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AN INTRODUCTION TO THE STUDY
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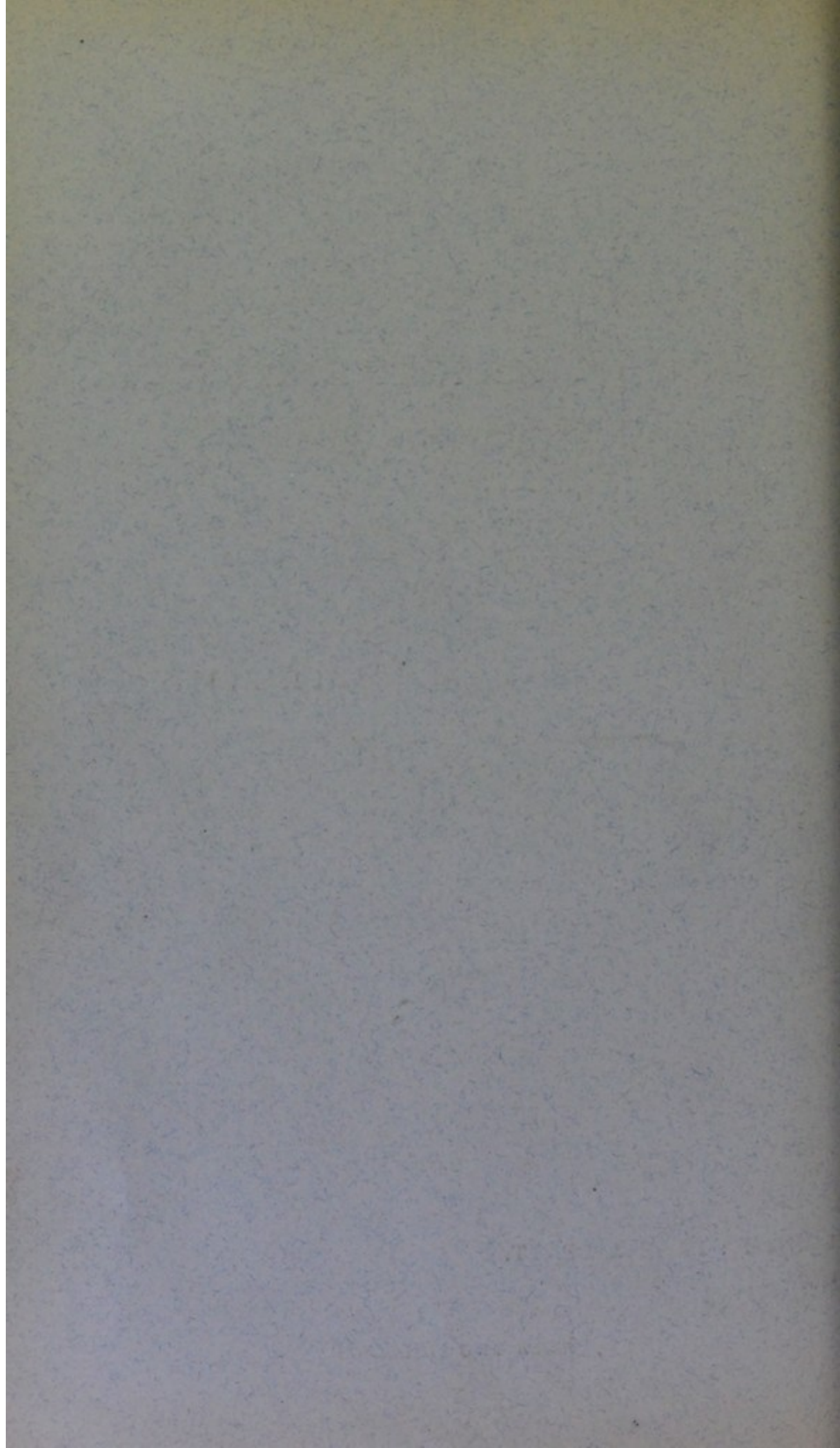
By ARTHUR KEITH, M.D.



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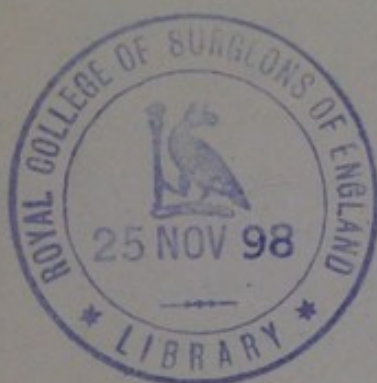
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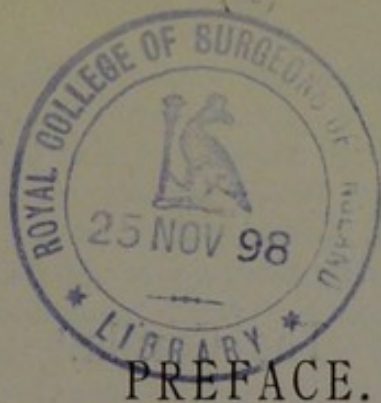
I. THE GORILLA	Page	2
II. THE CHIMPANZEE	"	14
III. THE ORANG-OUTANG	"	30
IV. THE GIBBON	"	41



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PREFACE.

THE Proprietors of NATURAL SCIENCE have been good enough to republish, in their present form, four articles I contributed to their valuable magazine. Those articles were written to save others the initial difficulties I myself experienced in making myself acquainted with the literature on the Anatomy of the Higher Primates. The literature on this subject is much more extensive than most people imagine, and new contributions cannot satisfactorily be made until it has been mastered. I am certain that many of the young medical men that join our Public Services would very willingly utilise their opportunities if they only knew what had been done, and what ought to be done, to enlarge our knowledge of the Higher Primates. Those, too, that are working out problems connected with the Anatomy of Man or other Primates will probably find these articles of use. I am indebted to the Editors for several corrections. Alterations and additions made for the first time in this reprint are enclosed in square brackets.

ARTHUR KEITH.

London Hospital Medical College,

February, 1897.

I. The Gorilla.¹

IT is possible that the recent addition of a young female gorilla to the Gardens of the Zoological Society of London may lead to a renewed interest in this bulkiest of Primates in the minds of many people; and if the interest aroused be sufficient to induce some of these to become better acquainted with the history of this alleged cousin of the human race, they will find it can be read only by picking their way through the European periodical and academical scientific literature of the last fifty years. Having been working at the anatomy of the higher Primates for a number of years past, and having in that time become acquainted with the better part of the literature dealing with this animal, it occurred to me that a short article, to act not only as a guide to work already done, but also as an index to the lines of future effort, might prove useful to some at the present time.

The Gorilla in Confinement.—Before getting well into the subject in hand, however, it would be better to dispose of what we know of the gorilla as a visitor to Europe. The example now in the Zoological Gardens is the third of its kind that has lived in England; its predecessor died after a short stay in the Gardens (*Proc. Zool. Soc.*, 1887, p. 559). The first gorilla came about 1860, and spent seven months in a menagerie in the north of England; its skin and bones are said now to rest in Ushaw College, Durham. It had the misfortune to be shown as a chimpanzee. In *Proc. Zool. Soc.*, 1877, p. 303, a fine drawing of it by Wolff is given. There have been at least five living gorillas in Germany. Four belonged to the Berlin Aquarium; Falkenstein's, which cost £1,000, lived there for fourteen months, and had been in confinement for over three years; Hermes' example lived two months, but was said to have been in the possession of a native chief for over six years; the other two lived for very short periods (25, 43, and 47). One lived for a short time in Paris (60). It will be seen that confinement in Europe is quickly fatal to the gorilla; this probably depends less upon the climate than upon its temperament, which is fierce, intolerant of bonds, and lacking the docility of the easily-confined chimpanzee.

¹ The literature, referred to by numerals in round brackets, will be found on pages 8-13 (Nos. 1-87*b*), 24-29 (Nos. 88-216), 37-40 (Nos. 217-289), 46-48 (Nos. 290-330).

Biological Beliefs, Methods, and Ends.—Scientific literature is becoming so bulky and unwieldy, with every prospect of becoming even more so, that it is of the utmost importance to come to some understanding as to the aim and end of such a study as that of the gorilla, and as to the methods by which the aim and end are to be attained. This is all the more necessary since our biological beliefs, our methods, our ultimate ends, are not those of the generations that have left the records with which we have now to deal. The creed, methods, and aims of the older anatomists were simple and primitive: they believed an individual could represent its race; the characters of any one average specimen were exactly the same as the characters of its species; their methods lay in the dissection and description of a certain type individual, with a commentary on its similarities and dissimilarities when compared with its neighbours. By a judicious grouping of similarities they sought to obtain a clear mental picture of the higher primates in their true perspective relationship, with man overtopping all and well apart from his anthropoid neighbours. In fact, this most laudable aim—the segregation of the human race—has occasioned the greater half of the research that has been done upon the anthropoids; the other half may be said to be due to museum-made strife over the number of gibbon, orang, and chimpanzee species. Hence the form in which we find the literature on the anthropoids—all more or less polemical. Now these creeds, aims, and methods are gone: they are dead as Bathybius. They have been gradually replaced by the tenets of a race of workers that refuse to accept one, two, or even five individuals, however selected, as fit to represent a species, as much as they deny the possibility of any one man embodying the characteristics of his nation. A species, they believe, can be represented in its full and absolute truth—were it possible—only by a dissection, description, and tabulation of every part of every living individual of that species. For example, if the individuals that make up the present living race of gorillas were superimposed muscle on muscle, artery on artery, brain-convolution on brain-convolution, the result would be, not the clear outline of a typical individual, but rather an amoeboid form with a considerable amplitude of variation in certain well-defined directions. This newer mental picture of a species, then, is of an amoeboid form with the lines of variation thrown out as pseudopodia, which may be regarded as feelers coordinating the race with its surroundings. Such a conception of the species by the modern biologist has necessarily led to a change in his methods. They are still, of course, dissection, description, and tabulation, though not of one, but of many individuals: few anatomists would accept less than one hundred individuals to represent a species. What is wanted first and most for the animal with which we are at present dealing is a thorough and minute dissection of one gorilla to act as a standard for future workers. There is only one description that nearly approximates to such a standard—Deniker's

(17); but, unfortunately, it is the dissection of a foetal animal. Much of the work that has already been done, such as that of Owen and Hartmann, is almost useless for future purposes, as a list of the material used is never explicitly stated—the first essential—and only general statements are given. In short, Owen and his school may be said to have been anatomists of the individual; his successors were and are anatomical census-takers of the race.

