de son front)," and other particulars, which have since, however, been proved to be peculiarities of the young individuals of the species in question. Cuvier briefly alludes, at the end of his description, to the great Ape of Borneo, called 'Pongo,' as known only by the skeleton, but which, "maugre the great prominence of its muzzle, the smallness of its cranium and the height of the branches of the lower jaw, might be deemed an adult, if not of the Orang-outang, at

* 8vo, Paris, vol. i. 1829.

least of a closely allied species." This Pongo Cuvier also affirmed to be the largest and most redoubtable of the Apes, as, in fact, it was in comparison with the species known at that time.

Believing the characters of the young Orang to be those of the genus, Cuvier places the Chimpanzee, although he knew it also from immature examples only, below the Orang, on account of the absence of the forehead, the cranium receding immediately behind the supraciliary ridge*.

It was obvious, therefore, that in order to a clear understanding of the zoological relations of the highest of the brute creation to each other as well as to Man, the characters of the full-grown and mature individuals of the Orang and Chimpanzee required to be determined; and to this point I devoted some of my earliest investigations into Comparative Anatomy. In the memoir "On the Osteology of the Chimpanzee and Ourang-Utan," published in the first volume of the 'Zoological Transactions' (p. 343), the great Ape to which Cuvier refers under the name of 'Pongo' was proved, by the comparison of its teeth with the germs of the permanent teeth in the skull of the type of the species called 'Orang-outang' by Cuvier, to be the adult of that supposed anthropoid species.

In my inquiries and researches after specimens which might throw corresponding light on the true nature of the Chimpanzee, I was unexpectedly gratified by finding that there existed in the private collection of a surgeon in London (the late Mr. Walker of St. George's Hospital)—unknown apparently to the naturalists and anatomists of the metropolis—the complete skeleton of an adult female Chimpanzee (*Troglodytes niger*, Geoff.). This specimen yielded the true cranial and other osteological characters of Cuvier's second species of Anthropoid Ape†; and, allowing for sexual distinction, it showed a retrogradation to the brute or baboon-like character in the Chimpanzee during its progress to maturity, analogous to that which had been proved to take place in the true Orang-utan (*Pithecus*).

The comparison of the adult Chimpanzee (*Troglodytes niger*) with the adult Orang (*Pithecus Satyrus*) also showed that the superior development of the forehead upon which Cuvier had relied in determining the relations of the Orang with Man was more apparent than real, and that the more immediate backward slope of the forehead in the Chimpanzee was due principally to the characteristic prominence of the thick supraorbital ridge. Sixteen characters were adduced in the memoir above cited (p. 369) by which the Chimpanzee in differing from the Orang approached nearer to Man, whilst only three equivalent characters of closer correspondence to Man were demonstrated in the Orang; whence it was inferred that the Chimpanzee ought to rank above the Orang and next to Man‡, a conclusion which was adopted by M. de Blainville in his 'Ostéographie§,'

* Règne Animal, 8vo, Paris, vol. i. p. 89, 1829.

† Zool. Trans. vol. i. p. 343, pls. 48, 50, 51 & 52.

‡ Zool. Trans. vol. i. p. 369. § Fasc. i. p. 32.

and has since generally influenced systematic mammalogists in restoring the genuine *Troglodytes* to the same relative position in regard to the *Pithecus Satyrus* which the fabulous *Homo Troglodytes* occupies in the 'Systema Naturæ' of Linnæus.

The dental and osteological differences between the Chimpanzee and Orang, coupled with other anatomical distinctions brought to light by dissection of specimens that had died in the Society's menagerie, enabled me to present a summary of characters showing the difference between those two tailless Apes to be equivalent to that which Cuvier (*loc. cit.* p. 90) sanctions as supporting the generic distinction between the Gibbons and the Orangs. So long, therefore, as groups of this value shall continue to retain proper generic or subgeneric names, *Troglodytes* and *Pithecus* will remain the signs of such distinctions of the Chimpanzees and Orangs respectively, just as *Hylobates* is universally used as the sign of the corresponding distinction of the long-armed tailless Apes*.

Whilst, therefore, the amount and kind of difference between the Chimpanzee and Orang were thus established, the actual extent to which both deviated from the human structure was made known and illustrated by reference not only to the normally developed skull in different races, but by those rare abnormal examples in idiots in which the development of the cranial part of the human skull is arrested at the point to which it arrives in the Anthropoid Apes (Ib. p. 372, Pl. 57 and 58).

In a subsequent memoir† the order of development and succession of the permanent teeth in the Orang (*Pithecus*) were described: the differences in the form of the cranium of the adult males of the two kinds of Orang with great canine teeth, inhabiting respectively the islands of Sumatra (*Pithecus Abelii*) and Borneo (*Pithecus Wurmbii*), were illustrated: some of the dental distinctions between the male and female *Pithecus Wurmbii*, especially in the relative size of the canines, were pointed out; and a smaller and more anthropoid species of Orang from Borneo, with canine teeth relatively shorter than in the female *Pithecus Wurmbii*, with absolutely smaller molar teeth, but with the superior incisors nearly as large, and the inferior incisors quite as large, as those of the *Pithecus Wurmbii*, was established on the characters of the skull and dentition. The differences observed in the two skulls belonging, the one to the great Orang of Borneo, and the other to the great Orang of Sumatra, were not deemed to establish satisfactorily their specific distinction; but with respect to those differences in the proportions of the molar and incisor teeth of a not merely adult but aged skull of the smaller Bornean Orang, as they were superadded to differences of size and figure of the skull itself, greater in degree than the differences between the skulls of the so-called *Pithecus Wurmbii* and *Pithecus Abelii*, they were regarded, according to the analogy of corresponding characters allowed to establish specific distinctions in other genera of Quadrumana,

* Professor Andreas Wagner has expressed his opinion, in his admirable Monograph on the *Quadrumana*, that the osteological differences which divide the Gibbons from the Orangs are greater than those which distinguish the true Orangs from the Chimpanzees. They are greater in degree, but not in kind.

† Zool. Trans. vol. ii. p. 165, 1836.

as significative of a second, smaller, and more anthropoid species of Orang, for which, therefore, I proposed the name of *Simia* (*Pithecus*) *Morio*.

This conclusion in my 'Second Memoir' did not meet with such general assent as those of the first. To the objections published by M. Dumortier*, and supported ably, candidly and openly by reference to all the facts that had led to his entertainment of them, and to his opinion that my *Pithecus Morio* was an immature stage of the larger *P. Wurmbii*, I have replied in detail†.

It will not be necessary to reiterate these arguments in refutation of the statement of the specific identity of the *Simia Morio* with the *Simia Wurmbii*, since made by Mr. John Edward Gray in the 'Synopsis of the Mammalia in the British Museum,' as no reasons are there adduced for the attempt to suppress the species; and I only here refer to the statement because it may have some weight with foreign naturalists, inasmuch as it emanates from the ostensible head of the Zoological department of the British Museum, and is enunciated in a work of a certain public authority and bearing the imprimatur of the eminent and distinguished personages constituting the Board of Trustees.

Temminck, Sandifort, Salomon Müller and Schlegel have contributed valuable facts to the history and anatomy of the great Orang (*Pithecus Wurmbii*), to which species their observations are limited‡.

Sir J. Brooke, the distinguished Governor of Labuan and Rajah of Sarāwak, affirms, as the result of his personal observations and according to the report of the natives of Borneo, that there exist in that island three species of Orang§. One species, called by the natives '*Mias Pappan*,' with cheek-callosities in both males, females and young, is my *Pithecus Wurmbii*. A male of this species measured four feet from the head to the heel. A second species, smaller and weaker, devoid of cheek-callosities in both sexes, and with relatively smaller hands and feet, is known to the natives by the name of '*Mias Kassar*.' The Rajah Brooke has killed an almost full-grown male and two grown females of this species, which he believes to be my *Pithecus Morio*. A third species, '*Mias Rambi*,' is as tall as the *Mias Pappan*, or even taller, but is not so stout, with longer hair, and without cheek-pouches in either sex. This may possibly be the variety or species called *Pithecus Abelii*.

Thus the former memoirs published in the 'Transactions of the Zoological Society' give the true characters of a species of large Orang (*Pithecus Wurmbii*) in Borneo, and demonstrate a sexual superiority of size of the large laniariform canine teeth in the male, with a concomitant development of zygomatic arches and sagittal and lambdoidal crests. They show that there were two well-marked varieties, if not species, of such large Orang-utans, of which one at least inhabits Sumatra, and both are probably to be

* Notice sur les Modifications du Crane de l'Orang-outang, 8vo, Bruxelles, 1838.

† Annales des Sciences, series 2. t. xi. p. 122.

‡ Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche overzeesche, &c. fol. Leyden, 1840.

§ Proceedings of the Zoological Society, July 13, 1841.

found in Borneo;—that, besides the *Pithecus Wurmbii* and the variety or species called *Pithecus Abelii*, a smaller and more anthropoid Orang (*Pithecus Morio*), with proportions of the incisor and molar teeth as contrasted with the larger species not hitherto known to characterize mere varieties of Ape, also exists in Borneo, and is apparently peculiar to that island;—and, notwithstanding the carnassial and baboon-like features are less strongly developed in the *Pithecus Morio* than in its larger congener, that the characters of the Orang-outang in the 'Règne Animal' of Cuvier apply only to the immature state of any of the species of *Pithecus* now known. The same essential correction of the current ideas respecting the facial angle and the proportions of the cranium and face was made with respect to the Chimpanzee, and the true adult characters of the skeleton and dentition as manifested in the female of the *Troglodytes niger* were described and illustrated; and it was shown by these that, although the departure from the bimanous type is not so great in the *Troglodytes niger* as in the *Pithecus Wurmbii*, it is quite equal to that in the *Pithecus Morio*.

§ 2. *Of the Skull and Dentition of the adult male* Troglodytes niger.

There remained then to be determined the true adult characters of the male of the *Troglodytes niger*, and especially those afforded by the bones and teeth. In general stature, the male of this species, when it has acquired its second or mature dentition, does not exceed the female by more than two inches, and does not attain a greater height, measured from the sole of the heel to the vertex in a straight line, than 4 feet, the height of the mature female being 3 feet 10 inches; but it presents a greater proportional breadth of chest and shoulders, and greater strength of arm. It is characterized, however, by the same sexual superiority in the size of the canines as is manifested in the genus Orang (*Pithecus*).

The following are the general characters of the mature dentition of the adult male Chimpanzee (*Troglodytes niger*):—

This dentition, though in all its principal characters strictly quadrumanous, yet, in the minor particulars in which it differs from the dentition of the Orang, approaches nearer the human type. In the upper jaw the middle incisors (Pl. LIX. *i* 1) are smaller, the lateral ones (*ib. i* 2) larger than those of the Orang*; they are thus more nearly equal to each other; nevertheless the proportional superiority of the middle pair is greater than in Man, and the proportional size of the four incisors both to the entire skull and to the other teeth is considerably greater. Each incisor has a prominent posterior basal ridge, and the outer angle of the lateral incisors is rounded off as in the Orang. The diastema between the incisors and the canine on each side is as well-marked in the male Chimpanzee as in the male Orang†. The crown of the canine (*ib. c*), passing outside

* Compare Pl. LIX. with Pl. XXXI. (*Pith. Wurmbii*) and Pl. XXXIII. (*Pith. Morio*), in vol. ii. Zool. Trans.

† Compare Pl. LVIII. with Pl. XXXII. (*Pith. Wurmbii*) in vol. ii. Zool. Trans.

the interspace between the lower canine and premolar, extends in the male *Troglodytes niger* a little below the alveolar border of the under jaw when the mouth is shut: the seventh character*, therefore, of the genus, 'apices of canines lodged in intervals of the opposite teeth,' when the mouth is closed, is applicable only to the female, and does not distinguish *Troglodytes* from *Pithecus*. The upper canine of the male *Troglodytes niger* is conical, pointed, but more compressed than in the Orang, and with a sharper posterior edge; convex anteriorly, becoming flatter at the posterior half of the outer surface, and concave on the corresponding part of the inner surface, which is traversed by a shallow longitudinal impression: a feeble longitudinal rising and a second linear impression divide this from the convex anterior surface, which also bears a longitudinal groove at the base of the crown. The canine is rather more than twice the size of that in the female. Both premolars (*ib.* 1 *p*, 2 *p*, Pl. LX.) are bicuspid; the outer cusp of the first and the inner cusp of the second being the largest, and the first premolar consequently appearing the largest on an external view (Pl. LVIII.). The difference is less marked in the female. The anterior external angle of the first premolar is not produced as in the Orang. In Man, where the outer curve of the premolar part of the dental series is greater than the inner one, the outer cusps of both premolars are the largest: the alternating superiority of size in the Chimpanzee accords with the straight line which the canine and premolars form with the true molars.

The true molars (Pl. LX. 1 *m*, 2 *m*, 3 *m*) are quadricuspid, relatively larger in comparison with the bicuspids than in the Orang: the last is the smallest by the feeble development of the two hind cusps. In the first and second molars a low ridge connects the antero-internal with the postero-external cusp, crossing the crown obliquely, as in Man. There is a feeble indication of the same ridge in the unworn molars of the Orang; but the four principal cusps are much less distinct, and the whole grinding surface is flatter and more wrinkled, than in the Chimpanzee. A low ridge girts the base of the antero-internal cusp of each of the upper true molars in the male Chimpanzee: it is less marked in the female. The premolars as well as molars are severally implanted by one internal and two external fangs, diverging but curving towards each other at their ends as if grasping the substance of the jaw. The two outer fangs of the second premolar are connate in one female specimen.