The aim and end to which all such work as this should be directed is, I take it, to find out not only how the individual, but also how the race, moves, lives, and has its being; and any fact which helps towards this end deserves to be recorded. We wish to discover, also, how races have come into their present shapes and habits; how they are co-ordinated with their surroundings; and to what extent we may prophesy with truth as to how these races might be moulded in changed surroundings. Such studies pursued upon man's nearer neighbours ought to give some understanding of the methods by which he has attained his present form and position. But, besides these more philosophical problems, the solution of which leads only to a certain mental satisfaction, the anthropoids offer, in the simplicity of their mind and body, a clue to the more practical study of the elaborate psychology and physiology of man.

The Nervous System.—Seeing that the brain is regarded as the organ that keeps the individuals of the higher races sexually and socially congregated together in a group known as a species, and seeing further that the form of the brain is moulded by and dependent upon function, its study becomes of the first importance. About a dozen gorilla brains have been seen altogether: Bischoff (4, 5, 9), Broca (11), Chapman (14), Deniker (17, a foetal brain), and Pansch (67) have given figures and descriptions of the convolutions; Féré (27), Gratiolet (32), Moeller (62), Thane (78), and Owen (66) have noted some points concerning it. As for the convolutions, we know neither their meaning nor what relationship they bear to function. They are probably of less value physiologically and morphologically than the basal parts of the brain, of the centres and tracts of which we know nothing. The cerebellum is still untouched. Waldeyer (85) has given us a splendid piece of research on the spinal cord, and Eisler's (24) account of the distribution of the nerves is very good. Hepburn (45) also gives a full account of the main nerves of the limbs. The microscopical structure and distribution of motor areas of the cortex of the brain are unknown. [See also 143, 151, 188, 188a, 189, 190, and 209].

The Muscles.—The muscles of the gorilla have been well described by Deniker (17) and Duvernoy (22); Hepburn (45) gives a full account of the muscles of the limbs. Partial descriptions have been given by Bischoff (7), Chapman (13), Chudzinski (16), Ehlers (23), Huxley (49b), Macalister (55), Ruge (70), Symington (76), and Wyman (87). As already pointed out, a standard dissection, to include at the same time the work already done, is still required.

The muscles ought to be treated in functional groups, their actions and nerve supplies being also noted. [See also 100, 148, 152*a*, 198, 199, and 214.]

Ligaments.—Ligaments have been described by Duvernoy, Deniker, Hartmann (39), and Macalister (55).

The Skull.—There are over 250 gorilla skulls in the museums of Europe and America. More or less partial records of over 100 of these are to be found in literature. Owen's descriptions are, perhaps, the best (64, 65, 66); others are given by Virchow (84), Bischoff (3 and 8), Deniker (17 and 18), Duvernoy (22), Giglioli (31), Halford (34), Hamy (35), Hartmann (40), Hervé (49), Török (80 and 81), Turner (83), and Wyman (87). Duckworth (20) has made an important contribution on the variations found in the gorilla skull. It may be safely said, by way of postscript to this list, that the skull has been the most sadly abused structure of the animal body. The present manner of description by angles and indices is a method that leads only to the accumulation of a mass of most useless, cumbersome material. The describers seem to have lost all sight of the skull as a functional organ, with its form adapted for its two main uses, as a brain cover and a tooth carrier. Its description, to be of use, must be given in relation to these two functions. [See also 205 and 208.]

The Skeleton.—For a general description of the skeleton the text-books of Flower, Huxley, and Owen are still as good as any. More elaborate descriptions are given by Aeby (1), Deniker (17), Duvernoy (22), Halford (33), Hartmann (40 and 43), Heckel (44), and Mivart (61). Struthers has dealt with the variations in the vertebral column (74). Kneeland (50), Lucae (54), Slack (73), Swayne (75), and Wyman (87) have also made smaller contributions. From the elaborate and expensive lithographs of bones which are sometimes given with these papers, one would conclude either that the scientific societies had a superabundance of funds, which is unlikely, or that these lithographs are more permanent and convenient for reference than are the bones themselves. On the ossification and fixation of the epiphyses to the shafts nothing is known beyond Deniker's work. [See also 104, 118, 119, 149, 153, 186*a*, 187*a*, and 204.]

The Teeth.—In the text-books of Tomes, Huxley, and Owen general descriptions of the teeth are given. Topinard has dealt with the cusps and fangs of the molars and premolars (82); Magitot (56 and 57) treats of the dentition of the gorilla. Duvernoy and Heckel also give a description of the teeth, while abnormalities are reported by Magitot (57), Gervais (*Journ. Zool.*, vol. iii., pp. 164–166; 1874), Bateson (*Proc. Zool. Soc.*, 1892), and in the *Trans. Odont. Soc.*, 1887, p. 266. Little is known of the dates at which the teeth cut the gum (see Famelart, 26).

The Alimentary System.—The mouth, tongue, and pharynx have been figured or described by Ehlers (23), Bischoff (7), Duvernoy

(22), Chapman (13), and Deniker (17). The viscera of the abdomen have never been thoroughly described. The liver has been dealt with by Chudzinski (15), Flower (28), Virchow (84), Deniker (17), Bolau (10), Bischoff (7), and Huxley (49*b*). The alimentary canal has been observed, though only in a cursory manner, by Virchow (84), Deniker (17), Chapman (13), Bischoff (7), Bolau (10), Flower (28), and Hartmann (40). Macalister and Deniker mention the presence of salivary glands (!) But of the pancreas, the supra-renal bodies, the arrangement of the peritoneum and mesenteries, and the sympathetic system of the abdomen, we know practically nothing. [See also 211.]

The Respiratory System.—A great deal has been written on the larynx and laryngeal sacs: Ehlers (23), Deniker (17 and 19), Bischoff (7), Duvernoy (22). The function of these sacs is unknown. The lungs are partially described by Ehlers, Bolau, Bischoff, Deniker, and Hartmann. [See also 203.]

The Circulatory System.—One would scarcely expect to find any peculiar feature about the heart of the gorilla, and none has been recorded, yet one would expect that the disposition of the pericardium and its relationship to the diaphragm would be different from that found in man. Only Bolau, Deniker, Ehlers, and Bischoff make mention of the heart. Our knowledge of the arteries of the gorilla we owe to Deniker (17) and Eisler (24). This system, especially as regards the veins, requires much more attention.

The Lymphatic System and the Ductless Glands.—Of the lymphatic system nothing is known except in a most general way [Eisler, 24.] The spleen has been figured by Bischoff (7) and Deniker; Virchow (84) alludes to it; so does Bolau. Deniker and Ehlers give a short description of the thyroid; the thymus, supra-renal bodies, pineal and pituitary bodies, the carotid, and coccygeal bodies have never been described.

The Genito-Urinary System.—The kidney of the gorilla, like that of the other anthropoids, has only one papilla, and has been described by Deniker (17), Virchow (84), Bolau (10), and Ehlers (23). Its microscopic structure and development require to be investigated. The bladder and its relationship to the pelvis and pelvic fascia have not been noted. The testicle is cursorily described by Ehlers and Chapman, but the prostate and the urethra have not been examined. Duvernoy, Ehlers, Huxley (49*b*), Owen (*Proc. Zool. Soc.*, 1859), and Chapman have described the external genital organs. The reproductive system of the female requires examination, although Bischoff (6), Deniker, Bolau, Ehlers, and Hartmann (42) have already made contributions to this subject.

Organs of Sense.—These are not likely to show any marked differences from those of man; yet it would be well to give them the attention they have not yet received.

External Characters, Configuration, and Proportions.—Pigeon-holing systematists have devoted most of their attention to

this aspect of the gorilla, so that a great part of literature is devoted to these more superficial and accessible characters. Very good figures of the gorilla are given by Hartmann (40), by Wolff (*Proc. Zool. Soc.*, 1877), Bolau (10), Chapman (13), Deniker (17), Du Chaillu (21), Falkenstein (25), Lenz (53), Meyer (58), and Owen (66). The ear has been figured by Deniker, Ehlers, Bischoff, Hartmann, Owen, Lenz, and Bolau. The hands and feet have been dealt with by Hepburn (46), Chapman, Hartmann, Deniker, Bolau, Owen, Huxley (49a), Lucae (54), and Hermes [47]. There was a silly question once raised whether the lower extremities were furnished with hands or feet; an index to the literature on the question is obtainable from Huxley's and Lucae's articles. The hair and its changes with age, as well as the pigment of the skin, and the method of its appearance and manner in which it is deposited and spread over the body, require some more observation, notwithstanding the elaborate descriptions of Lenz (53), Alix (2), Bischoff (7), Bolau (10), Chapman (13), Deniker (17), Du Chaillu (21), Ehlers (23), Famelart (26), Hartmann (40), Hermes (47), Meyer (58), Owen (66), Savage (71), and Wyman (87). Measurements are given by Bischoff, Hartmann, Bolau, Hermes, Deniker, Meyer, Owen, Chapman, Huxley (49a), and many others, but the subject and records are both alike unsatisfactory. [See also 89, 150 and 163.]

Psychology.—The intellectual and emotional characters of the gorilla have not been studied so much as even the few opportunities have allowed. Hermes gives the best description of its habits in captivity, and our knowledge of its habits in its native haunts is due for the most part to Du Chaillu. For the great amount of material, and the knowledge of the gorilla which he brought home, Du Chaillu had little in return but malaria, quinine, and scientific abuse, so that we need hardly be astonished that he has not pursued the subject further. The best *resumé* of the habits of the gorilla is still that by Huxley (49a), although further information may be picked from the accounts of Falkenstein (25), Famelart (26), Franquet (30), Ford (29), Hartmann (43), Laboullay (51), de Langle (52), Reade (68), Reading (69), Savage (71), and Walker (86).

Distribution.—The gorilla is confined to the French and German territories north of the Congo: see Hartmann (43), Savage (71), Reade (68), Reading (69), Ford (29), St. Hilaire (72), and Famelart (26). The extent of its distribution eastwards is unknown.

Classification.—Of all the literature on the gorilla this part of it is most marked by incompetence and prejudice. Luckily, Savage, the scientific discoverer of the gorilla, had Wyman to advise him, and they named it *Troglodytes gorilla*—regarding it as a large, sensual and ferocious form of chimpanzee. That seems to me the true and permanent scientific name and estimation of the gorilla. Duvernoy, however, called it *Gorilla tschego* [No! see p. 23], Is. Geof. St. Hilaire gave the name *Gorilla gina*, and over the gorilla's cage at the Zoological

Gardens is the name *Anthropopithecus gorilla*; who the sponsor is for this appellation, we do not know [see p.22]. The close relationship that exists between the gorilla and the chimpanzee came out very clearly in the famous dispute over "Mafuca." Mafuca was an animal in the Dresden Gardens labelled chimpanzee; Nissle (63) saw her and said she was a gorilla; Meyer, of Dresden, maintained she was a chimpanzee; Hartmann came from Berlin and declared her to be a gorilla; Bolau came from Hamburg and certified her to be a chimpanzee. The difference between the gorilla and the chimpanzee cannot be so very great when four such authorities cannot make up their minds in common. Koppenfels (59) accounted for the difficulty of distinguishing between the two by alleging that hybrids occur (a fact which I should not be astonished to find substantiated), and sent a skin and skull of such a supposed hybrid home from Africa to Meyer, who, however, did not agree that it was a hybrid. Local varieties will probably be found to occur; such seem to be the specimens described by Alix and Bouvier (2) under the name of *Gorilla mayema*. There may be distinct species of gorilla; but the specific characters ascribed by Alix and Bouvier to *Gorilla mayema* may be due to age, sex, individual, or local peculiarities of the two specimens described by them. At any rate, *G. mayema* cannot be accepted as a true species until it has been shown that the animals which possess its characters live, socially and sexually, apart from the common form of gorilla.

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2. **Alix, E., et Bouvier, A.**—"Sur un nouveau Anthrope (Gorilla Mayéma) provenant de la région du Congo." *Bull. Soc. Zool. France*, 1877. t. ii., pp. 488-490. From an examination of a young female animal and the skin and skeleton of an adult female, they came to the conclusion that there were at least two species of gorillas—this one, *Gorilla mayema*, and the more common one, *G. gina* of I. G. St. Hilaire. Abstract in *Compt. Rend.*, 1878, t. lxxxvi. pp. 56-58.
3. **Bischoff, T. L. W.**—"Ueber die Verschiedenheit in der Schaedelbildung des Gorilla, Chimpanse und Orang, vorzüglich nach Geschlecht und Alter." München: 1867. 4to, 94 pp., 22 pls. The skulls of two old male, three old female, and three young animals are partially described.
4. ————"Über das Gehirn eines Gorilla und die untere oder dritte Stirnwindung des Affen." *SB. Math.-Phys. Cl. Ak. Wiss. München*, 1877. Bd. vii., pp. 96-139, 6 figs. Pansch and Thane describe the same brain.
5. ————"Das Gorilla-Gehirn und die untere oder dritte Stirnwindung." *Morph. Jahrb.*, 1878. Bd. iv. Suppl., pp. 59-73. An argumentative article, the author being in doubts as to the brain described by Broca having really been a gorilla's brain.
6. ————"Ueber die äusseren weiblichen Geschlechts- und Begattungs-Organen des Menschen und der Affen, etc." *Abh. Math.-Phys. Cl. Ak. Wiss. München*, 1880. Bd. xiii., Abth. ii., pp. 209-274. Three young gorillas were examined.

7. **Bischoff, T. L. W.**—"Beiträge zur Anatomie des Gorilla." *Tom. cit.*, 1880. Abth. iii., pp. 1-48. Figs. of tongue, palate, larynx, heart, and abdominal organs are given. He used the body of a young female animal in a rather inferior state of preservation. This treatise is also published separately.
8. ————"Ueber Brachycephalie und Brachyencephalie des Gorilla und der anderen Affen." *SB. Math.-Phys. Cl. Ak. Wiss. München*, 1881. Bd. xi., pp. 379-390, 2 figs.
9. ————"Die dritte oder untere Stirnwindung und die innere obere Scheitelbogenwindung des Gorilla." *Morph. Jahrb.*, 1882. Bd. vii., pp. 312-322. (The author had the use of five gorilla brains—all that were in Germany at that time.)
10. **Bolau, H.**—"Die Menschenähnlichen Affen des Hamburger Museums." *Abh. aus dem Gebiete der Naturwiss. Hamburg-Altona*, 1876. Bd. vi., Festgabe pp. 61-90, 2 photo-plates. Bolau gives a description of the external characters and abdominal and genital organs of three animals, sent home from the Gaboon region in spirit. (See Pansch, 67.)
11. **Broca, Paul.**—"Etude sur le Cerveau du Gorille." *Revue d'Anthrop.*, 1878. Ser. 2, t. i., pp. 1-46, plates i.-iii. The brain was not in a good state of preservation, yet this is one of the best descriptions given. It was the brain of an adult male animal.
12. **Broesike.**—"Ueber die Krankheiten und Todesursache des Gorilla Mpungu." *SB. Ges. Naturforsch. Freunde Berlin*, 1877. Pp. 262-267. A post-mortem inspection of Falkenstein's Gorilla.
13. **Chapman, H. C.**—"On the Structure of the Gorilla." *Proc. Ac. Nat. Sci. Philadelphia*, 1878. Pp. 385-394. Gives figures of the face, head, hands, feet, and deep muscles of the sole. Dissection of a young male animal sent home in spirit.
14. ————"Observations upon the Brain of the Gorilla." *Op. cit.*, 1892. Pp. 203-212. Gives 4 figs. A young brain sent to him in spirit by a missionary in the Gaboon.
15. **Chudzinski, T.**—"Note sur le Foie d'un jeune Gorille mâle, etc." *Bull. Soc. Anthropol. Paris*, 1884. Ser. 3, t. vii., pp. 608-616, 2 figs. See also p. 743 for note on this by Deniker.
16. ————"Sur les Muscles peaussiers du Crâne et de la Face observés sur un jeune Gorille mâle." *Bull. Soc. Anthropol. Paris*, 1885. Ser. 3, t. viii., pp. 583-586.
- 16a. **Deniker, J.**—"Sur un fœtus de Gorille." *Compt. Rend. Ac. Paris*, 1884, t. xcvi. pp. 753-756.
17. ————"Recherches Anatomiques et Embryologiques sur les Singes Anthropoïdes." *Arch. Zool. Exper.*, 1885. Ser. ii., t. iii. bis., Mém. 3, pp. 265, 8 pls. Published separately at Poitiers, 1886. Profuse illustrations of brain, skull, skeleton, viscera, and external characters. Deniker's is the best work upon the gorilla; he describes very minutely the anatomy of a foetal animal, and used evidently the same foetus in his description in *Bull. Soc. Anthropol. Paris*, 1884. Ser. 3, t. vii., pp. 447-451. He used the body of an adult gorilla for comparison during his dissection.
18. ————"Sur le developpement du crâne chez le Gorille." *Bull. Soc. Anthropol. Paris*, 1885. Pp. 703-714.
19. **Deniker et Boulart.**—"Note sur les sacs laryngiens des Singes Anthro-
poïdes." *Journ. Anat. et Physiol.*, 1886. Vol. xxii., pp. 51-62, pls. iii.-iv.
20. **Duckworth, W. L. H.**—"Variations in crania of *Gorilla savagel*." *Journ. Anat. and Physiol.*, 1895. Vol. xxix., pp. 335-345.
21. **Du Chaillu, P. B.**—"Explorations and Adventures in Equatorial Africa, etc." London: 1861. 8vo, xviii. and 479 pp., 27 pls. "A Journey to Ashango Land, etc." London: 1867. 8vo, xxiv. and 501 pp., 22 pls.