In the lower jaw the lateral incisors are broader than the middle ones, but have their outer angle rounded off; they are all much larger and less vertically implanted than in Man (Pls. LVIII. & LIX.). The lower canines are two inches in length, including the root; the enamelled crown is three-fourths of an inch in length, and two-thirds of an inch across the base; it is conical and trihedral; the outer and anterior surface is convex, the other two surfaces are flattened or subconcave, and converging to an almost trenchant edge directed inwards and backwards; a ridge separates the convex from the antero-internal flat surface; both this and the posterior surface show slight traces of a

* Zool. Trans. vol. i. p. 372.

longitudinal rising at their middle part. The lower canine shows the same relative superiority of size as the upper one compared with that in the female Chimpanzee. The canine almost touches the incisor, but is separated by a diastema one line broad from the first premolar. This tooth is larger externally than the second premolar, and is twice the size of the human first premolar; it has a subtrihedral crown, with the anterior and outer angle produced forwards, slightly indicating the peculiar feature of the same tooth in the Baboons. The summit of the crown terminates in two sharp trihedral cusps, the outer one rising highest, and the second cusp being feebly indicated on the ridge extending from the inner side of the first: the crown of the first has a thick ridge at the inner and posterior part of its base. The second premolar has a subquadrate crown, with the two cusps developed from its anterior half, and a third smaller one from the inner angle of the posterior ridge. Both the lower premolars are implanted by two antero-posteriorly compressed divergent fangs, the anterior one being the largest. The three true molars are almost equal in size, the first being very little larger than the last, which is the only molar as large as the corresponding tooth in the black varieties of the human subject*, in most of which, especially the Australians, the true molars attain larger dimensions than in the yellow or white races. The four principal cusps, especially the two inner ones, of the first molar of the Chimpanzee are more pointed and prolonged than in Man: a fifth small cusp is developed behind the outer pair, as in the Orangs and the Gibbons, but is less than that in Man. The same additional cusp is present in the second molar which is seldom seen in Man. The crucial groove on the grinding surface is much less distinct than in Man, not being continued across the ridge connecting the anterior pair of cusps in the Chimpanzee. The crown of the third molar is longer antero-posteriorly from the greater development of the fifth posterior cusp, which however is rudimental in comparison with that in the Semnopitheques and Macaques. All the three true molars are supported by two distinct and well-developed antero-posteriorly compressed, divergent fangs, longitudinally excavated on the sides turned towards each other. The molar series in both jaws forms a straight line, with a slight tendency in the upper jaw to bend in the opposite direction to the well-marked curve which the same series describes in the human subject.

In the skull of a male *Troglodytes niger* (Plates LVIII. LIX. & LX.) in which all the teeth and especially the canines had been moderately worn, the cranium is not so much larger proportionally than the female's as it is in the male of the *Pithecus Wurmbii*, neither are the zygomatic nor the cranial cristæ so much more developed. The temporal ridges (Pl. LIX. 11) converge more rapidly from the ectorbital processes (12), and meet two inches behind the glabella, forming a low single sagittal ridge (7), extending backwards in one specimen for an inch and a half, and then dividing again and curving outwards to the better-developed lambdoid and mastoid ridges (fig. 1, 8); whilst in another

* See my Odontography, Pl. CXIX. fig. 2 *m*.

specimen the sagittal crest is continued, one quarter of an inch in height, to the middle of the lambdoidal crest.

This crest is more developed than in the female, but the supraoccipital preserves its convexity, though not quite to such a degree as in the female. The baboon-like length of the face and prominence of the orbits is quite as strongly marked in the adult male as in the female, but the carnivorous aspect arising from the sagittal and lambdoidal crests is not so striking as it is in the *Pithecus Wurmbii*; and although the canines of the male *Troglodytes niger* are decidedly superior to those of the female and extend beyond the intervals of the opposite teeth, yet this is to a less extent than in the *Pithecus Wurmbii*. The fossa for the insertion of the masseter and temporal muscles is better marked in the lower jaw of the male than in the female *Troglodytes niger*, and its posterior boundary was developed into a tubercle in the specimen figured in Pl. LVIII.

Upon the whole, the amount of sexual distinction in the skull and dentition of the *Troglodytes niger* accords with that which is observed in the *Pithecus Morio* or the smaller Orang of Borneo, and is not so great as in the *Pithecus Wurmbii*. With this knowledge, therefore, of the dental and osteological characters of the *Troglodytes niger*, we are in a condition for satisfactorily testing any similar evidence of that larger species of Chimpanzee, the existence of which was long ago indicated by Battell* under the name of 'Pongo' as contradistinguished from the 'Chimpanzee' of modern naturalists, which he calls 'Engeco'; the 'Pongo' or 'Boggo' being subsequently more definitely alluded to by Lacépède in the 'Supplément,' tom. vii. (4to, 1789) p. 2 of Buffon's 'Histoire Naturelle,' as a large African 'Orang-outang,' 5 feet in height, and of which Lacépède believed the smaller black Orang, $2\frac{1}{2}$ feet high, of whose docile and social habits, under the name of 'Jocko,' Buffon has left so pleasing a record, to have been the young.

Such indications however are of little other value in rigorous natural history than as guides and stimulants to more special inquiry, and as inciting to the collection of confirmatory evidence. Yet it must be admitted, that if Lacépède were open to the charge of yielding too ready acceptance to the older notices of the great African Chimpanzee, Cuvier, who subjected him to it, fell into the opposite extreme of scepticism in pronouncing this remarkable animal,—the Pongo of Buffon,—to have been "only the imaginary product of that great naturalist's combinations†." What has been, however, now securely gained for science is the determination of the true stature, dentition, facial angle and other adult characters of the Chimpanzee of Cuvier and others (*Troglodytes niger*); upon which basis I proceed to engraft further illustrations of the genus, which of all brute mammalia is the most important, from its demonstrated closest proximity to Man.

* See Purchas's Pilgrims, vol. ii. p. 982.

† Règne Animal, tom. i. p. 88.

§ 3. *Indications and discovery of the adult* Troglodytes Gorilla, *Savage.*

The first intelligence which revived a feeling of faith and interest in the subject of the notices above-cited from Battell and the continuator of Buffon, reached me in the early part of last summer in a letter from Dr. T. S. Savage, a zealous and accomplished Missionary of the Protestant Episcopalian establishment at New York, with whom I had previously corresponded on the subject of the Chimpanzee, and by whom specimens of the young animal had been transmitted from the west coast of Africa to the Royal College of Surgeons in London. The letter in question was dated

"Protestant Mission House, Gaboon River, West Africa,
April 24, 1847.

"My dear Sir,—Your known interest in the zoology of Africa will find a ready excuse, I trust, for the following communication, and lead you in the midst of various engagements to give me a few moments in reply. I am on my way to the United States in a vessel which, to complete its voyage, had to touch at this point. I find it a region rich and untried in all the departments of natural history, besides being full of interest in a far more important point of view,—that of a missionary field. I have found the existence of an animal of an extraordinary character in this locality, and which I have reason to believe is unknown to the naturalist. As yet I have been unable to obtain more than a part of a skeleton. It belongs to the Simiadæ, and is closely allied to the Orangs proper. It reaches nearly if not quite the height of five feet in the adult state, and is of a large size. I am considerably in doubt in regard to its identity with an animal said to have been known to Buffon as a large species of Orang-outang, under the name of Pongo. It is referred to in a note on the 58th page of the 1st volume of the American edition of Cuvier's 'Règne Animal,' where he asserts that Pongo is a corruption of Boggo, which is given in Africa to the Chimpanzee or to the Mandrill, and was applied by Buffon to a pretended large species of Orang-outang, the mere imaginary product of his combinations; and then he says that Wurmb, a naturalist of Batavia, transferred the name (Pongo) to a monkey in Borneo, which he thinks identical with *Pithecus Satyrus* (the real Orang-utan, a red Orang of Asia). My excellent friend the Rev. J. L. Wilson, Senior Missionary of the American Board of Commissioners for Foreign Missions to this part of Africa, thinks that Pongo comes from 'Mpongive,' the name of the tribe, and consequently the region, on the banks of the Gaboon river, near its mouth, among which tribe he has resided for about five years. The tribe once extended a great distance on the coast above and below the river Gaboon, and the languages spoken for a great distance both above and below, are evidently but dialects with the Mpongive of one language. Whence Buffon professed to receive his specimen of "large species of Orang-outang" I know not, but this region and its vicinity indefinitely are the only points at which, so far as I can ascertain, "a large species of Orang-outang" has been heard of except the Chimpanzee, which is now well-known. I have seen it mentioned that the skeleton of the Pongo of Borneo is in the Royal College of Surgeons, of which institution you are a Professor. Now, may I solicit your aid in this matter? I will send you outlines of the skull of the male and female (adults) and ask the favour of a reply to my letter, stating whether you can identify them with that of any animal you know of under the name of Pongo or any other cognomen. I have no correspondent in Paris: if you feel sufficient interest in the subject, will you do me the favour to ascertain from that city the fact whether such skulls exist in any cabinet there? The natives state that a young one was caught many years ago and sold to a French captain, who never returned, and that it was the only individual taken out of the river. From what I know, the young skull would very much resemble that of the Chimpanzee. I have four crania (two male and two female) with many bones, though not a perfect skeleton, but I hope to complete one before I leave the river,

and to procure a dead subject, which I shall preserve in spirits; great uncertainty, however, attends my success, as they are indescribably fierce and dangerous, and are found only far in the interior; they are killed by elephant-hunters only in self-defence.

"Below you have a sketch of the cranium of the male and female*, executed for me by Mrs. Prince, the wife of Dr. Prince, the English Baptist missionary at Fernando Po, who is here for a short time in search of health. *a a* are two low ridges converging, as seen in the sketch, and uniting at *x*, and forming a strong prominent ridge in the course of the sagittal suture, which comes into a junction with a lateral ridge (*d*) sent back from the petrous portion of such temporal bone: *e* is a strong fossa of triangular shape between the ridges *a a*. The space between the zygoma and temporal bone in a transverse direction is one inch and three quarters deep; the diameter from before backwards three inches; at *b* is a sinus about half an inch in depth and an inch in length, with foramina for the passage of blood-vessels and nerves. The two upper middle incisor teeth are absent, but their sockets show their size to have been nearly if not quite double the two outer ones. The two lower middle incisor teeth are narrower than the two outer. The female cranium is a full-grown one, but differing from the male in the prominence of the ridges: the two anterior corresponding to *a a* in the male and the central are rudimental only, except at the extremes of the latter, where it joins the posterior transverse ridge, lettered *d* in the male. It has lost the two middle upper incisors, which bear the same relation in respect to size to the two outer that those of the male do. All the incisors, both in the upper and lower jaw, are larger than they are in the male: the canines in the female are shorter than in the male. These points are all that I need specify to enable you to identify the crania with any in your possession. You will greatly oblige me by a comparison, and communicating the result at your earliest convenience."

I lost no time in making the comparisons and transmitting the results to my esteemed correspondent: they were in substance to the effect, that the skulls figured and described in his letter, though resembling that of the great Orang of Wurmb in the development of the sagittal and lambdoidal crests, and in the sexual difference in the development of the canine teeth, differed plainly from it by the greater size and prominence of the supraorbital ridge, and in that respect resembled the known Chimpanzee. As I had at that time ascertained the characters of the adult dentition of a nearly full-grown male *Troglodytes niger*, but had not seen a skull of the old animal, the superior size of the canines to those in the female led me to suspect that the sagittal and lambdoidal crests might acquire in strong and aged individuals the proportions of those represented by Dr. Savage, and that thus the resemblance to the Pongo of Wurmb in this respect might be manifested by the adult male of the *Troglodytes niger*. Without the means of making a more detailed comparison, and in the absence of the skull of an old male Chimpanzee (which by the kindness of my friend Mr. Stutchbury I have now been enabled to describe and figure, Plates LVIII. LIX. and LX.), I could not feel satisfied that the specimens alluded to by Dr. Savage had belonged actually to a distinct species of *Troglodytes*. In the absence, therefore, of means of making comparisons of other characters, besides superior size, larger canine teeth, and concomitant strong sagittal and lambdoidal cristæ, as these were indicated in the sketches transmitted, I deemed it better to communicate my doubts to Dr. Savage than to hazard in the publications of the

* Woodcuts of these figures are given in the abstract of the present memoir published in the 'Proceedings of the Zoological Society,' Feb. 22, 1848, p. 29.

Society a premature indication of a species which might prove to be a sexual, or a local, larger and stronger, variety of Chimpanzee.

My friend Mr. Samuel Stutchbury of Bristol, having received similar statements of the existence of a large and formidable species of Chimpanzee in the Gaboon district, from the officers of vessels trading from Bristol to the west coast of Africa, urged them to endeavour to obtain specimens of it; and the result was that Captain George Wagstaff succeeded in procuring at the Gaboon river, in December 1847, three skulls of the large species and one of the smaller species of Chimpanzee, all adult.

One of the skulls of the large species (*Troglodytes Gorilla**) was of a very old male; the length of the skull was 11½ inches (0·29), with the molars worn nearly to the stumps and the crown of the canine reduced, partly by fracture, partly by attrition, to its basal portion: its pulp had been inflamed, and had produced ulceration of the alveolus.

A second skull (Pls. LXI. LXII. and LXIII.) was also of a male of equal size, with the full dentition of maturity, but a younger animal, with merely the summits of the cusps of the molars and the margins of the incisors slightly worn.

The third skull of the large *Troglodytes* was of a female, 9 inches (0·23) long, with the mature dentition, and with the molars not more worn than in the younger adult male.

The fourth skull was of a female adult Chimpanzee, 7¼ inches (0·185) in length, of the smaller species (*Troglodytes niger*), with the complete permanent dentition, and the teeth more abraded than in the two preceding skulls. Mr. Stutchbury afterwards transmitted to me the cranium of an old male *Troglodytes niger*, 8½ inches (0·220) in length. The lower jaw was wanting in each of the foregoing specimens, and the occipital or basal part of the skull had been more or less fractured; the skull of the young but full-grown male of the great *Troglodytes Gorilla* being the most perfect.

Captain Wagstaff reached Bristol in a broken state of health, and died soon after his arrival. The only information relative to these rare and valuable contributions to zoology which Mr. Stutchbury was able to obtain from him was that the natives, when they succeed in killing one of these Chimpanzees, make a 'fetish' of the cranium. The specimens bore indications of the sacred marks in broad red stripes crossed by a white stripe, of some pigment which could be washed off. Their superstitious reverence of these hideous remains of their formidable and dreaded enemy adds to the difficulty which a stranger has to contend with in obtaining specimens.

* In the original description of these specimens I had called the species after its discoverer; but I subsequently received the memoir by Dr. Savage and Prof. Wyman in which the name *Gorilla* is proposed for it, which I have therefore substituted for the name *Troglodytes Savagei*, which appears in the abstract of the present memoir in the 'Proceedings of the Zoological Society,' Feb. 22, 1848, p. 27.

§ 4. *Comparison of the Skull of the* Troglodytes Gorilla, *Savage, with that of the* Troglodytes niger, *Geoff.*

Independently of the superiority of size of the *Tr. Gorilla*, the sexual difference in respect of which is greater in that large species than in *Tr. niger*, there are well-marked differences of form, differences in the development and proportions of the intermuscular ridges, and, what is more decisive of specific distinction, in the disposition of certain sutures and in the structure and proportions of certain teeth. Compared in profile, as in Plates LVIII. and LXI., the skulls of both species present the striking difference from the two Orangs (vol. ii. Pls. XXXI. and XXXIII.) in the prominence of the supraorbital ridge; but this is greater in the *Tr. Gorilla*, and occasions a deeper concavity below it, the vertical prominence descending from the middle of the supraorbital ridge being more marked. The temporal ridges, after their junction upon the frontal, rise into a strong and lofty sagittal crest, which is continued to the lambdoidal crest. This is enormous in the *Tr. Gorilla*, and, with the zygomatic process, renders all the posterior and lateral parts of the calvarium concave. The same extent of the lambdoidal crest masks or rather destroys the posterior convexity of the occiput in *Tr. Gorilla*, so that in the direct side view of the cranium only the outline of the large mastoid cells appears at this part. The *foramen auditorium externum* being of the same size as in the *Tr. niger*, is relatively smaller in the *Tr. Gorilla*. The zygomatic arch is proportionably much stronger in the large Chimpanzee, and also differs from that in *Tr. niger* by the squamosal part (27) being of equal depth with the malar part (26), and by its having its upper border convex or produced into an angle instead of being straight or slightly concave. The alisphenoid (6) is longer and narrower in *Tr. Gorilla*, and contributes less to the back wall of the orbit than in *Tr. niger*, in which it forms a much smaller proportion of that part than in Man. The spheno-maxillary fissure is not only larger in *Tr. Gorilla*, but is narrower and more vertical, not angularly bent as in *Tr. niger*. The extent of the premaxillary bones below the nostril is not only relatively but absolutely less in *Tr. Gorilla*, and the profile of the skull less convex at that part, or less 'prognathic,' than in *Tr. niger*.

More important differences appear on comparing the two skulls in a front view (Plates LIX. and LXII.). The breadth of the premaxillaries (22) and of the incisor teeth is the same in both, whilst in all other dimensions the *Tr. Gorilla* greatly surpasses the *Tr. niger*: this is seen in the height of the sagittal crest, the thickness of the great supraorbital bar of bone, the prominence of the ectorbital walls (12, 26′, Pl. LXII.), and of the inferior tumid malar boundaries of the orbits. But the decisive specific character is given by the form and connections of the nasal bones. These have coalesced together in *Tr. Gorilla* as in *Tr. niger*, but less completely, the median suture remaining along the lower half (15, Pl. LXII.). The coalesced upper portions of the nasals (15′) ascend higher above the nasal processes of the maxillary than in *Tr. niger*, become contracted between

those processes and there project slightly, their median coalesced margins being inclined forwards, and thus offering a feature of approximation to the human structure, which is very faintly indicated, if at all, in the skull of the *Tr. niger*. The nasal bones however subside in the larger species as they expand at their lower halves, where they form a nearly flattened oval disc, terminating in a slight point below, and articulating laterally not only with the maxillary bones, but with an expanded superior portion of the premaxillaries (22′). A considerable extent of the sutures uniting these bones with the maxillaries remains in both the adult male and female skulls of *Tr. Gorilla*, whilst those sutures are very early obliterated in the *Tr. niger*. The ninth character, therefore, by which the Chimpanzee more nearly resembles Man than the Orang does*, applies to the smaller species of *Troglodytes*, and not to the genus.

In the specimen of the skull of an immature *Tr. niger*, with only the twenty deciduous teeth in place, in the museum of the College of Surgeons†, the maxillo-premaxillary sutures, still traceable at the sides of the nasal aperture as well as on the palate, show that each premaxillary bone terminates above in a point which does not reach the nasals: in another specimen, a little more advanced, for the inspection of which I am indebted to Mr. Stutchbury, the upper pointed ends of the premaxillaries reach the confluent nasals, and divide their lower extremity from the nasal processes of the maxillaries; but they do not expand there as in the *Tr. Gorilla*, and the sutures of the premaxillaries disappear in the adult of the *Tr. niger*‡. In all the specimens of the adult *Tr. Gorilla* a greater or less proportion of the sutures of the premaxillaries remain, and show that the premaxillaries expand at their upper extremities and form a triangular plate of bone on the outer surface of the face which ascends, above the bony nostril, upon the sides of the lower half of the lower expanded part of the confluent nasals, separating that part from the maxillary bones, and excluding the maxillaries from the periphery of the external nostril. This character of the premaxillaries is constant in three skulls of the *Tr. Gorilla* first transmitted by Mr. Stutchbury, and in two others which he has subsequently sent; and I regard it as decisive of the specific distinction of the *Tr. Gorilla*.

The inferior or alveolar part of the premaxillaries, on the other hand, is shorter and less prominent in *Tr. Gorilla* than in *Tr. niger*, and in that respect the larger species deviates less from Man. The anterior surface of the premaxillaries is more irregular or undulated by the prominent sockets of the incisors in *Tr. niger* than in *Tr. Gorilla*. The nostril is a wider and more regular ellipse in *Tr. Gorilla*; it is contracted above in *Tr.*

* Zool. Trans. vol. i. p. 368.

† This is the specimen alluded to by Mr. Lawrence when treating of the intermaxillary bone in the fourth chapter of his "Lectures on the Natural History of Man," 8vo, 1819, p. 174.

‡ M. de Blainville, describing the skull of the Chimpanzee from a young specimen of the *Tr. niger*, says, "Mais les prémaxillaires, qui offrent la particularité de toucher à peine les os du nez et de souder de fort bon heure avec les maxillaires." (Ostéographie, fasc. i. p. 33.)

niger, which gives it an ovate form with the great end downwards, and thus it more resembles the form of that aperture in Man.

The orbits have a more subquadrate form, with the angles rounded off, in *Tr. Gorilla* than in *Tr. niger*; but their periphery is less sharply defined, especially below, than in *Tr. niger*. The æthmoidal cells are more swollen out, giving the interorbital space a greater breadth below and the lachrymal fossæ a more anterior aspect in *Tr. Gorilla*.

The infraorbital canal is open from its posterior commencement to where it perforates the lower border of the orbit, and it issues upon the face relatively lower and further from the orbit in the *Tr. Gorilla* (21′). In two skulls of the *Tr. niger* the infraorbital canal is overarched by bone at both ends, and is a deeper and narrower fissure at the intervening part than in *Tr. Gorilla*: in a third skull of *Tr. niger* the canal is deeper, narrower and longer than in *Tr. Gorilla*.

The whole nasal bone is relatively longer, and the distance from the orbits to the external nostril greater in the *Tr. Gorilla*.

The malar bone is more convex outwardly, and is more remarkable for its vertical extent: it is flatter and developed more transversely in the *Tr. niger*.

The larger proportional size of the canines in *Tr. Gorilla* impresses a corresponding difference upon the alveolar part of the maxillary bone in that species.

In comparing the skulls of the two species by a view of their base (Plates LX. and LXIII.), the first remarkable difference is the broad, flat, or slightly concave supraoccipital surface of the larger species as compared with the uniformly convex character of the same part in the other, the outline of this part being rounded in *Tr. Gorilla* and almost angular in *Tr. niger**: the difference is due to the much thicker and broader lambdoidal ridge in the larger species, which prolongs the surface far beyond the cerebellar fossa, and gives the condyles and foramen magnum a rather more advanced position as compared with the *Tr. niger*. The next character, which is also a more anthropoid one, though explicable in relation to the greater weight of the skull to be poised upon the atlas, is the greater prominence of the mastoid processes in the *Tr. Gorilla* (*m*, Pl. LXIII.), which are represented by only a rough ridge in the *Tr. niger* (*m*, Pl. LX.). These protuberances are cellular, and with a very thin outer layer of bone in the *Tr. Gorilla*. The lower surface of the long tympanic or auditory process (28, Pl. LX.) is smooth and flat, or slightly concave, in *Tr. niger*, and developes a slight tubercle anterior to the stylohyal pit (38): in the *Tr. Gorilla* the same process (28, Pl. LXIII.) is more or less convex below, and developes a ridge (*v*), answering to the vaginal process, on the outer side of the carotid canal (*c*); and in one instance the ridge extended, like the vaginal process in Man, the whole length of the auditory process, the under surface of which was, as it were, pinched up orcompressed from before backwards.

* In one of the skulls of the male *Tr. niger* before me, there is a small vascular, supraoccipital foramen, like that in certain parrots and pigeons, and which I have pointed out in the Dodo (Zool. Trans. vol. iii. p. 351).

The processes posterior (*p g*) and internal (*g*) to the glenoid articular surface are better developed, especially the internal one in Pl. LXIII., than in the *Tr. niger* (Pl. LX.): the ridge which extends from the ecto-pterygoid (25, Pl. LXIII.) along the inner border of the foramen ovale (*t r*) terminates in *Tr. Gorilla* by an angle or process answering to that called 'styliform' or 'spinous' in Man, but of which there is no trace in the *Tr. niger*.

The palate is narrower in proportion to its length in the *Tr. Gorilla*, but the premaxillary portion (22) is relatively longer in *Tr. niger*. Two anterior palatine foramina, one on each side the almost confluent incisive foramina, are more constant and conspicuous in *Tr. Gorilla*: the posterior palatine foramina are nearer the posterior border of the bony palate in the *Tr. niger*. The pterygoid fossæ (24) are relatively deeper and longer in the *Tr. niger*. The posterior nares are deeper or longer in proportion to their breadth in *Tr. Gorilla*; and the posterior border of the bony palate is emarginate at its middle, instead of being produced backwards into a point as in *Tr. niger*.

As decisive marks of specific distinction as any of those deducible from the forms, proportions and connections of the bones are presented by the greater relative dimensions of the canine and molar teeth, as compared with the incisors in the *Tr. Gorilla*, and by the more complex grinding surface of the last molar (*m* 3, Pl. LXIII.), and its equality of size with the first molar (*m* 1) in *Tr. Gorilla*. The transverse extent of the four incisors of the upper jaw is as great in the *Tr. niger* as in *Tr. Gorilla*: the interspace between the right and left canines is even greater, as is also the extent of the diastema between the canines and the incisors of the upper jaw in *Tr. niger*. The median incisors are, however, larger in proportion to the lateral ones in *Tr. Gorilla*.

In one example of a male *Tr. Gorilla* the antero-posterior extent of the five grinding teeth is 2 inches 8 lines; in a second male it is 2 inches 9 lines; in one male *Tr. niger* the antero-posterior extent of the same teeth measures 1 inch 10 lines; in an older male it measures only 1 inch 9 lines.

The crown of the canine is more inclined outwards in *Tr. Gorilla*; the anterior inner groove is much deeper; the base of the posterior trenchant border is more produced; the ridge between the two inner grooves is more prominent, and the hinder inner groove is continued more decidedly upon the fang in the *Tr. Gorilla*. The following are the dimensions of the canines in the males of the two species:—

	Tr. Gorilla.	*Tr. niger.*
Total length	2″ 8‴	2″ 0‴
Length of the crown	1″ 3‴	0 10½‴
Breadth of its base	0 10‴	0 7‴
Thickness of ditto	0 7½‴	0 5½‴

The last molar (*m* 3) of the *Tr. Gorilla* is more nearly equal to the penultimate one than in *Tr. niger*, being only slightly narrower across the back part: it has the posterior outer cusp, and particularly the posterior inner cusp, much more distinctly developed,

and there is a distinct connecting ridge between the posterior outer and the anterior inner cusps, as in the first molar (*m* 1), and which ridge is not developed in the last molar of the *Tr. niger*.

In comparing the interior of the cranium the olfactory fossa is much deeper in the *Tr. Gorilla* than in the *Tr. niger*, and the 'crista galli' is either more rudimental than in *Tr. niger*, or is absent, and there is no ridge continued upwards from the fossa upon the inner surface of the frontal bone as in *Tr. niger*. The optic chiasma indents the presphenoid with a deeper transverse groove in the *Tr. Gorilla*. The foramen lacerum anterius is subquadrate in *Tr. Gorilla*: it is triangular in *Tr. niger* by the elongation of the upper and outer angle. The roofs of the orbits form a more convex prominence in the interior of the cranium on each side the olfactory fossa in *Tr. niger* than in *Tr. Gorilla*. The posterior clinoid ridges overhang the *sella turcica* in the *Tr. niger*, in which they are more produced forwards than in *Tr. Gorilla*. The fossæ for the middle lobes of the cerebrum or 'natiform protuberances' are deeper in the *Tr. niger* than in the *Tr. Gorilla*.

The inner surface of the cranium of the *Tr. Gorilla* is smooth and even; the indications of the convolutions of the brain are very feeble; the middle meningeal artery leaves impressions of its chief ramifications on the sides of the cavity; the longitudinal sinus begins to indent the inner surface of the calvarium near the end of the sagittal suture, which however was obliterated in all the specimens; it descends to the middle of the supraoccipital surface, then divides into the lateral sinuses which form deep channels at the back part of the petrosal on the inner surface of the mastoid.