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23. **Ehlers, E.**—"Beiträge zur Kenntniss des Gorilla und Chimpanse." *Abh. Phys. Cl. Ges. Wiss. Göttingen*, 1881. Bd. xxviii., no. 1, 77 pp., 4 pls. The anatomy of a young male and adult female gorilla is partly described.
24. **Eisler, P.**—"Das Gefäss- und periphere Nerven-system des Gorilla, etc." Halle: 1890. 4to, 78 pp., 9 pls. Excepting Deniker's, this is the only description of the arteries and nerves of the gorilla in existence.
25. **Falkenstein, J.**—"Ein lebender Gorilla." *Zeitschr. Ethnol.*, 1876. Bd. viii., pp. 60, 61, pl. ii. "Die Loango-Küste." Berlin: 1876. A photograph of his gorilla is given. Also "Die Loango-Expedition." Abth. ii., Leipzig, 1879.
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27. **Féré, C.**—"Deuxième note sur la Topographie cranio-cérébrale chez les Singes." *Journ. Anat. et Physiol.*, 1885. t. xxi., pp. 298-303. Gives outline of a gorilla brain.
28. **Flower, W. H.**—"The Organs of Digestion of the Mammalia." *Med. Times and Gaz.*, 1872. Feb. 24-Dec. 14. For gorilla see under March 23. Huxley and he base their descriptions upon the viscera of the same individual.
29. **Ford, H. A.**—"On the characteristics of the Troglodytes Gorilla." *Proc. Ac. Nat. Sc. Philadelphia*, 1852. Vol. vi., pp. 30-33. A note accompanying a skeleton sent from Glasstown, Gaboon River.
30. **Franquet, E.**—Appendix to St.-Hilaire (72). Pp. 91-97. External characters, habits, etc.
31. **Giglioli, E. H.**—"Studii Craniologici sui Cimpanze." *Ann. Mus. Civ. di Storia Nat. Genova*, 1872. Vol. iii., pp. 56-179, 2 pls. He employed three gorilla skulls for comparative purposes.
32. **Gratiolet, P.**—"Note sur l'encéphale du Gorille (*Gorilla gina* I. Geof.-St. H.)" *Compt. Rend. Ac. Paris*, 1860. t. l., pp. 801-805.
33. **Halford, G. B.**—"Lines of Demarcation' between Man, Gorilla, and Macaque." Melbourne: 1864. 4to, 21 pp. A purely polemical article.
34. ————"On the Skeleton of the Gorilla." *Trans. and Proc. R. Soc. Victoria*, 1866. Vol. vii., pp. 34-49. Male and Female in Nat. Mus., Melbourne.
35. **Hamy, E. T.**—"De l'épine nasale antérieure dans l'ordre des Primates." *Bull. Soc. Anthropol. Paris*, 1869. Ser. 2, t. iv., pp. 13-28.
36. **Hartmann, R.**—"Beiträge zur . . . Kenntniss der Sogennanten Anthropomorphen Affen." *Archiv. Anat. und Physiol. Leipzig*, 1872. Pp. 107-152. Historical, Ext. Charact., etc. 1875, pp. 265-303, pp. 723-744, Osteology. 1876, pp. 636-661, Bones of extremities.
37. ————"Ueber neues die anthropomorphen Affen betreffendes Material." *SB. Ges. Nat. Freunde Berlin*, 1876. Pp. 22-26.
38. ————"Beiträge zur Kenntniss der sogenannten anthropomorphen Affen, iv., v." *Zeitschr. Ethnol.*, 1876. Bd. viii., pp. 130-133; 1877. Bd. ix., pp. 117-128.
39. ————"Ueber das Hüftgelenk der Anthropoiden Affen." *SB. Ges. Nat. Freunde Berlin*, 1877. Pp. 85-89.
40. ————"Der Gorilla, etc." Leipzig: 1880. 4to, pp. 160. 84 figs. of 28 skulls are given, with very good coloured illustrations and photographs of the external characters of the gorilla.

41. **Hartmann, R.**—"Ueber den Torus occipitalis transversis, etc." *SB. Ges. Nat. Freunde Berlin*, 1880. Pp. 159-162. A critical article.
42. ————"Ueber die Weiblichen Geschlechtstheile der Anthropoiden Affen und die Brunst der Affen im Allgemeinen." *Verh. Berl. Ges. Anthropol. in Zeitschr. Ethnol.*, 1886. Bd. xviii., pp. 431-433.
43. ————"Anthropoid Apes." *Internat. Sci. Ser.*, London, 8vo, 1885, viii. and 326 pp. This volume contains all Hartmann's general results; a very good *resumé* of the literature on apes is given. Hartmann's work is of very little use for future purposes, owing to the fact that he deals only in general statements, and never gives a list of the material on which these statements are based.
44. **Heckel, Ed.**—"Etude sur le Gorille du Musée de Brest." *Revue d'Anthrop.*, 1876, t. v., pp. 1-20, pl. i.
45. **Hepburn, David.**—"The Comparative Anatomy of the Muscles and Nerves of the Superior and Inferior Extremities of the Anthropoid Apes." *Journ. Anat. and Physiol.*, 1892. Vol. xxvi., pp. 149-186, pl. iii., and pp. 324-356, pl. ix.
46. ————"The Integumentary Grooves on the Palm of the Hand and Sole of the Foot of Man and the Anthropoid Apes." *Op. cit.*, 1893, vol. xxvii., pp. 112-130. Numerous figures are given.
47. **Hermes, O.**—"Aus dem Gefangleben des Gorilla." *Zeitschr. Ethnol.* Berlin: 1892. Bd. xxiv., p. 576-582.
48. **Hervé, G.**—"Le Circonvolution de Broca chez les Primates." *Bull. Soc. Anthropol. Paris*, 1888. Pp. 275-314.
49. ————"Crâne du Jeune Gorille." *Op. cit.*, 1893. Pp. 387-389.
- 49a. **Huxley, T. H.**—"Evidence as to Man's Place in Nature." London: 1863. 8vo.
- 49b. ————"The Structure and Classification of the Mammalia." *Med. Times and Gaz.*, 1864, Feb. and March.
50. **Kneeland, S.**—"On the Skeleton of the Great Chimpanzee, *Troglodytes gorilla*." *Boston Journ. Nat. Hist.*, 1853. Vol. vi., pp. 336-347. Description of the skeleton of an adult male gorilla.
51. **Laboullay, G.**—Appendix to St.-Hilaire (72), pp. 83-91. Habits and proportions.
52. **Langle, F. de.**—"Mœurs d'un jeune Gorille." *Compt. Rend. Ac. Paris*, 1866. t. lxiii., p. 739.
53. **Lenz, H. W. C.**—"Die Anthropomorphen Affen des Lübecker Museums." Lubeck: 1876. 4to, 20 pp. Numerous photographs of museum specimens are given.
54. **Lucae, J. C. G.**—"Die Hand und der Fuss." *Abhand. Senckenbergisch. Naturf. Ges. Frankfurt*, 1865. Bd. v., pp. 275-332, 4 pls.
55. **Macalister, A.**—"Muscular Anatomy of the Gorilla." *Proc. Roy. Irish Acad., Science*, 1873. Ser. 2, vol. i., pp. 501-506. Only some of the muscles were noted; figures of the ligaments of the shoulder joint, pronator radii teres and short muscles of the hand are given. The body of a young female animal was used.
56. **Magitot, E.**—"L'Homme et les Singes Anthropomorphes." *Bull. Soc. Anthropol. Paris*, 1869. Ser. ii., t. iv., pp. 113-145. Deals with the teeth of the gorilla in part of the article.
57. ————"Traité des Anomalies du Système Dentaire, etc." Paris: 4to, 1877, iv. and 303 pp., 20 pls.
58. **Meyer, A. B.**—"Notizen über die Anthropomorphen Affen des Dresdener Museums." *Mitth. Zool. Mus. Dresden*, 1877. Pp. 223-247, 13 pls.
59. ————"Ein angeblicher Bastard zwischen Gorilla und Chimpanse." *Zoolog. Garten.*, 1881. Bd. xxii., pp. 231-236. Von Koppenfels' supposed hybrid.
60. **Milne-Edwards.**—"Sur l'existence d'un Gorille à la Ménagerie du Muséum d'Histoire Naturelle." *Compt. Rend. Ac. Paris*, 1884. t. xcvi., pp. 959-960. The first living gorilla in France.

61. **Mivart, St. George.**—"On the Appendicular Skeleton of the Primates." *Phil. Trans.*, 1867. Vol. clvii., pp. 299-429, pls. xi.-xiv.
- 61a. ————"Contributions towards . . . Knowledge of the Axial Skeleton in the Primates." *Proc. Zool. Soc. London*, 1865. Pp. 545-592.
62. **Moeller, J.**—"Beiträge zur Kenntniss des Anthropoid-gehirns." Berlin: 1891. 4to, 17 pp., 2 pls. [See reference 166.]
63. **Nissle, C.**—"Beiträge zur Kenntniss der sogenannten anthropomorphen Affen, III. 'Mafuca'—ein Gorilla." *Verh. Ges. Anthropol. Berlin in Zeitschr. Ethnol.*, 1876. Bd. viii., pp. 46-60.
64. **Owen, R.**—"On a New Species of Chimpanzee." *Proc. Zool. Soc. London*, 1848. Pp. 27-35. (Founded upon three skulls sent to him by Savage).
- 64a. ————"On the Gorilla (*Troglodytes gorilla*, Sav.)." *Op. cit.* 1859, pp. 1-23, characteristics and distribution of gorilla.
65. ————"Osteological Contributions to the Natural History of the Chimpanzees, etc." *Trans. Zool. Soc. London*, 1849, vol. iii., pp. 381-422, pls. lviii.-lxiii.: description of the skull of *Troglodytes gorilla* discovered by Savage. 1853, vol. iv., pp. 75-88, pls. xxvi.-xxx.: cranium of adult male from R. Danger, W. Africa. 1853 (?), vol. iv., pp. 89-115, pls. xxxi.-xxxvi.: jaws and vertebral column. 1862, vol. v., pp. 1-31, pls. i.-xiii.: bones of extremities. 1865, vol. v., pp. 243-284, pls. xliii.-xlix.: external characters.
66. ————"Memoir on the Gorilla." London: 1865. 4to. The description of the soft parts is based upon a young animal sent home in spirit and not in a good state of preservation. The external characters are described from three skins. The memoir contains the substance of Owen's articles in the *Transactions of the Zoological Society* for 1849, -53, -57, -62.
67. **Pansch, A.**—"Ueber die Furchen und Windungen am Gehirn eines Gorilla." Part of Bolau (10), pp. 84-90.
68. **Reade, W. W.**—"The Habits of the Gorilla." *Amer. Nat.*, 1867, vol. i., pp. 177-180. Popular note.
69. **Reading, J. H.**—"Habits [and Distribution] of the Gorilla." *Amer. Nat.*, 1884, xviii., pp. 1,277 and 1,278.
- 69a. **Rex, H.**—"Ein Beitrag zur Kenntniss der Muskulatur der Mundspalte der Affen." *Morph. Jahrb.*, 1887. Bd. xii., pp. 275-286, pl. xvii.
70. **Ruge, G.**—"Untersuchungen über die Gesichtsmuskeln der Primaten." Leipzig, 1877, fol., pp. 130, 62 figs. Supplementary to that work is an article specially devoted to the facial muscles of the gorilla in *Morph. Jahrb.*, 1887. Bd. xii., pp. 459-529, pl. xxiv.
71. **Savage, T. S.**—"Notice of the External Characters and Habits of *Troglodytes Gorilla*, a new species of Orang from the Gaboon River; Osteology of the same, by J. Wyman." *Boston Journ. Nat. Hist.*, 1847. Vol. v., pp. 417-443. 4 pls. of skulls. This (or rather, the short abstract in *Proc. Boston Soc. N.H.*, vol. ii., pp. 245-247, published Aug., 1847) is the first notice of the gorilla in scientific literature. A review appeared in *Amer. Journ. Sci. and Art*, 1849, 2nd series, vol. viii., p. 141.
72. **St. Hilaire, I. G.**—"Description des Mammifères Nouveaux, etc." *Arch. Mus. Hist. Nat.*, 1858-61, t. x., pp. 1-102. Including appendices by Franquet and Laboullay, q.v. He had six more or less complete animals to found his conclusions on. He names the gorilla—*Gorilla gina*.
73. **Slack, J. H.**—"Mammalogical Notices." *Proc. Ac. Nat. Sci. Philadelphia*, 1867, pp. 34-38.
74. **Struthers, John.**—"On the Articular Processes of the Vertebrae in the Gorilla, etc." *Journ. Anat. and Physiol.*, 1893. New ser., vol. vii., pp. 131-138. Deductions are drawn from an examination of twenty adult skeletons.
75. **Swayne, S. H.**—"Comparative Measurements of the Skeleton of Man and the Gorilla." *Proc. Bristol Nat. Soc.*, 1868, vol. iii., pp. 39-41. Skeleton in the Bristol Museum.