The lateral walls of the cranium formed by the lower borders of the parietals are thin and diaphanous, but compact and without diploë; this is the case also with some parts of the supraoccipital plate: but the cranial walls are remarkably unequal in thickness; there is much diploë along the base of the sagittal and lambdoidal crests, and this receives air where it is continued upon the mastoids.

The sinuses of the basisphenoid were divided by a complete septum in one specimen, but this was absent in another; they extend into the alisphenoids and into the bases of the pterygoids. The frontal sinuses are divided by a strong vertical septum, whence they extend outwards to the base of the external orbitar process; they also reach far back and communicate, as in Man, with the middle meatus of the nose, above the smaller opening of the antrum.

The inflated or posterior part of the maxillary has thin, almost papyraceous walls: the vast antrum extends to the floor and inner wall of the orbit and into the malar bone; it communicates with the nostrils by a wide aperture, overarched by the inferior turbinal, and sometimes also by a smaller opening overarched by the turbinal process above. Its walls being broken away on the left side in a skull of an old male *Tr. Gorilla*, shows what appears to be the convex back part of a second wall of the antrum, about half an inch from the outer one, and which is cribriform or reticulate: a portion of this convexity, removed vertically on the right side of the same skull, exposed a light and delicate

osseous texture of two kinds; the upper half was finely but irregularly spongy, and this terminated halfway down the mass by a compact, thin surface or floor, convex downwards and backwards, from which a vast number of delicate bony plates and threads proceeded vertically to it, from 5‴ to 8‴ in length: they interlaced together as they diverged, and expanding and uniting at their extremities, formed the reticulate inner convex plate of the antrum above described: an interspace extends between this plate and the alveoli of the teeth.

The posterior part of the malo-maxillary suture is finely and deeply indented: the zygomatic suture is beautifully crenulate, so likewise is the infraorbital part of the malo-maxillary suture. The margins of the expanded part of the nasals are joined to the maxillaries and intermaxillaries by true sutures, not harmoniæ, as in the *Tr. niger* and in Man.

As the male *Troglodytes Gorilla* differs from the male *Troglodytes niger* in the superior development of the sagittal crest, so the female *Tr. Gorilla* differs from the female *Tr. niger* in the nearer approximation of the temporal ridges, which meet along the sagittal suture instead of being separated by a smooth tract of between one and two inches in breadth as in the female *Tr. niger*; a difference which indicates a corresponding superiority of size of the temporal muscles in the female of the larger species as compared with the smaller species of Chimpanzee to that which obtains in the males of the two species.

The lambdoidal crista is also more developed in the female *Tr. Gorilla* than in the female *Tr. niger*, and the occiput is flatter and broader. The *os frontis* is flatter behind the prominent supraciliary ridge, and the convexity of the calvarium rises more gradually and remotely from the ridge.

The zygomata offer the same relative superior depth and strength, the same equality of the squamosal portion, and the same elevation and convexity of its upper border. The malar bones show the same superior prominence; the spheno-maxillary fissure the same greater length, narrowness, and nearer approach to a vertical direction.

The maxillo-premaxillary sutures have the same degree of persistency in the adult female *Tr. Gorilla*, being obliterated both upon the face and palate only near the openings of the contiguous alveoli, and demonstrating the same upward extension and triangular expanse of the premaxillary bones, above the nasal aperture, which distinguishes the male *Tr. Gorilla* from the same sex in the *Tr. niger*. The bony palate shows the same superior length as compared with breadth, and the same difference in the relative position of the postpalatine foramina and in the form of the posterior border, as have been noticed in the male skull. There are two small tuberosities between the postpalatine foramina in *Tr. niger*, one on each side of the median suture, but there is no trace of such in the female or the younger male of the *Tr. Gorilla*. The alveolar parts of the premaxillaries have the same relative shortness as compared with the female *Tr. niger*. Although the canines exhibit the same sexual inferiority of size in the female

Tr. Gorilla as in that sex of the *Tr. niger*, the incisors are proportionally to those in *Tr. niger* as much smaller, and the molars as much larger, as in the male *Tr. Gorilla*. The last molar not only shows the same equality of size as in the male *Tr. Gorilla*, but in the skull of the female here described presents a greater complexity of the crown by the outer and posterior lobe being notched, so that the outer half of the wisdom-tooth is here trilobate.

The infraorbital canal is short, wide and shallow, the *foramen lacerum anterius* subquadrate, and the olfactory fossa as deep and well-defined in the female as in the male *Tr. Gorilla*. In short, all the distinctive characters of the species afforded by the disposition of sutures, forms of foramina, and proportions of bones and teeth, are as well-marked in the comparison of the skulls of the females of the two species as in that of the males: in such modifiable characters as the bony ridges dependent upon muscular development we find a more marked distinction in the female *Tr. Gorilla*, as compared with the female *Tr. niger*, in the presence of a ridge, the parietal one, *e. g.*, which does not exist in the female of the smaller species of Chimpanzee at any age.

Even in the female *Tr. Gorilla*, in which the apices of the tubercles of the teeth are but slightly abraded, the temporal ridges have met along the whole line of the sagittal suture, where a narrow groove indicates their original distinction. In one old male of the *Tr. Gorilla* the temporal ridges, though confluent along their bases, diverge as they rise and form two parallel parietal cristæ, divided by a deep angular channel. Amongst other varieties noticeable in the series of skulls of this remarkable species, I may mention the existence of a venous foramen in each squamosal of the female skull, situated about ten lines above the *meatus auditorius*: the infraorbital foramen is double on one side and single on the other in two of the skulls.

With regard to varieties in the skulls of the adult *Tr. niger*, I have seen in one old male three anterior condyloid foramina on each side instead of the normal single foramen; and in the same skull the middle of the basioccipital was perforated from above obliquely downwards and forwards by a canal, probably venous, of two lines in diameter.

On a review of the differences pointed out in the preceding comparisons, the stronger zygomatic arches, with the more developed sagittal and lambdoidal crests, might be viewed as adaptive developments concomitant on the presence of larger canines, and indicative of a larger and more powerful variety of Chimpanzee; but the larger proportional molars and the smaller proportional incisors, the more equal and complex ultimate molar tooth, together with the prominence—slight as it is—of the nasal bones at their median line of coalescence, and above all, the reappearance of the premaxillaries upon the face above the nostril with their longer enduring sutures, constitute a series of differential characters of more importance than such as are due to greater bulk or activity of muscles, and not to be explained by the operation of external circumstances favouring greater general development of size and power. These characters, also, repeated in

both the male and female, leave no alternative, according to the value given to such characters in other Quadrumanous genera, than to pronounce the *Troglodytes Gorilla* to be distinct from the *Troglodytes niger*, and this to be, as the *Pithecus Morio* is to the *Pithecus Wurmbii*, a smaller, feebler and more anthropoid species of its genus.

Having thus pointed out the particulars in which the *Troglodytes Gorilla* differs from the *Tr. niger*, I proceed next to compare the larger and more formidable species of Chimpanzee with its Asiatic analogue, the great Orang or Pongo of Wurmb, *Pithecus Wurmbii*.

§ 5. *Comparison of the Skull of the male* Troglodytes Savagei *with that of the male* Pithecus Wurmbii.

In size, these most powerful and formidable examples of the Quadrumanous order are nearly equal; the great Chimpanzee upon the whole, however, surpasses the great Orang, and therefore claims to be regarded as the giant of the Quadrumanous order. Both are alike remarkable for the superior development in the male sex of the conical canines and the strong carnassial-like sagittal and lambdoidal crests, and the massive zygomatic arches and malar bones. In both the facial angle is low and brutal, the few degrees in favour of the Chimpanzee being due to the enormous supraorbital ridge characteristic of its genus*. This is the first and most striking feature of distinction between the two great Apes; and while its presence impresses a peculiarly forbidding, scowling physiognomy even upon the dry skull of the great Chimpanzee, its absence gives a more open and milder aspect to that of the slothful Orang.

The cranium is absolutely longer in the Chimpanzee, and longer in proportion to the face: the lambdoidal crista is more developed, especially at its upper and middle part, where it is joined by the sagittal crest. The upper border of the squamosal is longer and straighter in the Chimpanzee, and joins the frontal: in the Orang it is commonly separated from the frontal by the broader alisphenoid. The zygomatic arch is deeper and stronger in the Chimpanzee, the zygomatic portion of the arch is shorter and its upper border is convex or angular, whilst in the Orang it is longer, more slender, and its upper border is straight. The outer boundary of the orbit is much thicker. The spheno-maxillary fissure is much longer in the Chimpanzee; in the great Orang it is very short, but wider.

The line of the external border of the orbit and of the posterior contour of the maxillary bone is less oblique from above downwards and forwards in the Chimpanzee than in the Orang: the alveolar border of the maxillary, especially its molar part, is longer in the Chimpanzee: instead of the rough oblong tract upon the mastoid, there is the distinct hemispheric mastoid process in the great Chimpanzee. Such are the chief differences in the comparison of the side views.

* Compare Pl. LXI. with Pl. XXXI. p. 192. vol. ii.

Viewed from before, the enormous supraorbital arch with the tumid malar bones again form the most striking characteristic of the Chimpanzee: the orbits are subquadrate with the angles rounded off; in the Orang they are full ellipsoids with the long diameter vertical. The zygomata are more directly continued backwards from the malars, which contribute a larger proportion to the arch in the Chimpanzee, whilst in the Orang they curve more outwards. The flat and narrow nasal of the Orang contrasts strongly with the form of the same bone, which is prominent above and expanded below, in the Chimpanzee; and the oval nostril, contracted above in the Orang, equally contrasts with the full elliptic nostril in the Chimpanzee. The alveolar portion of the premaxillaries is longer in the great Orang than in the great Chimpanzee, and, with the canine-alveoli, this part of the face is broader as well as more prognathic in the great Orang. The malar process of the maxillary is shorter in the Orang; it is more deeply impressed outside the socket of the canine, and the inferior angle at its junction with the malar is more produced downwards: the suborbital outlet is more constantly divided into two or three foramina in the Orang.

In the basal view the occipital region is both broader and flatter in the great Chimpanzee; it approaches Man nearer in the minor degree of its inclination from the horizontal plane of the basis cranii, in the more advanced position of the condyles and zygomatic arches, by the shorter extent of the basioccipital and basisphenoid, and by the greater concavity of the glenoid fossæ for the lower jaw. The occipital condyles are less convex in the Chimpanzee and somewhat smaller than in the Orang; they appear therefore disproportionately small as compared with the size of the skull, which is poised by them upon the atlas. The basioccipital is narrower and more convex anteriorly in the Chimpanzee.

The precondyloid foramen, which is usually single in the Chimpanzee, opens immediately below—almost into—the jugular foramen; whilst in the Orang, in which there are usually two precondyloid holes, the exoccipital extends forwards and outwards a quarter of an inch beyond them before it forms the posterior border of the jugular foramen.

The processus jugularis of the exoccipital is longer and more curved forwards in the Orang, and the rough ridge representing the paroccipital process is better developed: the form and extent of the jugular process (*j p*, Pl. LXIII.) in the Chimpanzee is more like that in Man.

The angular process of the petrosal (*p j*) encroaching upon the foramen jugulare is more developed in the Chimpanzee, and more resembles that in Man.

The carotid foramen is more oblique, being defended by a ridge along its outer side in the Chimpanzee answering to that continued from the vaginal process in Man; there is no such ridge in the Orang.

The eustachian process (*e*) of the petrosal is much thicker and less sharply pointed in the Chimpanzee; the apex of the petrosal itself is also thicker and less pointed.

Between the foramen caroticum and the foramen stylo-mastoideum in the Chimpanzee, there is a deep stylohyal fossa (38, Pl. LXIII.) answering to the root of the stylohyal in Man; this is less deep and less constant in the Orang.

The mastoids are relatively larger in the Chimpanzee, and develope a true process instead of a rough oblong tract.

The glenoid articulation of the squamosal is more concave, especially from side to side, in the Chimpanzee, and it rises above the level of the tympanic meatus. In the Orang the surface is almost flat, and is carried below the level of the auditory process; the inner process of the glenoid cavity is wanting in the Orang, but the hinder one is as large as in the Chimpanzee.

In the Chimpanzee a styliform process of the sphenoid (6 *s*) abuts against the inner glenoid process (*g*), and is wedged between this and the eustachian process (*e*) of the petrosal. In the Orang the styliform process is absent.

In the Chimpanzee the pterygoids are narrower than in the Orang, the external plate is less developed, and the internal plate is thicker and shorter: a ridge is continued from the base of the external plate into the styliform process in the Chimpanzee: the pterygoid fossa is deeper and longer in the Orang.

The posterior nostril is shorter and wider in the Chimpanzee.

The bony palate is longer and shallower in proportion to its width in the Chimpanzee; it is more expanded anteriorly in the Orang. In the Orang the two posterior palatal foramina are nearer each other, and have two tuberosities between them; these are absent in the great Chimpanzee. The prepalatal foramen is larger and more distinctly divided in the Chimpanzee. There is a moderate-sized foramen on each side nearly in the line of the obliterated premaxillary-palatine suture, the course of which is marked by two or three small foramina in the Orang.

The incisors are thicker from before backwards in proportion to their breadth in the Orang than in the Chimpanzee.

The interspace between the incisors and canines is narrower in the Chimpanzee, but the canines have longer and broader crowns in the Chimpanzee.

The outer lobe of the first premolar, *p* 1, is larger than the inner one, and *vice versâ* in the second premolar, *p* 2, in the Chimpanzee: the outer lobe of *p* 1 is a little larger than the inner one, and both lobes are equal in *p* 2 in the Orang.

The antero-posterior diameter of the true molars is greater in comparison with the transverse diameter in the Chimpanzee than in the Orang, and the last molar is more equal in size and similar in structure to the others; hence the longitudinal extent of the series of grinding teeth, including the premolars, is longer; the five teeth in the Orang equalling only the last four teeth in the Chimpanzee.

The structure of the grinding surface of the true molars is so modified in the Orang as to deviate further from that in Man than it does in the Chimpanzee: both the first and second true molars have the four principal cusps in the Orang, but they are less

developed: the oblique ridge joining the antero-internal to the postero-external cusp is wanting. The sigmoid course of the prominent part of the enamelled surface resulting from this ridge is a material mark of the closer affinity of the Chimpanzee to Man. The whole grinding surface of the crown is more minutely wrinkled in the Orang. The number of roots of both premolars and molars is the same in both Apes.

The skulls of the great Chimpanzee and Orang offer very striking differences from one another when viewed from above, looking down upon the vertex. The cerebral dome is more prominent, and the chamber of the brain seems at first sight to be more capacious in the Orang; but it is not so absolutely, being only less masked by the lambdoidal and supraorbital ridges than in the Chimpanzee, in which their extraordinary development, with that of the base of the zygomata, changes the convexity of the outer surface of the cranial dome into a concavity at its periphery: the anterior and posterior parts of the calvarium are rendered broader in the Chimpanzee, the external orbital processes are much stronger, and the whole cranium is both longer and larger in proportion to the face. The supraorbital prominence renders the plane of the orbits more vertical in the Chimpanzee, and a less proportion of these cavities is visible in the top view than in the Orang.

The means of comparing the lower jaw and teeth of the *Troglodytes Gorilla* of Africa and the *Pithecus Wurmbii* of Borneo have not yet reached me.

In the foregoing comparison the points in which the *Troglodytes Gorilla* offers a closer resemblance to Man than the *Pithecus Wurmbii* does, are the following:—

1. The cranial part of the skull is larger in proportion to the facial part.
2. The foramen magnum is more advanced, and its plane bends upwards two degrees less from that of the basioccipital than it does in the Orang.
3. The plane of the supraoccipital* forms an angle of 120° with that of the basioccipital: in the Orang it forms an angle of 140°.
4. The mastoid processes are convex cellular protuberances; but in the Orang they are rough ridges.
5. The precondyloid foramen is single on each side, and opens closer to the jugular foramen.
6. The presence of a vaginal process.
7. The presence of a styliform process of the sphenoid.
8. The shorter basioccipital and basisphenoid.
9. The deeper glenoid cavities for the lower jaw.
10. The wider posterior nares.
11. The shorter and straighter zygomatic arches.
12. The foramen ovale is completely perforated in the alisphenoid, but in the Orang it is a notch, completed behind by the petrosal, and is of a longer and narrower form.

* A line drawn from the back part of the foramen magnum to the spinous process at the middle of the lambdoidal ridge crossing the line drawn along the basioccipital.

13. The alisphenoid extends outwards more beyond the ecto-pterygoid before it ascends upon the side of the cranium.

14. The greater length of the spheno-maxillary fissure.

15. The more outward development of the malar process of the maxillary.

16. The squarer form and less oblique plane of the orbits.

17. The prominence of the upper half of the nasal bones.

18. The narrower and less produced muzzle (alveolar part of premaxillaries and contiguous parts of maxillaries lodging the canines).

19. The absence of orbito-malar foramina.

20. The greater breadth of the interorbital space. The smaller size of the orbito-sphenoids (lesser alæ of the sphenoid). The greater development of the frontal sinuses.

21. The greater breadth of the sella turcica and the wider separation of the optic foramina.

22. The minor convexity of the roofs of the orbits at the sides of the olfactory fossa.

23. The ento-jugular process of the petrosal, and the size, shape and position of the aquæductus vestibuli with its overhanging plate.

24. The configuration of the grinding surface of the premolars and molars.

The *Pithecus Wurmbii* more nearly resembles Man :—

1. In the greater relative extent of the convex part of the calvarium.

2. In the minor prominence of the supraorbital ridges.

3. In the greater length and breadth of the upper part of the alisphenoids, which more commonly join the parietals than in the Chimpanzee.

4. In the greater proportion of the orbital plate of the sphenoid, and the less proportion of that of the malar.

5. In the larger size and squarer form of the lachrymal, which joins more constantly and to a greater extent the os planum (orbital part of prefrontal).

6. In the greater length and depth of the pterygoid fossæ.

7. In the triangular form of the fissura lacera anterior.

8. In the deeper fossæ for the natiform protuberances.

9. In a minor development of air-cells in the squamosal and alisphenoid.

These characters of nearer approach to Man, besides being fewer in number, are of less importance in the Orang, since they depend for the most part on the inferior development of characters which are nevertheless present, and which are strictly apish, distinguishing both the large anthropoid species from Man, and only not equally so, because they are present on a larger and more decided scale in the skull of the Chimpanzee, and give it a more brutish and forbidding physiognomy.

§ 6. *Comparison of the Skull of the male* Troglodytes Gorilla *with that of a male Negro.*

In the side view the most remarkable difference is the small proportional size of the cranium, as defined by the supraorbital ridge and the zygomatic arch from the facial part of the skull, in the Chimpanzee; notwithstanding the presence of the strong sagittal and lambdoidal cristæ which are superadded to the cranial part of the skull, and prolong its extent upwards and backwards beyond the proper walls of the brain-case in the great Ape.

The temporal ridge, arching upwards and backwards, and blending with its fellow to form the parietal crest, defines the upper contour of the cranium in the Chimpanzee, the intercepted part of the frontal sinking below the converging ridges and forming a concavity in their interspace. In Man the frontal swells out into a broad convexity between those ridges, which are feebly defined by the slight subsidence of the muscular temporal surface below the level of the rest of the frontal, and this indication of a ridge usually disappears before it reaches the coronal suture, where nearly the whole upper surface of the cranial dome intervenes between such indications.

The rudiment of the lambdoidal ridge in Man curves with the convexity upwards below the suture to terminate in the occipital spine or tubercle, a free tract of bone more than an inch in breadth dividing the lambdoidal from the temporal ridges, and being continued between them upon the mastoid process. In the Chimpanzee the enormous lambdoidal crest, blended with the back part of the temporal ridge, curves with the concavity upwards, as it extends from the mastoid, obliterating the suture, to join the hind end of the sagittal crest; and the lambdoidal crest terminates the contour of the cranium behind as the sagittal does above.

In Man the parietal dome rises high above and the occiput swells out below the rudimentary lambdoidal ridge, whilst the larger and longer mastoid process, projecting downwards and extended forwards beneath the meatus auditorius externus, supports the vaginal plate of the tympanic or auditory process; but in the Chimpanzee the tympanic or auditory process, presenting the form of a semicylindrical tube, is wholly in advance of the shorter mastoid process, and has no vaginal process at its outer end. The post-glenoid process of the squamosal (middle root of the zygoma) is relatively thicker and longer, but more obtuse in the Chimpanzee.

The zygoma is not only much stronger, but the squamosal and malar portions have different forms and proportions in the Chimpanzee; the squamosal is as deep and as long as the malar part, instead of being shallower and longer as in Man; and its upper border rises in the Chimpanzee into an angular form. The malar portion is accordingly longer, and does not decrease in depth after leaving the body of the bone as in Man. The posterior border of the frontal process of the malar is slightly concave or nearly straight in the Chimpanzee; it forms a strong sigmoid curve in Man, convex backwards at its upper half. The supraorbital ridge projects very slightly beyond the slope of the

frontal between the external angle and the prominent sinus even in the lowest Negro or Australian skull: the prominence of the whole supraorbital ridge, which is the characteristic of the genus *Troglodytes*, reaches its maximum in the present great species, and forms the most marked distinction in the comparison of its skull with that of Man. The interorbital part of the ridge, however, projects more suddenly over the root of the nasal in the Ethiopian and especially Australian skulls than in the Chimpanzee. But even in the low race of Man selected for the comparison, the development of the prosencephalon carries the interorbital part of the frontal forward so as to bring the orbital cavity into view in advance of its lateral malar boundary; but no part of that cavity is seen in the same direct side view in the Chimpanzee.

The prominent nasal bone forms part of the anterior outline below the overarching frontal in Man; but notwithstanding the characteristic projection of the nasal in the great Chimpanzee, the thick swollen external wall of the orbit shuts it out of view. Below the malar the alveolus of the great canine in the maxillary, and then the prominent premaxillary and incisors, complete the anterior contour in the Chimpanzee; but in Man the concave maxillary border of the external nostril leads from the nasal to the short and slightly projecting anchylosed premaxillary bone, supporting the almost vertical crowns of the incisors.

The great cuspidate canine, the interval dividing it from the incisors, the superior size of the first premolar over the second, the prominent double socket for the two diverging external fangs of each premolar, and the equal-sized true molars, are all distinctive characters in the Chimpanzee of the most decisive nature in contrast with the specific peculiarities of the dentition in Man.

In the direct side view of the human skull, a part only of the crown of the outer incisor and scarcely any of the inner incisor can be seen projecting beyond the canine; whilst the whole crown of the outer incisor and the more prominent part of the inner incisor extend beyond the canine in the Chimpanzee. The whole alveolar border of the upper jaw extends much further below the base of the cranium in the Chimpanzee than in Man, in whom the superior depth of the brain-case brings the mastoid process almost on a level with the alveoli of the maxillary bone. The relatively shorter, deeper, subquadrate form of the upper jaw is also a marked characteristic of Man. In the Chimpanzee, although the alveolar border forms a right angle with the posterior border of the upper jaw, the long anterior border slopes forwards towards the lower border at an acute angle, and to the same degree departs from its parallelism with the posterior border.

The spheno-maxillary fissure is longer, narrower and less curved in the Chimpanzee than in Man: the ectopterygoid is shorter, but the antero-posterior extent of the base of this process is relatively much greater. The styliform process of the sphenoid terminates the arch behind the pterygoid in both; but the vaginal process with its anchylosed stylohyal is a character quite peculiar to the human skull.

Another feature peculiar to Man is the arch or upward curve of the basal contour of the cranium between the occipital condyles and the lower end of the posterior border of the vomer, and the near approach to parallelism of the line of the occiput below the superior transverse ridge with the line of the teeth. The difference in the plane of the occipital foramen of the human skull from that in the Chimpanzee is as well-marked in the lowest as in the highest races of Man.

Such is the enormous development of the facial part of the skull as compared with the cranial part in the Chimpanzee, that in taking a direct front view with the nasal cavity as the centre of the perspective plane, little more of the cranium is visible than that which forms the base of the sagittal crest (Pl. LXII. 7). The thick supraorbital ridge (12) and outstanding malars (26) and maxillaries (21) compose the major part of the plane, and the prognathic premaxillaries (22) and incisors with the great canines and their tumid alveoli complete with the broad and deep lower jaw the view below.

In Man the upper half of the corresponding view is formed by the frontal part of the cranial dome; the expanded sides of that dome are visible behind and beyond the outer walls of the orbits, and the mastoid processes come into view behind the angles between the malars and maxillaries. Of the regular arch formed by the equable teeth only the hinder molars are excluded from view, and not always these in the white races.

The prominence of the entire nasal bones; the relatively larger, broader, and more sharply defined orbits; their comparatively slender outer boundaries; the concavity of the surface which descends from the orbit to the alveoli of the premolars in contrast with the convexity of the same part in the Chimpanzee; the vertical plane of the nasal aperture (which slopes from above downwards and backwards in more favoured races of Man); and the slight prominence of the premaxillaries (which are vertical in well-formed Caucasian skulls), are eminent characteristics of the human species in this comparison.

In the orbits of the Chimpanzee the lachrymal bones are either separated from the 'ossa plana' or are united to them in a much smaller proportion than in Man; and the orbital plate of the lachrymal is much smaller as compared with the part excavated for the lachrymal fossa than it is in Man. The entorbital angle or plate of the malar is longer and extends deeper into the orbit than in Man.

In a comparative view of the skulls from above, in which the beginning of the sagittal suture is the centre of the perspective plane, scarcely anything is seen but the smooth expanded vault of the cranium in Man; the narrower temples of the Negro and Australian allow the zygomata to come into view, and in the most prognathic examples the incisors just appear between the prominences of the frontal sinuses.

In the Chimpanzee the whole length of the face from the lower border of the orbits is seen sloping from beneath the supraorbital ridge; the whole span of the large zygomatic arches, with parts of the temporal fossæ, appear at the sides of the narrower temples; the oval cranial vault after a certain expanse changes its curve, and from

being convex becomes concave, expanding into a broad base formed by the supraorbital ridge in front and by the lambdoidal crest behind, continued into the zygomatic arches at the sides. The small cranial dome also supports the strong sagittal crest which at the coronal suture divides and diverges, curving outwards to the external angles of the supraorbital ridge.

No quadrumanous animal, and few other mammals, offer a greater contrast with Man in the form and structure of the upper surface of the cranium than the great male Chimpanzee does.

In the basal comparison of the skulls most of the differences pointed out in my former memoir between the *Troglodytes niger* and Man are repeated, but are the more striking as being presented on a larger scale by the *Troglodytes Gorilla*. As a consequence, however, of the enormous development of the lambdoidal crest, which carries further backwards and outwards the flattened occipital region, the foramen magnum appears to be more advanced in position than in the *Troglodytes niger*; but this seeming nearer approach to the human structure disappears when the base of the skull is viewed in true perspective, placed upright with the palatal surface perpendicular, as in Plate LXIII.

The basioccipital (1) is longer, thicker vertically, flatter below, and broader in front than in Man; it sends out short precondyloid processes or prominences into the jugular foramina (*j*) on each side; these are overlapped by the synonymous processes (*p j*) of the petrosal anterior to the precondyloid holes (*p*): the basioccipital does not anchylose with the basisphenoid; both extend straight forwards, parallel to the plane of the palate, instead of curving from below upwards and forwards as in Man. The *fissura lacera media* (*f*), which divides the basioccipital from the petrosal (16), is longer and narrower, and does not expand at its fore-part: the posterior border of the basioccipital becomes less expanded where it joins the condyles.