76. **Symington, J.**—"Observations on the Myology of the Gorilla and Chimpanzee." *Rep. Brit. Assoc.*, 1889. London, 1890. Pp. 629 and 630.
77. ————"The Vertebral Column of a Young Gorilla." *Journ. Anat. and Physiol.*, Oct., 1889. New series, vol. iv., pp. 42-51. Two figs.
78. **Thane, G. D.**—"The Brain of the Gorilla." *Nature*, 1876, Dec., vol. xv., pp. 142-144. On the description by Pansch.
79. **Thomson, W.**—"The Transversalis Pedis in the Foot of the Gorilla." *Austral. Med. Journ.*, Melbourne, 1864, vol. ix., pp. 15-24. The writer had never examined the foot of a gorilla.
80. **Török, A. von.**—"Sur le Crâne du jeune Gorille du Musée Broca." *Bull. Soc. Anthropol. Paris*, 1881, ser. 3, t. iv., pp. 46-57.
81. ————"Ueber den Schadel eines jungen Gorilla. Zur Metamorphose des Gorillaschadels." *Month. Internat. Journ. Anat. and Physiol.*, 1887, vol. iv., pp. 137-176, 227-274, pls. iv-vi. For his "Neuere Beiträge zur Reform der Kraniologie" see vols. x., xi., and xii. (1893-94-95) of the same journal.
82. **Topinard, P.**—"De l'Evolution des Molaires et des Prémolaires chez les Primates, etc." *L'Anthropologie*, 1892, t. iii., pp. 641-710. Many figures are given.
83. **Turner, W., & Burt.**—"Exhibition of Three Skulls of the Gorilla, received from M. du Chaillu, etc." *Proc. Roy. Soc. Edinburgh*, 1865, vol. v., pp. 341-350.
84. **Virchow, R.**—"Ueber den Schadel des jungen Gorilla." *Monatsber. Akad. Wiss. Berlin*, 1880, pp. 516-543, 8 figs.; also *SB. Akad. Wiss. Berlin*, 1882, pp. 671-678. Deals with the characters of three skulls of young animals.
85. **Waldeyer, W.**—"Das Gorilla-Rückenmark." *Abh. Akad. Wiss. Berlin*, 1888, art. 3, 147 pp., 12 pls., published 1889.
86. **Walker, R. B. N.**—Report of Meeting. *Proc. Lit. Phil. Soc. Liverpool*, 1866. No. xix., pp. 224-229. Remarks on skeleton presented by him to Liverpool Museum.
87. **Wyman, J.**—"Report on the Cranium of the Engéena (*Troglodytes gorilla*) . . . presented to the Society by G. A. Perkins; also on that belonging to the Essex County N. H. Soc." *Proc. Boston Soc. N. H.*, 1850, vol. iii., p. 179.
- 87a. ————"Observations on the Cranium of a young Gorilla." *Proc. Boston Soc. N. H.*, 1863, vol. ix., p. 203.
- 87b. ————"On the Skeleton of a Hottentot." *Tom. cit.*, 1865, pp. 352-357. Measurements of pelvis and limb-bones. See also under Savage (71).

II. The Chimpanzee.

The Chimpanzee in Europe.—However desirable, it is almost impossible to give an approximately accurate statement of the amount of material, the live animals studied in confinement, the skeletons and carcasses studied in museums and dissecting rooms, upon which is based our knowledge of the chimpanzee species. There is to be found in literature the description of parts belonging to over two hundred chimpanzees, but of that great number the anatomy of only one animal has been described with an approximation to completeness, that of Gratiolet (131), and even it lacks much. Small parts of many specimens have been studied and recorded with great accuracy, and by piecing these together one may obtain a rough mental picture of the structure of the species. The partial character of our knowledge results not from lack of material, but rather from its abundance. In the Gardens of the Zoological Society of London alone, during the last fifty years, there have been about fifty chimpanzees, and that number probably only represents about one-third of the live visitors to Europe. The chimpanzee, if its health could stand it, would take very kindly to confinement, for, when young at any rate, it is of a lively, playful, and contented disposition. As a rule, it does not keep its health in confinement in Europe. Of eight chimpanzees that came to the Gardens at Rotterdam, four lived between 1-27 days, four between 100-380 days. In the Gardens at London it appears to fare better, Sally, for instance, living eight years. Although a few instances might be collected of animals that have passed from three to five years in confinement, I do not think that, on an average, one could insure the chimpanzee for a six months of life in Europe. Of the animals in confinement, males and females occur in about equal numbers, but adults are unknown. [See Schmidt 274a.]

The Nervous System.—There are partial records of forty-eight chimpanzee brains, but, almost without exception, they deal with the surface anatomy only. A great deal of the work on this part of the subject is very excellent. Of treatises dealing with the fissures of the brain, Cunningham's best repays consultation (115, 116), and Rüdinger's (188) is of great worth. Very good descriptions and figures are given by Giacomini (130), Moeller (165), Beddard (93), Benham (94), Chapman (111), Dwight (123), Embleton (126), Barkow (90), Marshall

(158), Parker (178), Schroeder and Vrolik (196), Symington (202), Turner (207), while Traill (206), Tyson (208), and Macartney (155) give very fragmentary accounts. The convolutions, sulci, lobes, and fissures have been treated in a general way, but from fresh material, by Broca (103), Gratiolet (131), Hamy (136), Kükenthal and Ziehen (151), Pansch (176), Parker (177), and Rohon (185). The Island of Reil, its limiting sulci and opercula, the third frontal convolution, have received a great deal of attention, and respecting them the following authors may be consulted: Bischoff (4, 5), Cunningham (116, 117), Hervé (48), Marchand (157), and Rüdinger (188*a*). Of the deep anatomy of the brain, its commissures, its tracts, its deep and basal centres, and its peduncles, nothing is known except from inference. The ventricles have been touched upon by Schroeder and Vrolik (196), Moeller (165), Marshall (158), and Macartney (155). Moeller (166) has examined and described the hypophysis and epiphysis cerebri.

The extent to which the cerebellum is overlapped by the occipital lobes of the cerebrum has been a matter of very keen observation, and has quite a considerable literature of its own. Like all points of anatomy that have given rise to a great deal of discussion and contradiction, it has turned out to vary widely with the individual, and to have received an amount of attention quite outside its real importance. As far as this matter concerns the chimpanzee, observations have been made by Chapman (111), Cunningham (115, 118), Macartney (155), Marshall (158), Moeller (166), Schroeder and Vrolik (196), and Wilder (213). For papers dealing with the weight of the chimpanzee brain, see Moeller (166) and Keith (146). There is no microscopic work on the brain, except that of Moeller (168). The medulla oblongata has been figured by Barkow (90), and its nerve centres examined and described by Kallius (145) and Cunningham (117). The external appearance of the spinal cord has been described by Kallius (145). Moeller (166, 167) has examined the finer structure of the optic chiasma. [See also 281 and 298*a*.]

The cranial nerves of the chimpanzee have never been examined with any degree of detail (Vrolik, 210). The lumbar plexus, especially the spinal nerves that enter into its formation, has received a very great deal of attention from Von Jhering (143), Ruge (191), Rosenberg (187*a*), and Ütschneider (209). Hoefer (140) has given a full description of the nerves of the upper extremities, and Macalister (154) gives a figure of the brachial plexus. The nerves of both extremities have been dealt with by Champneys (110), Hepburn (45), Chapman (111), Gratiolet (131), Nepheu (170), Sutton (201), Traill (206), and Vrolik (210), but only the first two writers give at all a full description.

The Muscles.—Although the myology of eighteen chimpanzees has been described, only Gratiolet's (131) is an approximately complete treatise. Tyson's (208), Traill's (206), Vrolik's (210), Wilder's (212), Beddard's (93), Champneys' (110), Huxley's (49*b*), Embleton's (126), and Sutton's (201) are fairly full. Partial records of dissections are

given by Chapman (111), Dwight (123), Fick (127), Humphry (142), Macalister (154), Mayer (160), Symington (76), and Wyman (215). The muscles of the extremities have been very fully investigated by Hepburn (45), and from the articles of Brühl (108) and the fine figures of Barkow (90) a good deal may be learned concerning the myology of these parts. The muscular anatomy of the face has been very accurately worked out, although in very few specimens, by Ruge (70) and Rex (69a). The muscles that act on the digits have received much attention from Bischoff (100, 101), Brooks (106, 107), Keith (148), and Windle (214). Records of the rectus abdominis are given by Ruge (190) and Keith (148); of the serratus posticus and obliquus abdominis externus by Seydel (198, 199), and of the levator ani by Lartschneider (152a).

The above list, however formidable it may appear, in reality only indicates material enough to serve as an introduction to the myology of the species. The first necessity in the meantime is a thorough dissection and description of one animal to serve as a basis for further work, so that in detailing the dissection of any other individual one would have to record only the points wherein it differed from the 'type' description. Gratiolet's is the only description that could serve as a 'type,' and even it could be considerably improved upon. The lists that have been drawn up of muscular characters or peculiarities of the chimpanzee, or of a species or sub-species of chimpanzee, are almost without exception merely lists of characters peculiar to the individual that has been dissected. It is extremely probable that future and more accurate work will show that the myological characteristics of the anthropoids, especially of sub-species, lie not in any one, or any set of constant peculiarities, but in the proportion or frequency with which these peculiarities occur in a large number of individuals. Besides such census-taking work, however, good descriptions of the muscles of the palate, of the tongue, of the pharynx, of the back, and of the penis are required. The arrangement of the involuntary muscle of the œsophagus, stomach, bladder, and rectum would also repay investigation.

The Joints and Ligaments.—There is no thorough description of the ligaments and joints of the chimpanzee. Gratiolet's (131) is the most complete. Concerning those of the foot and ankle, see Thomson (204), Humphry (142), and Aeby (88). Traill (206), Sutton (201), Macalister (154), Humphry (142), and Hartmann (39), treat cursorily of some of the ligaments and joints. The synovial bursæ and tendinous sheaths, the ligaments of the trunk and pelvis, have scarcely been touched upon.

The Skull.—It is always an easier and more pleasant matter, when one wants to consult any point in the skull or skeleton, to refer to the originals in the shelves of a museum than to the descriptions of them in a library. At first, when such specimens were rare and costly, descriptions were necessary, but now, when they have become numerous and common, descriptions, unless there is something uncommon to record, are superfluous. What is really wanted is a

tabulation of the characters of a long series, say of one hundred, of skulls. As in the myology of the chimpanzee, so in the skulls, there is quite an enormous amount of individual variation, most of the features that have been assigned as characters of sub-species being in reality only individual peculiarities, although it is highly probable, especially in connection with the skulls of Central African chimpanzees, that if a large series of this supposed species were contrasted with a large series of the ordinary West African animal, a very distinct difference in mass would be noted between them. The collections in museums are rapidly becoming big enough for such an undertaking. In London museums, for instance, in the museums of South Kensington, Royal College of Surgeons, and of the various medical and scientific schools, there are over sixty chimpanzee skulls, most of them with the necessary history attached to them; and in the museums of Europe and America, there are, at a low estimate, over three hundred skulls, certainly material enough for working out a very full understanding of this part of the chimpanzee. Anyone who has tried to bring all the descriptions of skulls in periodical and academical literature together and fuse them into a concise and clear whole, must have felt the wish to start the whole subject afresh upon our greatly increased stock of material. At best the literature upon the skull will serve only as an introduction to anyone who wants to start work on fresh material; it is almost useless for the purpose of addition to his own research. It is rather a big literature, the smaller articles, dealing with some definite structure or variation, being the most satisfactory. Such are those, for instance, of Thomson (205), Regnault (182), and Bianchi (95), dealing with the lachrymo-ethmoidal suture; of Maggi (156) dealing with the cranio-pharyngeal canal; Zuckerkandl's (216) with the turbinate bones; Morselli's (169) with the vermian fossa; of Chudzinski (113) and Manouvrier (156a) with the nasal bones; of Hamy (35) with the nasal spine; of Sutton (201) on certain foramina of the skull; of Bischoff (8) on the cranial indices; and of Flower (128) on an acrocephalic skull. Partial records or figures of skulls are given by Barkow (90), Lenz (53), Meyer (58, 59), Hartmann (40), Gratiolet (131), Dwight (123), Bolau (10), Bischoff (96), Beddard (93), Traill (206), and Vrolik (210). Keith (146) treats of the cranial capacity. The literature upon the skull of the Central African chimpanzee is by Giglioli (31), Hartmann (138), Issel (144), and Noack (171). Owen (175), Huxley (49b), Duvernoy (22), Bischoff (3), and Hartmann (138, 38) describe the characters of the chimpanzee skull in a general way, pointing out its generic, specific, and sexual characters, and the changes it undergoes with age.

The Skeleton.—One may say of the other bones as of the skull: it is an easier and more satisfactory matter to refer to specimens than to literature. For articles dealing with the chimpanzee skeleton as a whole one may consult Owen (175), Mivart (61, 61a), Duvernoy (22), Hartmann (138, 38), Bouvier (102), and Gratiolet (131). Records or

figures of one or more skeletons are given by Bolau (10), Dwight (123), Barkow (90), Lenz (53), Meyer (58), Tyson (208), Vrolik (210), and Traill (206). Cunningham (118, 119), deals with the curve and cartilage of the lumbar region of the vertebral column; Broca (104), Chudzinski (112), and Paterson (179) with the sacral and coccygeal vertebræ; Keith (149) with the *manubrium sterni*; Rosenberg (187a) and Wyman (215) with the regional series of vertebræ; Sutton (201), Rosenberg (187a), Lucae (54), and Vrolik (210) with the bones of the hand; Lazarus (153), Lucae (54), Humphry (142), and Thomson (204) with the bones of the foot. Records of measurements of bones are given more especially by Rollet (186a), Meyer (58), Issel (144), Lucae (54), Slack (73), and Wyman (87b).

The Teeth.—Great weight has been placed upon the form and structure of the teeth of the chimpanzee for classificatory purposes, especially for establishing its generic value, and upon the cusps of the last molar teeth for establishing the specific value of certain groups of chimpanzees. It must be admitted that the enamel on the cusps of the gorilla's teeth assumes, as a rule, a sharp crystalline form never found on the teeth of the chimpanzee, and gives support to those that separate the gorillas from the chimpanzees as two well-marked and separated genera; but the last molar teeth, being of the nature of degenerating structures in the chimpanzee, and therefore very variable, are quite unreliable characters for splitting the group into species or sub-species. Very probably a fifth cusp appears much more frequently on the last lower molar of the individuals of one variety of chimpanzee than on the last lower molar of another variety; but its presence or absence can never be accepted as diagnostic. It will be some time before such points can be settled, because the skulls only have the teeth in a fit condition for study from a little time before until a little time after the animals have reached maturity, and it must take time to accumulate such a series. Irregularities in the dental series have been recorded by Bateson (92) and Bischoff (96). Descriptions and figures are given by Duvernoy (22), Ehlers (23), Beddard (93), Giglioli (31), Gratiolet (131) and Barkow (90). Practically nothing is known of the dates of irruption, although some data in connection with this matter may be picked from Beddard (93), Broderip (105), and Magitot (56). Topinard (82) treats of the variations of the cusps. Huxley, Tomes, and Owen (174) deal with the teeth in their well-known general treatises.

The Alimentary System.—Figures or descriptions of the tongue, dealing mostly with its papillæ, are given by Bischoff (7), Cunningham (118), Duvernoy (22), Dwight (123), Ehlers (23), Flower (28), Gratiolet (131), Humphry (142), Cavanna (109), Mayer (162), Symington (202), Traill (206), and Tyson (208). It is very noticeable in the literature of the anthropoids, as exemplified by the literature on the tongue, how subsequent observers pay particular attention to, and discuss, the points raised by their predecessors, so that one

may safely assume that any point or question, once raised, is sure in time to gather a very full literature round it. It has been so also with the rugæ of the hard palate. Bischoff (7), Beddard (93), Ehlers (23), Gratiolet (131), Symington (202), and Waldeyer (211) figure or describe them. Ehlers (23) describes the buccal folds of mucous membrane that occur between the gums and cheeks, and Tyson (208) and Symington (202) also have made observations on the cavity of the mouth. Tyson (208) and Gratiolet (131) have made some observations on the salivary glands. Barkow (90) gives a very fine drawing of the stomach and its blood vessels; Bischoff (99), Cavanna (109), Gratiolet (131), Traill (206), and Tyson (208) give descriptions of the stomach; certain points concerning the length and form of the intestine have been recorded by Bischoff (99), Cavanna (109), Chapman (111), Dwight (123), Ehlers (23), Flower (28), Gratiolet (131), Huxley (49*b*), Barkow (90), Symington (202), Traill (206), and Tyson (208), while Embleton (126), Mayer (160), Owen (172, 173), and Vrolik (210) make minor contributions to the same subject. Cunningham (118) gives a very fine figure of a section, showing the topographical relationships of the abdominal viscera. Figures or descriptions of the liver are given by Bischoff (99), Flower (28), Gratiolet (131), Barkow (90), Cavanna (109), Symington (202), Traill (206), and Tyson (208); of the pancreas by Bischoff, Flower, Gratiolet, Cavanna, and Tyson (*opp. cit.*)

The Respiratory System.—The air-sacs of the larynx have got quite an extensive literature of their own, and although their morphology and development may be said to be fairly well known, we are as far from knowing their functional meaning as ever. There have been nearly as many theories regarding their nature as there have been observers. Records of them may be found written by Bischoff (99), Chapman (111), Cunningham (118), Deniker and Boulart (19), Duvernoy (22), Ehlers (23), Mayer (161), Traill (206), Tyson (208), and Vrolik (210). The best work on the structure of the larynx and its muscles has been done by Gratiolet (131) and Mayer (161); but Bischoff (99), Cunningham (118), Ehlers (23), Humphry (142), Barkow (90), Symington (202), Traill (206), Tyson (208), and Vrolik (210) give descriptions of many points worth referring to. The trachea and bronchi have partial records by Aeby (88*a*), Ehlers (23), and Gratiolet (131). The lungs have been examined by Mayer (161), Ehlers (23), Gratiolet (131), Cavanna (109), Traill, Tyson, and Vrolik (*opp. cit.*) The limits of the pleura and its variations have been very accurately described and figured by Ruge (189) and Tanja (203). Cunningham's section (118) shows very well the relationships of the lungs, trachea and larynx.