The occipital condyles (2') are much smaller compared with the size of the skull than in Man; they are also less convex and more rounded at their extremities; they are wider apart, and their axes diverge at a more open angle from before backwards. The posterior condyloid fossa (*c f*) extends forwards along the outer side of the condyle to the jugular process (*j p*); in Man it usually terminates in a post-condyloid foramen, and is filled up by the rough paroccipital ridge which sometimes developes a small (paroccipital) process; this is represented by a feeble tuberosity below the jugular process (*j p*) in the Chimpanzee, in which there are no post-condyloid holes. The sutures between the exoccipitals (2) and mastoids (8) remain, but the rest of the lambdoidal suture is obliterated in the Chimpanzee: the extent of the exoccipitals outside the condyles is less than in Man.

The supraoccipital (3) is a much broader plate than in Man, and is flat or slightly concave externally, with all trace of the superior angle lost in the anchylosis consequent on the development of the great lambdoidal ridge: it shows nothing answering

to the crucial ridge or spine of the human convex occiput, except, in some skulls, the vertical ridge dividing the great subconcave expanse.

The basisphenoid (5), besides its non-confluence with the basioccipital, has a larger extent uncovered by the vomer and by the bases of the anchylosed alisphenoids (6) and pterygoids (24): it is excavated by large sinuses extending into both the alisphenoids and pterygoids: the sinuses are confined to the basisphenoid and presphenoid in Man.

The broader pterygoids in the Chimpanzee anchylose with and, as it were, embrace a greater part of the base of the alisphenoid: the foramen ovale (*t r*) is more remote from the foramen caroticum, and is pushed by the broad ectopterygoid (25) further back from the pterygomaxillary fissure (*s p*): the extent of the basis cranii between the carotid foramen and sphenomaxillary fissure being twice that in Man. The styliform process (6 *s*) is less developed, and the inner border of the glenoid cavity (*g*) of the squamosal abuts against its whole length, or even extends below or beyond it.

Outside the pterygoid the alisphenoid (6) becomes narrower, and is continued more directly upwards into the temporal fossa than in Man: the ectopterygoid ridge (25) is less developed, and the fossa on the outer side of the ectopterygoid is not present, or is very feebly developed. The alisphenoid contracts instead of expanding as it rises, terminates before it gains half the height of the orbit, and is excluded from junction with the parietal by the meeting of the squamosal with the frontal. The expanded spine (Pl. LXI. 7) of the parietal vertebra is thus entirely separated from its neurapophyses (6) in the Chimpanzee. In the Australian the alisphenoid ascends higher than the malar, but not so far as in the European. Besides the relatively smaller size of the parietal bones, the early obliteration of the sagittal suture, and the development of the crista upon it, the lower border of the parietal is straighter than in Man and more equally divided between the squamosal and the mastoid. The diploë is obliterated at the middle of each parietal in the Chimpanzee.

The presphenoid, where it forms the seat of the optic chiasma, is not defined, as in Man, by the abrupt excavation of the sella behind it; but the sphenoidal cells raise the floor of the sella to a level with the chiasmal platform into a convexity which gradually sinks as it recedes into the hollow of the sella, which is shallower than in Man, and the longitudinal diameter is greater than the transverse one. If the sella or space between the anterior and posterior clinoid processes be divided into a convex chiasmal and a concave pituitary part, these are more equal in the Chimpanzee than in Man.

The orbitosphenoids coalesce nearer their origin with the orbital plates of the alisphenoid, obliterating the fissure which in Man is continued outwards from the 'foramen lacerum anterius;' so that this foramen is better defined and has a subquadrate form in the Chimpanzee; and there are no ridges, called 'lesser alæ,' defining the fossa of the anterior lobe from that of the middle lobe as in Man. The suture between the orbitosphenoids and the frontals is quite obliterated in the Chimpanzee. A short

triangular plate divides the optic hole from the foramen lacerum anterius on each side, which plates answer to rudiments of the 'alæ minores' and to the bases of the anterior clinoid processes, but those processes are not extended backwards as in Man. The foramen rotundum is closer to the foramen lacerum anterius than in Man, and the styliform foramen (*s t*) is closer to the foramen ovale (*t r*).

The mastoid bone (Pl. LXIII. s *m*) is relatively larger, but developes a smaller and more hemispheric mastoid process (*m*). Traces of the suture between the mastoid and squamosal continue longer in the Chimpanzee than in Man. Its upper part extends outwards into a strong angular ridge, and its under part extends from the process inwards as a horizontal plate (s) to join the exoccipital, which plate is of greater extent than in Man, and is not grooved by the digastric muscle; thus the space between the occipital foramen (*o*) and the external auditory foramen (*a u*) is considerably greater in the Chimpanzee than in Man. The stylomastoid foramen (*s m*) is exterior to the stylohyal fossa (3s), not directly behind it as in Man, in whom the stylohyal bone becomes anchylosed at maturity with that fossa and forms the so-called 'styloid process of the temporal.' There is but a rudiment of the vaginal process (*v*).

The tympanic (2s), which anchyloses with mastoid, squamosal and petrosal as in Man, is of greater length than in Man: it forms no part of the glenoid fossa, which is divided from it by the post-glenoid process, and the rudiment of the 'fissura Glaseri' is quite behind the glenoid fossa in the Chimpanzee, whilst in Man, from the different relative position and shape of the tympanic or auditory process, the 'fissura Glaseri' is described as dividing the glenoid fossa transversely. The inner termination of the meatus auditorius is very obliquely cut off, but in a different direction from that in Man; in him it is from behind inwards and forwards, the anterior wall of the meatus being longer than the posterior one. In the Chimpanzee the inner end of the meatus is cut off obliquely from above inwards, downwards and forwards: at the beginning of the meatus its vertical diameter is greatest, but as it penetrates the cranium the transverse diameter becomes greater, the depth decreasing, and it rather suddenly expands at its inner very oblique termination.

The superior size of the parapophyses of the middle cranial vertebra* in Man relates to the greater amount of muscular action required for the support and movements of the skull, which is so nicely and peculiarly balanced upon the erect vertebræ of the trunk: in the Quadrumana, where the skull is thrown more forwards, its support is derived more from the action of the great nuchal muscles inserted into the occiput than from that of the sternomastoids; but we may infer, from the nearer approach which the *Troglodytes Gorilla* makes to Man, in comparison with the *Troglodytes niger*, or with the known species of Orang, in regard to its mastoid processes, that it assumed more nearly and more frequently the upright attitude than the inferior anthropoid Apes do.

* The arguments in proof of this general homology of the mastoids will be found in my work on the 'Archetype of the Vertebrate Skeleton,' 8vo, pp. 29, 110, 120, 131.

The air-cells, which are confined to the mastoid in Man, extend in the Chimpanzee into the squamosal, inflating it above the base of the zygomatic process, and as far forwards as its junction with the frontal, where the squamosal sinuses are contiguous to, though they seem not to communicate with, those of the alisphenoid.

The petrosal (Pl. LXIII. *p j*, 16) is larger in the Chimpanzee than in Man; its antero-posterior diameter especially is greater: its eustachian process (*e*)* is much more developed and more distinct from the proper apex (16) of the petrosal, which is less jagged than in Man, and rests more completely upon the base of the alisphenoid, almost filling up the vacuity called 'foramen lacerum medius' in Man. The carotid foramen (*c*) is smaller than in Man; it is defended by an angular ridge (*v*) externally, which divides it from the stylohyal fossa (38) in the Chimpanzee, and is the sole representative of the vaginal process: the prejugular (*p j*) process from the inner side of the foramen caroticum abuts upon a corresponding process of the basioccipital, and with it forms the anterior boundary of the foramen jugulare (*j*).

The intracranial part of the petrosal is relatively shorter in the Chimpanzee than in Man: its upper surface is more even: the channel of the lateral sinus which defines it behind is narrower. The foramen auditorium internum has not the overhanging ridge; the superior ridge is not grooved by the petrosal sinus.

The chief characteristics of the frontal, due to its smaller size and the supraorbital ridge, have already been noticed: besides these deviations from the human type, the ectorbital processes stand further out before they bend down to join the malar, and the postorbital angles descend much lower into the temporal fossa and form a longer wedge between the alisphenoid and malar bones, the point terminating on a level with the floor of the orbit.

The vomer (13) is deeper and more oblique than in Man, and does not reach so far forwards.

The coalesced prefrontals (*laminæ mediæ æthmoidei*) are connate, as in Man, with the olfactory capsules forming the æthmoidal cells, the superior turbinals, the 'partes planæ' and the cribriform plate, but they do not extend backwards to form a 'crista galli.' The cribriform plate is much smaller, and is sunk into a deep (rhinencephalic) fossa.

The palatines (20) form a smaller proportion of the bony palate; their mesial anterior ends advance forwards in a point between the maxillaries, but the mesial posterior ends, which project backwards in a point in Man, are truncate, and the border of the bony palate there presents either a shallow median emargination, between two slighter ones, or the whole posterior boundary (in the younger male) is slightly undulated with a general curve concave backwards; whilst in every variety of the human race the same border presents two lateral concave emarginations divided by the median point. The posterior palatine foramina (20) are close to the anterior palato-maxillary suture:

* This process may belong to the tympanic rather than to the petrosal.

in Man they are nearer the posterior border of the palate. The pterygoid and orbital relations of the palatal bones resemble those of Man.

The maxillary bone, besides its greater relative size, has a relatively longer and shallower palatal portion without any median convexity: it is more expanded anteriorly, instead of being contracted between the premolars: its malar process is considerably deeper, and is perforated by the maxillary or suborbital nerve at a greater distance below the orbit: the single foramen for this nerve is the rarer variety than the double one in the Chimpanzee: the most decisive distinction from the Human type furnished by the maxillary bone in the present comparison is its exclusion from the nostril by the elongation of the premaxillary and the interposition of the upper angle of that bone between the maxillary and the nasal in the large species of Chimpanzee. The double fangs of the premolars render the alveolar border or 'process' of the Chimpanzee's maxillary bone more complex than it is in Man; and it is tumid, and produced anteriorly by the sockets for the enormous canines.

The premaxillaries differ from those of Man by their vastly greater proportional size, their greater prominence, the longer persistence of their sutures with the maxillaries and their nasal processes (Pl. LXII. 22′). The extent of their palatal part (Pl. LXI. 22) removes the prepalatal foramina further back from the alveoli, and these foramina are double, or not so completely blended into a single hole below, as in Man. Their median suture with each other, instead of being supported on a prominent ridge at the anterior surface of the bone, as in Man, is sunk into a smooth fossa, and the nasal ridges for the support of the septum narium commence quite within the nostril behind an arched transverse eminence or bar.

The malar bone, besides its superior relative size, has a more convex exterior surface (26), which is turned more towards the front of the face than in Man: the line of the malomaxillary suture descends more directly downwards and outwards; in Man it extends more outwards before it descends, the suborbital angle of the malar being longer, more slender and pointed than in the Chimpanzee; the orbital margin is sharp in Caucasians, but is rounded off in Australians. The posterior border of the ectorbital or frontal process (Pl. LXI. & LXII. 26′) is straight at its commencement, not convex as in Man: the entorbital plate of the malar extends further backwards, and unites in a smaller proportion with the alisphenoid than with the frontal; it is imperforate. The zygomatic suture is a regular or slightly wavy oblique line, not made angular or curved by a sudden notch in the upper part of the zygomatic process of the malar, as in Man.

The zygomatic portion of the squamosal equals in depth the malar portion of the arch, and is not shallower, as in Man: the post-glenoid process (Pl. LXI. *p g*) is stronger and projects down more freely, and relatively lower as respects the tympanic. The squamous plate (27) is lower and more angular in the Chimpanzee; its upper border, which does not rise higher than opposite the middle of the orbit, being almost straight; the continuation of the line of this border by the mastoid makes the squamosal appear much longer from before backwards than this temporal element really is. In Man

the mastoidal element developes no continuation of the squamous plate, but the hind border of this plate curves down to the place of the primitive suture between the squamosal and mastoid. The whole of the squamosal receives air-cells from the mastoid in the Chimpanzee, and its exterior surface is made convex and, as it were, swollen out by them: no part of the squamosal is so modified in Man*.

At the first view of the skull of the great Chimpanzee, one is struck by its superior size to the human skull, especially its greater length, and the greater breadth of the face and of the occiput: the brain-case is made to appear more contracted in proportion than it actually is, by the superaddition of the enormous intermuscular crests and supraorbital ridge: it would seem, indeed, as if the osseous matter required to form the expanded cerebral chamber in the human skull had been here expended in the formation of the great external crests and ridges. Notwithstanding, however, this superiority of size in certain dimensions, and the apparently massive character of the skull of the great Chimpanzee, it is actually lighter than that of Man. The cranium of the adult male *Troglodytes Gorilla*, figured in Plates LXI. LXII. & LXIII., weighed 1 lb. 7 oz. 8 drs. avoirdupois, whilst the cranium of a male Australian, without the lower jaw, weighed 1 lb. 8 oz. 10 drs. This unexpected result is due to the greater size and extent of the air-cells in the *Troglodytes Gorilla*. The air introduced from the tympanic chamber into the mastoid extends backwards into cells, continued along the base of the lambdoidal crista to its junction with the parietal crista, and from the mastoid forwards, inflating the whole squamosal plate as far as the alisphenoid, which, with the pterygoids, receives air from the sphenoidal sinuses.

The upper part of each sphenoidal cell is divided by a plate of bone entering inwards and downwards from the upper and outer wall and folded round the canal continued from the foramen rotundum, and conveying the second division of the trigeminal nerve to the sphenopterygoid fossa. In Man, the canal continued from the foramen rotundum to the back-part of the orbit does not impress the wall or encroach upon the cavity of the sphenoidal sinus. The sphenoidal sinuses communicate, each by a small round aperture, with the back-part of the superior nasal meatus, as in Man.