The Circulatory System.—The heart of the chimpanzee is so similar to that of man, that there is little left to observe or describe. Its position and relationships have been investigated by Ruge (189), and can be well seen in Cunningham's section (118). Bischoff (99),

Dwight (123), Ehlers (23), Gratiolet (131), Cavanna (109), Traill (206), Tyson (208), and Vrolik (210) give some details concerning it. The arch of the aorta and its branches are described or figured by nearly all the above writers, their observations being brought together by Keith (147). The arterial and venous systems have been recorded in a very fragmentary way. Barkow's figures (90) give much better information as to their distribution than any other record; but a good deal concerning the arteries may be obtained from Bischoff (99), Chapman (111), Dwight (123), Ehlers (23), Gratiolet (131), Humphry (142), and Sutton (201). Ruge (189) described the relationships of the pericardium, while Gulliver (135) has made a study of the size of the red blood corpuscles.

The Lymphatic System and Ductless Glands.—There has as yet been no proper investigation of this system. The spleen has scarcely been more than mentioned—Bischoff (99), Gratiolet (131), Symington (202), and Tyson (208). The thyroid has been remarked upon only by Bischoff (99), and Ehlers (23), and, so far as I know, no work has been done upon the lymphatic system or upon the thymus.

The Genito-Urinary System.—The external genitals of young female animals have been figured or described by Bischoff (6, 99), Chapman (111), Gratiolet (131), Hartmann (42), Barkow (90), Hoffmann (141), Symington (202), and Traill (206); the external genitals of the male by Duvernoy (22), Barkow (90), and Tyson (208); Crisp (114) has made observations on the os penis. The external genitals are of surprisingly small development; but it must be kept in mind that they have been studied upon animals, for the greater part, quite immature, or, if adult, upon subjects contracted by long immersion in alcohol. The uterus and internal organs of the female are described by Hoffmann (141), Symington (202), Gratiolet (131), Bischoff (6, 99), and Traill (208). So far as I know, Bolau (23) is the only one who has observed menstruation in the chimpanzee. The prostate, vesiculæ seminales, and bladder are figured by Barkow (90), Tyson (208), and Humphry (142), while in the section given by Cunningham (118) the situation and relationships of the pelvic organs of the male are very well brought out. There has been no good examination of the kidney made, most of the authors already mentioned in this section merely remarking casually upon it.

The Organs of Sense.—The eye of "Mafuca" was examined with some minuteness by Hirschberg (58); Gratiolet (131) and Traill (206) also give some details concerning it. Zuckerkandl (216) has described the turbinate region of the nasal cavities (*see* also references under tongue, p. 12, for the organ of *taste*, and under references 170, 150, and 89, for organs of *touch*).

External Characters, Configuration, and Proportions.—Many contributions to this part of the literature on the chimpanzee have been accompanied by very fine illustrations, such as those with the papers by Beddard (93), Bartlett (91), Nissle (170a), Hermes (139a),

Hartmann (138*a*), Meyer (58), and Geoffroy St. Hilaire (72); in fact, almost every paper is accompanied by a figure, of greater or less merit of the animal dealt with by the numerous observers. The hair is black, often mixed with a slight rufous tinge, and tending to become colourless in the vicinity of the openings of the body, where the skin becomes continuous with the mucous membrane. The hair of the face especially, but also of the other parts of the body, although it has always the same arrangement, varies much in length and shade of colour with the sex, the individual, the age, and probably, also, with the variety. Upon the hair, its arrangement and colour, see Bartlett (91), Beddard (93), Bolau (10), Broderip (105), Deniker (121), Du Chaillu (122, 21), Duvernoy (22), Ehlers (23), Embleton (126), Franquet (30), Fick (127), Friedel (129), Geoffroy St. Hilaire (72), Giglioli (31), Gratiolet (131), Hartmann (43, 139), Issel (144), Lenz (53), Martin (159), Meyer (58), Noack (171), Schlegel (193), Traill (206), and Tyson (208). Pigment appears early in life in patches, which gradually fuse together, until all the skin becomes of a slate or melanoid tint. Remarks concerning the deposition and distribution of the pigment may be picked up from most of the writers cited above, especially from Du Chaillu; but very few of them seem to appreciate the fact that it is more a character of age than an indication of species. Its appearance at an early stage of life may turn out to be a character of only one variety. Meijere (163) has shown that the hairs are grouped together in small colonies. The external configuration of the hands and feet has received a great deal of attention: see Alix (89), Barkow (90), Duvernoy (22), Dwight (123), Embleton (126), Gratiolet (131), Hepburn (46), Kollmann (150), Nissle (170*a*), Tyson (208) and Meyer (58). Figures of the ear are given by Beddard (93), Barkow (90), Du Chaillu (21), Dwight (123), Hartmann (40), and Schmidt (194). Of the four anthropoids, the chimpanzee retains the ear in the most pristine and fully-developed form, having none of the marks of degeneration that characterise the ear of man, gorilla, orang, and gibbon. It varies very considerably with the individual, and on the sides of the same individual; but it is quite probable that it may turn out to be of value in assisting to characterise sub-species, although it can never be of value for absolute diagnosis. Measurements of the limbs and trunk have been given by the following authors: Ehlers (23), Rollet (186*a*), Meyer (58), Slack (73), Wyman (87*b*), Owen (173), Noack (171), Marshall (158), Lucae (54), Issel (144), Broderip (105), Gratiolet (131), Fick (127), Embleton (126), Dwight (123), and Chapman (111).

Psychology.—With the exception of Darwin (120) and Romanes (187), scarcely anyone has attempted to analyse the mental status of the chimpanzee. Mitchell (164) has also made a contribution to the subject, but most of the other references apply to articles containing merely passing notices of the habits and manners of the chimpanzee in confinement. Du Chaillu's (21) and Reichart's (183) observations,

however, were made in the jungle. Broderip (105), Deniker (121), Eismann (124), Fick (127), Friedel (129), Hartmann (43), Hermes (139a), Laborde (152), Martin (159), Nissle (170a), and Sayers (192) made their observation upon animals in confinement.

Pathology.—Nothing is known of the diseases to which the chimpanzee is subject in its native surroundings; in Europe it commonly falls a prey to diseases of the respiratory system. See Owen (172, 173), Schmidt (195), Rollet (186), and Meyer (58).

Distribution.—The chimpanzee occurs over a much wider area than any of the other anthropoids. Noack (171) and Reichart (183) report specimens occurring in the country along the western shores of Lake Tanganika; Schweinfurth (197) and Emin Pasha (125) found it in Niam Niam, and it has been seen in the region lying between Niam Niam and Tanganika. In fact, its distribution may roughly be said to be the areas drained by the Congo and Niger, and it also occurs along the banks of the smaller rivers on the west coast as far north as lat. 16°, and as far south as lat. 14°. See Du Chaillu (21), Franquet (30), Giglioli (31), Hartmann (137, 139), and Issel (144).

Classification.—Mr. Sclater (NATURAL SCIENCE, vol. ix., p. 143, August), has very courteously given his reasons for assigning the generic name of *Anthropopithecus* to the gorilla and chimpanzee. I was aware that Gmelin had given the name and that Fischer had adopted it; also that Flower and Lydekker had accepted it because *Troglodytes* had already been applied to another genus. But there is one very strong reason, it seems to me, why the generic term *Troglodytes* should be retained; it had come to be recognised all the world over as the scientific name of this genus, at any rate, of the chimpanzee. Universality of usage is such a difficult matter to obtain and so absolutely necessary, that it seems to me almost a scientific sin to disturb it once the fixation process has fairly set in. Italian, German, American, French and English anatomists, excepting always those that received their material from the Gardens of the Zoological Society of London, have for the last fifty years used the name *Troglodytes niger* for the ordinary chimpanzee. What I fear most is a state of matters arising in the nomenclature of the anthropoids, such as has already arisen among the names of the macaques, where one cannot with any certainty recognise, from the name, the material with which the author has been dealing. But in ordinary morphological work there is not much danger of any difficulty arising in connection with the nomenclature of a limited group like the anthropoids, because one can always fall back upon the terms gorilla, chimpanzee, orang, and gibbon, names of definite signification for civilised nations.

A great deal of work has been done to show the position of the chimpanzee in relation to the other anthropoids and also its position in descent as regards man. Geoffroy St. Hilaire held the opinion very strongly that the gorilla and chimpanzee should not be included in one genus, but ought to be separated into two well-marked genera,

and this opinion has been accepted in France, while all other countries have followed Savage, Wyman, and Owen, and retained them in one genus. There is no absolute standard of generic value; but this much is certain, that the chimpanzee and gorilla are much more nearly correlated in structure than is either of these to the orang or gibbon, or the gibbon to the orang. (See Huxley, 59*a*, 59*b*; Geoffroy St. Hilaire, 72; Broca, 104*a*; Duvernoy, 22; Hartmann, 139, 43; Gray, 133, 134; and Peters, 180.) [Also Wagner, 258*a*.]