The frontal sinuses are divided from each other by a strong median vertical septum, and extend far outwards along the base of the supraorbital crest; they open below into the middle meatus, as in Man. The great maxillary sinus or antrum is chiefly remarkable for its extension upwards, where it swells out the maxillary contribution to the inner wall of the orbit; the nasal aperture of the antrum, of a rounded form and two-thirds of an inch in diameter, is covered by the overhanging inferior turbinal bone: the lachrymal canal terminates at the upper part of the orifice of the antrum, not in advance of it, as in Man.

The osseous parts of the olfactory capsule, which have coalesced with the prefrontals and form the 'superior' and 'middle' turbinal processes of the æthmoid, are present,

* The extension of the auditory cavity into this element of the temporal is found in many Marsupials and Rodents.

as well as the large independent inferior turbinals: these are all longer in proportion than in Man.

The chief differences which the cranium and teeth of the *Troglodytes Gorilla* present as compared with those parts of the Human structure may be summed up as follows:—

1. The smaller proportional size of the cranium.

2. The more backward position of the foramen magnum, and its more oblique plane in relation to that of the base of the skull.

3. The smaller relative size and more backward position of the occipital condyles.

4. The longer basioccipital, and broader, flatter and lower supraoccipital.

5. The longer basisphenoid and shorter alisphenoids.

6. The smaller size of the coalesced parietals, and their separation from the alisphenoids.

7. The conversion of a greater part of the outer surface of the parietals into concavities or depressions for the lodgement of the temporal muscles by reason of the bony crest developed from the line of the obliterated sagittal suture and of the lambdoidal crest.

8. The larger proportion of this crest and of the squamosal plate developed from the mastoid and the smaller size of the proper mastoid process.

9. The smaller size of the vaginal and styliform processes, and the absence of the styloid process, arising from the non-anchylosis of the stylohyal bone.

10. The larger post-glenoid process and the longer auditory process (tympanic bone), with their relative position, one behind, but not below the other.

11. The position of the stronger zygomata opposite the middle third of the basis cranii.

12. The prominent supraorbital ridge.

13. The longer nasal bones, anchylosed together and flattened at their lower half.

14. The greater proportional size and greater prominence of the upper and lower jaws.

15. The longer osseous palate, and the median emargination of its posterior border.

16. The parallelism of the alveoli of the molars and canine of one side with those of the other.

17. The diastema or vacant place in front of the socket of the canine in the upper jaw, and behind that socket in the lower jaw.

18. The larger and more produced premaxillaries; the persistence of more or less of their sutures showing the intervention of their upper extremities between the nasal and maxillary bones.

19. The minor extent of connection of the lachrymal with the 'pars plana' of the æthmoid, or their separation by the junction of the orbital plate of the maxillary with that of the frontal behind the lachrymal.

20. The depth of the olfactory fossa, and the absence or rudimental state of the 'crista galli.'

21. The squamosal, lambdoidal, alisphenoidal and pterygoid air-cells.
22. The more prominent cusps of the molar teeth.
23. The larger relative size and more complex grinding surface of the last molar tooth in both jaws.
24. The larger relative size of the premolars, especially of the first.
25. The more complex implantation of the premolars by three roots, two external and one internal.
26. The much larger and longer canines.
27. The sexual distinction in the development of these teeth.
28. The more sloping position of the crowns of the incisors.
29. The broader and higher ascending ramus of the lower jaw.
30. The total absence of the prominence of the symphysis forming the chin.

In the form of the premaxillaries and the earlier obliteration of their sutures, the smaller species of Chimpanzee more nearly resembles Man than the great Gorilla does; it seems also to deviate less through the minor development of the canine teeth, and of the parietal and sagittal crests; but it has been shown, in the comparison of the skulls of the *Troglodytes Gorilla* and *Troglodytes niger*, § 3, that the latter departs in more numerous and important particulars further from the Human type.

§ 7. *Concluding Observations.*

There finally remains for consideration the import and value of the differences which have been pointed out between the great Chimpanzee—the most anthropoid of all known brutes—and Man, in regard, more especially, to the often-mooted and lately-revived hypothesis of the origination of the species of animals by gradual transmutation of specific characters, and that in a progressive or ascending direction.

It would be argued, in the spirit of that hypothesis, that the gradual cessation of combative habits in successive generations of the Chimpanzee might be attended with a diminution in the size of the canine teeth, and a concomitant subsidence of those cranial cristæ that are developed to increase the surface of attachment of the muscles of the jaws; whilst the cranial chamber might gradually expand under the influence of circumstances inducing such peaceful habits, and tending to improve the instincts and develope those psychical powers that dawn in the anthropoid apes, and the manifestations of which have been observed, always with interest and sometimes with astonishment, in the young specimens of the Chimpanzees and Orangs that have been brought alive to Europe.

It is a well-established fact in human physiology, that the skeleton may be modified to a certain extent by the action of the muscles to which it is subservient. 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 anatomist judges of the muscular power of the individual to whom a skeleton under comparison has appertained.

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 Chimpanzee 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; whilst in the large deer-hound those bony cristæ are as strongly developed as in the wolf. Such modifications however are unaccompanied by any change in the connections, 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 unmistakeable 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 circumstances 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 *Troglodytes* 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 great prominent supraorbital 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 *Troglodytes* from the time of birth to extreme old age: by the prominent supraorbital 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 *Troglodytes* 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 supraorbital 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 supraorbital 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 or suppression of this ridge is respectively characteristic of the Chimpanzees and Orangs.

The equable length of the human teeth, 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 the ordinary dentine of mammals, are not organized 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 *Troglodytes 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 exercise, which afterwards characterize 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 foreordained,—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 and the connections of the premaxillary bones, which so remarkably distinguish the great *Troglodytes 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 which are cited in the summary at p. 413, 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 *Troglodytes Gorilla* has led legitimately to the conclusion that it is specifically distinct from the *Troglodytes 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 *Troglodytes niger* as compared with the *Trogl. 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 *Troglodytes* in that continent and that of the genus *Pithecus* in the great islands of the Indian Archipelago is very close and interesting. As the *Troglodytes Gorilla* parallels the *Pithecus Wurmbii*, so the *Troglodytes 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; *Pithecus* has but two species, or at most three; *Troglodytes* is represented by two species.

The unity of the human species I regard as demonstrated by the constancy of those osteological and dental characters to which my attention has been more particularly directed in the investigation of the corresponding characters in the higher *Quadrumana*, and the importance of the comparison will justify the minuteness with which they have been detailed.

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 mark the primary (unguiculate) division of the placental subclass of Mammalia.

Supplementary Note on the Great Chimpanzee (Troglodytes Gorilla, *Savage*, Troglodytes Savagei, *Owen*, Proc. Zool. Soc. Febr. 1848).

Since the communication of my description of the skulls of the great Chimpanzee of the Gaboon district, I have received from an esteemed correspondent, Prof. Wyman, Professor of Anatomy in Harvard University, United States, and a most accomplished anatomist and physiologist, a copy of his description of the parts of the skeleton of the great Chimpanzee which Dr. Savage had taken with him on his return to America, together with a preliminary and highly interesting sketch of the natural history of the species by its discoverer, who proposes to call it *Troglodytes Gorilla*, adopting the term used by Hanno in describing the wild men, or anthropoid apes, which he discovered on the coast of Africa during his famous voyage*.

Prof. Wyman gives dimensions of the skulls of a male and female *Troglodytes Gorilla*, with comparative measurements of a characteristic skull of a Negro, and those of the *Troglodytes niger* and *Simia satyrus* (Sumatran variety, or *S. Abelii*) from my Memoir in Trans. Zool. Soc. vol. i. p. 374; and he sums up the following points as showing that from the *Tr. niger* the *Tr. Gorilla* "is readily distinguished—

"1. By its greater size;

"2. By the size and form of the supraciliary ridges;

"3. By the existence of the large occipital and interparietal crests in the males, and by rudiments of the same in the females;

"4. By the great strength and arched form of the zygomatic arches;

"5. By the form of the anterior and posterior nasal orifices;

"6. By the structure of the infraorbital canal;

"7. By the existence of an emargination on the posterior part of the hard palate;

"8. The incisive alveoli do not project beyond the line of the rest of the face, as in the Chimpanzee and Orang;

"9. The distance between the nasal orifice and the edge of the incisive alveoli is less than in the Chimpanzee;

"10. The ossa nasi are more narrow and compressed superiorly."

The 5th, 7th and 9th are the characters which are most decisively repeated in the Bristol specimens of the skulls of *Tr. Gorilla*, and are those that are least ascribable to age or the operation of external circumstances tending to produce a stronger variety of Chimpanzee. The value of the character from size is established by the concurrence of the foregoing more fixed ones. The supraciliary ridges are relatively as strongly developed and as prominent in the skull of a female adult *Tr. niger* as in that of the *Tr. Gorilla*, and they are as angular and rough or uneven in the skull of the adult male *Tr. niger* as in that of the adult male *Tr. Gorilla*. The male *Tr. niger* shows also the median prominence between the orbits above the root of the nose.

* See the passage cited at p. 13, 'Falconer's Translation of the Voyage of Hanno,' London, 1797.

In six skulls of *Troglodytes niger* Prof. Wyman found that "the temporal ridges are generally separated from each other by a space varying from half an inch to one or two inches, according to age, but in none of them is to be seen even a rudiment of the interparietal ridge." In the adult, but by the condition of the teeth, not old male *Tr. niger*, described and figured by me, the temporal ridges have met above the obliterated suture, and developed the rudiment of an 'interparietal ridge,' which would probably have risen above its rudimental state had the exercise of the large temporal muscles been longer continued. Processes, ridges and crests dependent upon the stimulus of muscular action for their development, are the seats of most variety, and the least safe or satisfactory osteological marks of specific distinction. In the great males of the *Tr. Gorilla* even a certain range of variety is presented by the skulls of the four adult males, which we are now able to compare.

In the one described by Prof. Wyman the interparietal or sagittal crest is elevated about $1\frac{1}{2}$ inch above the skull, and terminates above in a thin and free edge: in the fine male skull figured, and in the older male's skull, the two temporal ridges, though touching each other at their base, do not coalesce to form a single sagittal crest, but each terminates in a free edge, inclining from its fellow, and neither of them rise to half an inch at their highest part, three inches behind their point of contact.

With regard to the 4th difference, it appears to me that the specific character of the zygomatic arches is best shown by the depth and convex or angular upper contour of the squamosal portion of the arch.

In respect to the 5th difference, Prof. Wyman has well indicated the characteristic forms of the anterior and posterior nares; and the conformity of the four skulls, two males and two females, submitted to his able and scientific scrutiny, in this important character, with the three skulls which I have described, adds to the confidence in its constancy and value. The observed range of variety does not materially affect the well-marked difference of form in the posterior nares. Prof. Wyman finds in the *Tr. niger* that "the transverse diameter of the orifice exceeds that of the vertical, but in the *Tr. Gorilla* the vertical is twice that of the transverse, a condition which results from the elongation downwards of the superior maxillary bones." In one skull of an adult female *Tr. niger*, in the Bristol Museum, the vertical diameter equals the transverse diameter of the posterior nares, and it exceeds it by about one-half only in the three skulls of the *Tr. Gorilla* in the same museum.

With regard to the 6th character, which was pointed out to Prof. Wyman by Prof. Agassiz, it is stated that "in the Chimpanzee the infraorbital canal forms a deep groove, terminating in the sphenomaxillary fissure, its depth remaining uniform to its termination; but in the Engé-ena (*Tr. Gorilla*) the canal becomes gradually less deep from before backwards, and at the fissure is scarcely obvious." In the skull of the female *Tr. Gorilla* examined by me, the infraorbital canal is also shorter and shallower than in the skull of a female *Tr. niger*, but the varieties observable in the condition of this canal

in different individuals of the *Tr. niger* are more marked than those above noticed in the skulls of the two species, and induce me therefore to attach less importance to this character as a specific one. In two skulls of adult males of the *Troglodytes niger* in the College of Surgeons, the infraorbital groove as it passes backwards again becomes a canal by the meeting, and in one specimen by the coalescence of the two sides of the groove above the canal for an extent of from two to three lines before it enters the sphenomaxillary fissure. Prof. Wyman indeed notices a similar conformation in an adult cranium of the Chimpanzee belonging to Dr. J. C. Warren of Boston. Now this is a more decided difference from the continuous open groove at the floor of the orbit in the adult female *Tr. niger* than that groove presents in comparison with the shorter and shallower one in *Tr. Gorilla*. I find too that the second character of *Tr. Gorilla* pointed out by Prof. Agassiz,—"from the internal walls of the orbits which recede from each other in descending towards the floor, thus leaving a large pyramidal space for the lodgement of the os ethmoïdes,"—is so much less marked in the female skull of *Tr. Gorilla*, as contrasted with that of *Tr. niger*, as to induce me to view it more in the light of a sexual than a specific modification.

The 7th difference is a good character, and is repeated by each of the skulls of *Tr. Gorilla* examined by me. All the skulls of *Tr. niger* also show the backward projecting point, where the emargination exists in *Tr. Gorilla*.

In regard to the 8th character, the minor relative projection of the incisive alveoli beyond the line of the rest of the face is as characteristic of the three skulls of *Tr. Gorilla* now in England as of the four in the United States, and results from the same comparative shortness of the premaxillary bones, between the nasal orifice and the edge of the incisive alveoli. But the ossa nasi, besides being more narrow and compressed superiorly, are more prominent at that part in *Tr. Gorilla* than in *Tr. niger*, and they are also more expanded and broader inferiorly, and I cannot but regard the most decisive mark of the specific distinction of the *Troglodytes Gorilla* to be the longer persistence of the maxillo-premaxillary sutures, and the evidence thereby given of the peculiar form, development and connexions of the upper portions of the premaxillary bones. It is remarkable indeed, since these sutures remain so distinct in the adult female skull and in two of the adult male skulls in the Bristol Museum, that no trace of them should have been detected in any of the four skulls taken by Dr. Savage to America, in which Prof. Wyman describes the *ossa nasi* as being "firmly co-ossified with each other and with the surrounding bones."

The triangular expanded facial part of the upper end of each premaxillary intervening between the nasal and maxillary bones will always serve to distinguish the cranium of an immature *Tr. Gorilla* from that of a *Tr. niger*.

Table of Dimensions.

	Troglodytes Gorilla.		*Troglodytes niger.*		*Simia Wurmbii.*	
	Adult Male.	Adult Female.	Adult Male.	Adult Female.	Adult Male.	Adult Female.
	in. lin.	in. lin.	in. lin.	in. lin.	in. lin.	in. lin.
Length of the head from the *inion*, or posterior plane of the occiput, to the margin of the incisors	11 4	9 0*	8 0	7 9	10 6	7 6
Length of the head from the *inion* to the fronto-nasal suture	7 5	6 1	5 4	5 3	5 3	4 7
Length of the head from the fronto-nasal suture to the margin of the incisors	4 8	3 9	4 0	4 4	5 7	4 4
Longest lateral diameter of the *cranium* at the post-auditory ridges	6 10	5 6	5 0	4 6	5 8	5 4
Shortest lateral diameter of the *cranium* behind the orbits	3 3	2 4	2 6	2 8	2 9	2 6
Length of the *os frontis*	4 3	†	2 8	2 9	2 6	2 8
Length of the sagittal suture	3 9	†	2 5½	2 6	2 6	2 7
Least distance between the temporal ridges	nil	nil	nil	1 10	nil	0 6
Diameter of the face at the zygomata	6 6	5 3	5 0	4 8	6 9	6 0
Length of the zygomatic *fossa*	2 0	2 0	1 9	1 9	2 6	2 6
Breadth of the zygomatic *fossa*	1 8	1 5	1 3	1 1½	1 6	1 4
Diameter of the face taken from the outsides of the middle of the orbits	6 0	4 8	4 3	4 0	4 6	4 2
Interorbital space	1 3	1 1	0 8	0 7	0 7	0 5
Lateral diameter of the orbit	1 9	1 6	1 5	1 6	1 6	1 4
Perpendicular diameter of the orbit	1 7	1 7	1 3	1 3	1 7	1 6½
Transverse diameter of the nasal aperture	1 2	1 2	1 0	1 0	1 0	1 1
Perpendicular diameter of the nasal aperture	1 5	1 3	1 0	1 1½	1 6	1 6
Distance between the infraorbital *foramina*	1 8	1 4	2 3	2 1	2 0	1 8
Breadth of the alveolar portion of the *maxilla superior*	2 9	2 7	1 6	2 4	2 8	2 4
Distance from the inferior margin of the nasal bone to the inferior margin of the inter-maxillary bones	2 6	2 3	2 5	2 6	3 3	2 7
Length of the bony palate	4 1	3 3	3 0	2 10	4 0	3 3
Distance from the anterior margin of the inter-maxillary bones to the anterior palatal foramen	1 1	0 10	0 10	0 10	1 3	1 3
Antero-posterior extent of the palatal process of the palate bone	1 1	0 9	0 6	0 6	1 0	0 8
Breadth of the crown of the first incisor	0 6	0 5‡	0 5½	0 5	0 7	0 5
Breadth of the crown of the second incisor	0 4½	0 4‡	0 3½	0 3	0 4	0 3
Breadth of the four incisors	1 8	1 6§	1 7	1 6	1 9	1 6
Length of the grinding surface of all the *molares*, the *bicuspides* included	2 7	2 7	1 10	1 9	2 5	2 0
Length of the crown of the upper canine tooth	1 4	‖	0 11	0 7	1 2	0 8
Breadth of the enameled crown of the canine tooth	0 10	‖	0 7	0 4	0 9	0 5
Interspace between the canine and incisor teeth, upper jaw	0 2	0 1½	0 3	0 2	0 3½	0 3
Distance from the anterior margin of the occipital *foramen* to the posterior margin of the bony palate	3 0	¶	2 3	2 4½	2 10	2 9

* To border of premaxillaries.
† Not perceptible.
‡ Of the alveolus.
§ Of alveoli.
‖ Tooth absent.
¶ Base mutilated.

DESCRIPTION OF THE PLATES.

PLATE LVIII.

Side view of the skull of the adult male Chimpanzee (*Troglodytes niger*).

PLATE LIX.

Front view of ditto.

PLATE LX.

Base view of ditto.

PLATE LXI.

Side view of the skull of the adult male Gorilla (*Troglodytes Gorilla*), wanting the lower jaw, which is indicated in outline.

PLATE LXII.

Front view of ditto.

PLATE LXIII.

Base view of ditto.

All the figures are of the natural size: the letters and numerals are explained in the text. I beg to express my obligation to the skill and care of the accomplished artist, Mr. Erxleben, for his important aid in the elucidation of the subjects of the present memoir.

Trans Zool Soc Vol 3. Pl 58. p. 385.

From Nature on Stone by J. Erxleben.

Troglodytes niger, mas.
nat. Size.

Day & Son Lith.rs to the Queen

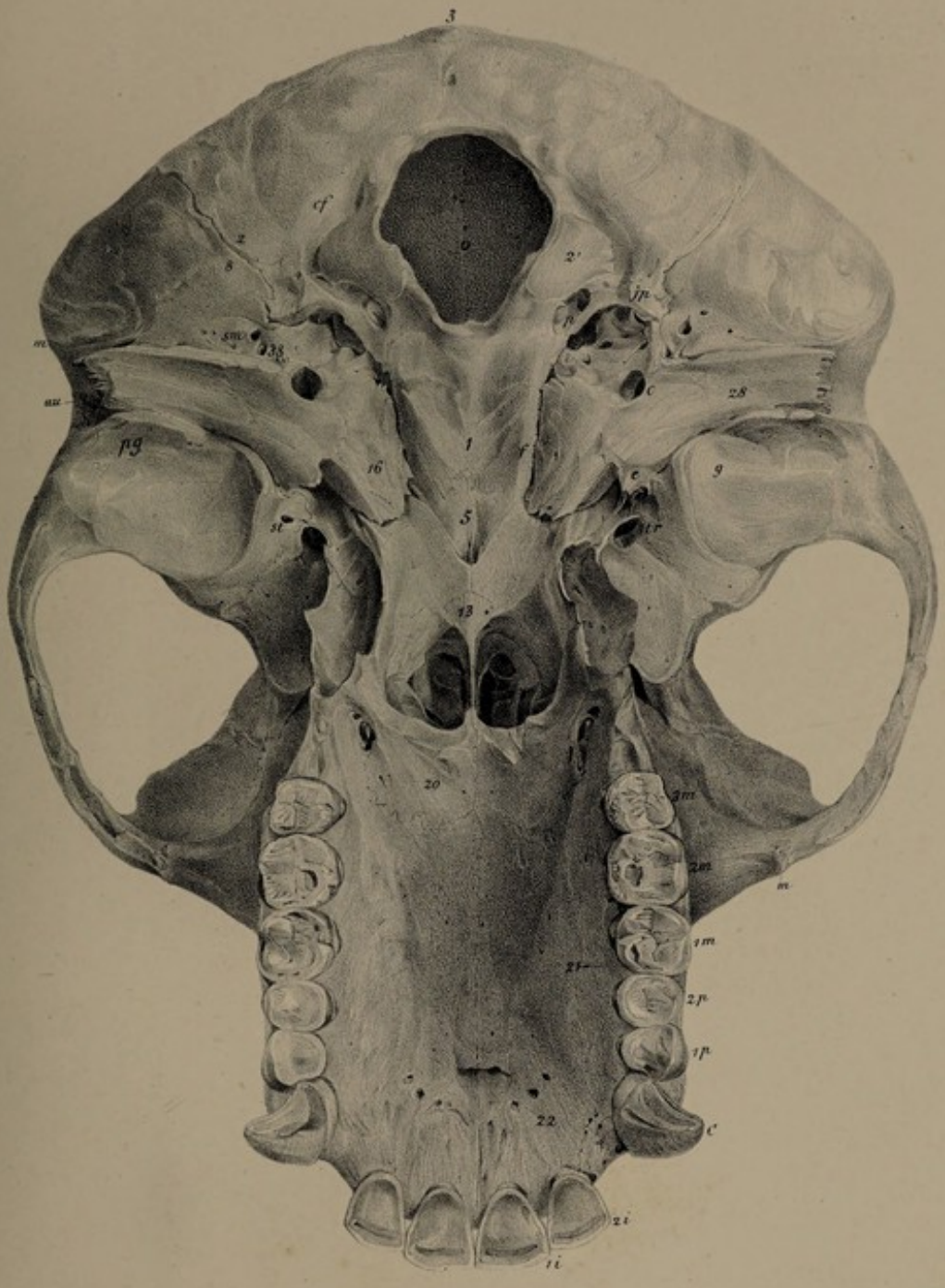
Trans. Zool. Soc. Vol. 3. Pt. 59. p. 385

Troglodytes niger mas.
nat. Size.

From Nature on Stone by J. Erxleben.

Day & Son. Lith.rs to the Queen.

Trans. Zool. Soc. Vol. 3 Pl. 60, p. 385.



From Nature on Stone by J. Erxleben

Troglodytes niger, mas.
nat. Size.

Day & Son Lith^rs to the Queen

Trans. Zool. Soc. Vol. 3, Pl. 61, p. 392

From Nature on Zinc by J. Erxleben.

Troglodytes Gorilla, mas.
nat. Size.

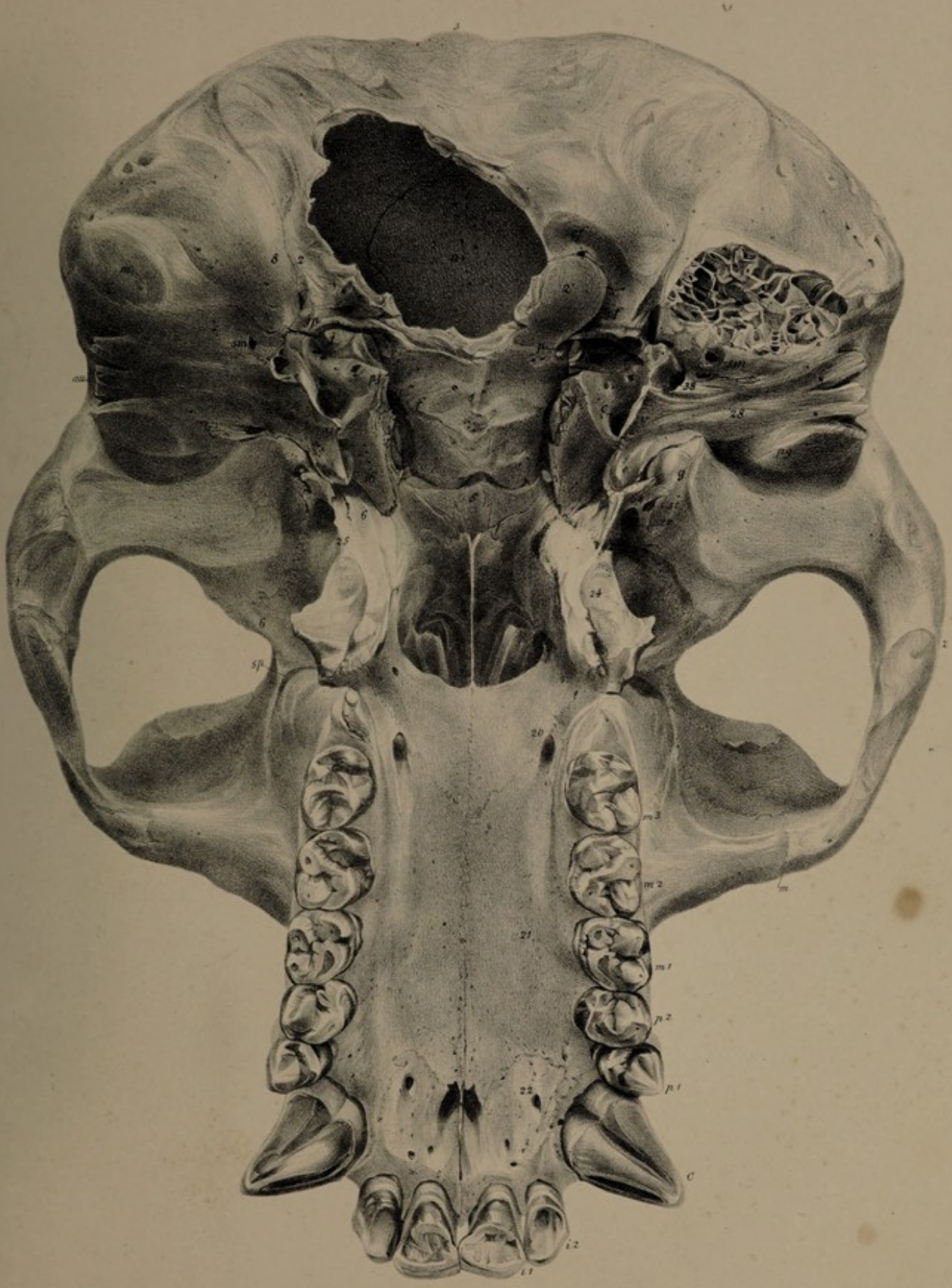
Day & Son Lith.rs to the Queen

Trans. Zool. Soc. Vol. 3. Pl. 62. p. 392.

From Nature on Stone by J. Erxleben.

Troglodytes Gorilla, mas.
nat. Size.

Day & Son Lith.rs to the Queen.



Troglodytes Gorilla, mas.

nat. Size.

From Nature on Zinc by J. Erxleben.

Day & Son. Lith.rs to the Queen.