There may be well-marked species, sub-species, or varieties of the chimpanzee, but as yet the material at home and notes of habits from the jungle are totally insufficient for their determination. A very considerable literature has sprung up round the chimpanzee of Central Africa, but as already said, our material and information are not enough to afford us any certain grounds for separating the chimpanzee of this region from that of the West Coast. (See Giglioli, 31; Issel, 144; Hartmann, 138*a*, 139; Peters, 180; and Noack, 171.)

As regards the number of species or well-marked varieties of chimpanzees on the West Coast of Africa, it is a very hard matter to decide in the present state of our information how far characters that have been assigned as of specific value are really so or are only individual peculiarities. Du Chaillu appears to me to be our safest guide in determining this question, and if he is right, and he can hardly have made a mistake, in saying that the voice and cry of *T. Kooloo-Kamba* is perfectly distinct in character from that of the other forms of chimpanzee, then I do not think he could have adduced any other feature or features so indicative of its being a certain and distinct species. Unfortunately he shot only one specimen, and its external configuration, so far as he describes it, agrees well enough with that of *T. niger*. He found it living also in a country inhabited by another form of chimpanzee, Nshiego-Mbouvé (*T. calvus*). Bartlett (91) and Beddard (93) assigned "Sally" to the latter species. Unfortunately, Du Chaillu on his own statement had rarely seen *T. niger* in his travels, his acquaintance with it being almost restricted to a few young specimens in confinement, and he was therefore unaware of the amount of variation that might occur among the members of that species.

In the article on the gorilla, p. 7, I made a very stupid blunder, which I now wish to remedy, and confounded the name *Trogloodytes tschego* of Duvernoy with *Gorilla gina* of Geoffroy St. Hilaire. *T. tschego* is certainly a name applied to a chimpanzee, but the specific characters assigned by Franquet (30), Slack (73), and Duvernoy (22) are, every one of them, variable. The degree of prognathism, the last molar teeth, the pigmentation of the skin, the colour of hair, the external ear, and proportions of limbs to trunk are subject to considerable fluctuation in different individuals. "Mafuca" (170*a*, 58), *T. aubryi* (130), *T. vellerosus* (132) may or may not be representatives of distinct species; probability is all in favour of their being only peculiarly marked individuals of the more common form.

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III. The Orang-Outang.¹

MATERIAL for the study of the orang has always been more plentiful than that for the study of the chimpanzee or gorilla. Consequently the literature on this animal is the more extensive, and founded upon a wider basis of observation. Some idea of the amount of material may be obtained from the fact that within the last fifty years about seven hundred skulls have been collected for purposes of exhibition and study in museums. Skeletons and stuffed specimens are not so plentiful as skulls, but yet common enough, especially in museums, such as those of Holland and India. Living animals, too, are not unfamiliar exhibits in Europe. In the zoological garden of Rotterdam there have been twenty specimens in the last forty years, and about an equal number in the gardens at London. In captivity they do not, as a rule, live long, five years, perhaps, being the longest, and two months being the average length of life (Schmidt, 274a). The supply of animals has been fairly abundant, yet descriptions of the soft parts of their anatomy are very few. Perhaps the most complete are those added quite recently by Milne Edwards (258), with the assistance of colleagues, and by Fick (235), although valuable contributions to the general anatomy of the animal had previously been made by Sandifort (271), Beddard (93), and Chapman (229). The four animals dissected by Milne Edwards and Fick were full grown and the first mature adults seen in confinement in Europe. Much that is known of the anatomy of the orang is included incidentally in descriptions of the anatomy of other animals—see Vrolik (210), Giglioli (31), and Bischoff (293).

The Nervous System.—As far as I am aware, the nerves of the head and trunk have never been investigated, but, on the other hand, the nerves of the extremities have been well described by Westling (287), Hoefer (140), Kollmann (150), Hepburn (45), and slightly by Fick (235, 127). The lumbar plexus has been figured by Utschneider (209), Jhering (143), and Westling (287). No description has been given of the visceral nerves. The microscopic structure and minute anatomy of the centres and tracts of the cerebro-spinal axis remain

¹ Temminck gives *Orang-Outan* as the correct spelling; Sal. Müller, who was familiar with the Malay language, rendered it *Orang-Oetan*, but *Orang-Outang* is the form in most common use. [See, however, Dr. A. B. Meyer's letter at the end of this chapter, p. 40.]

untouched. It is quite different as regards the surface anatomy of the brain. The fissures, lobes, sulci, and convolutions of brains of individual orangs have been described and figured by Bischoff (222), Chapman (229), Fick (235, 127), Rolleston (266), Sandifort (271), Schroeder and Vrolik (275, 196), Tiedemann (281), and Barkow (90). The surface anatomy of the brain has been treated in a more general way, and from a greater number of specimens, by Cunningham (115, 116), Benham (94), Bischoff (221), Gratiolet (130a), Huxley (49b), Kükenthal and Ziehen (151), Pansch (176), and Eberstaller (298a). The Island of Reil and the third frontal convolution have been specially studied by Cunningham (115, 116, 117), Hervé (48), Marchand (157), and Rüdinger (188a). As to the relative development of the lobes to each other, the relationship of the cerebellum to the cerebrum, and of both to the cranial walls, one may consult Cunningham (118), Féré (234), Flower (237), Schroeder and Vrolik (196, 275), Hamy (136), and Rolleston (266). Beever and Horsley (220) have investigated the motor areas of the cortex, and Hitzig (246a) has made some observations respecting the morphology of these areas. The weights of the several parts of the brain have been estimated by Moeller (166), and Keith (146) has dealt with the brain weight as a whole.

The Muscular System.—There is not to be found anywhere in literature one complete account of the muscular system of the orang. The fullest descriptions are those given by Beddard (92), Chapman (229), Church (231), Fick (235, 127), Huxley (49b), Owen (263, 261), Vrolik (210), and Sandifort (271). A great deal can be ascertained from drawings given by Cuvier (231a) and Barkow (90), and something from the writings of Camper (228), Mayer (160), and Westling (287). The muscles of the extremities have received most attention, having been fully described by Hepburn (45), Langer (252), and Barnard (219). Quite a number of anatomists have paid attention to certain muscles or groups of muscles: Lartschneider (152a) to the muscles of the pelvis; Ruge (70), Bischoff (7), and Rex (67a) to the muscles of the face; Bischoff (100) to the extensor indicis and flexor pollicis muscles; St. John Brooks (106, 107) to the short flexor muscles of the thumb and little finger; Keith (148) to the rectus abdominis thoracicus and flexor profundus digitorum; Ruge (190, 268, 269) to the rectus abdominis, muscles of the planta and extensors of the toes; Koerner (251) and Mayer (161) to the muscles of the larynx; Ottley (260a) to the muscles of the eye; Westling (287) to the muscles of the tongue and pharynx; Seydel (198, 199) to the serrati muscles of the back. Langer (252) and Fick (235) record the weights of most of the limb muscles, a labour which seems well worth the extra trouble, as weight is far the best index of degree of function. By adding together these various accounts, one may obtain a fairly complete picture of the muscular system of an orang. The involuntary muscles still require investigation.

Ligaments and Joints.—Very little attention has been given to the ligamentous or articular structures of the orang. Fick (235) gives many details concerning the articulations; Aeby (88) and Thomson (204) of the ankle joint and foot; Hartmann (39) of the hip joint, while Keith (250) gives a description of many of the ligamentous structures.

The Skull.—In the examination of a large collection of orang skulls, such as is available in London through the courtesy of the curators of the leading museums (British Museum (Natural History), Royal College of Surgeons, and Royal College of Science), including over eighty skulls, one is struck by the amount of variation they exhibit. This great diversity of form is due, for the most part, to the fact that at no time of life does the orang's skull cease from growing and changing, altering nearly as much in old age as in youth; but it is also due to the fact that there is a great amount of individual variation. It is owing, in a lesser degree, to the fact that skulls are impressed to a variable extent with sexual characters. It is commonly quite easy to tell the skull of an adult female from that of a male, but at times this is hardly possible, the skull of the female having assumed characters commonly found in the male or *vice versa*. It is worthy of remark, however, that skulls coming from the same locality have a striking similarity of form, even to the minutest features. These observations will help to explain the vast literature that has arisen around the skull of the orang. The wide fluctuation in form and size was thought to be due to there being several species of orang, and an immense amount of labour was expended upon skulls to discover the cranial characters of each species by Blyth (224), Brühl (227), Fitzinger (236), Temminck (280), Schlegel and Müller (272), Giglioli (31), Lucae (252a), Wagner (285a), and many others. There can be no doubt that the crania in the Natural History Museum at South Kensington, assigned by Owen (262) and Wallace (284) to *Simia morio*, are the skulls of scarcely mature individuals, and all the characters assigned to them as specific are those which distinguish the skulls of young from fully adult animals. Lucas (253), on the other hand, concluded that the cranial characters of *Simia wurmbii*, Fischer, were simply marks of old age, a conclusion with which I agree. What is really wanted at present more than aught else is a thorough examination of a wide series of skulls, perhaps three hundred might be sufficient, including all ages, and a final determination of the characters due to age and sex changes, and those due really to individual irregularity. Selenka (277) appears to possess ample material for such an enterprise, but as yet he has only published a very brief review of his collection. Age changes so far have been noted by Dumortier (232, 233), Heusinger (246), Mayer (257), Temminck (280), and Lucas (253), who had at his disposal the large collection brought home by Hornaday (247) from Borneo. The generic characters, which distinguish the skull of the orang from that

of the gorilla or chimpanzee, have been dealt with by a very great number of writers—Bischoff (3), Brühl (227), Duvernoy (22), Huxley (49*b*), Geoffroy St. Hilaire (72), Owen (264, 175), and Hartmann (40). Figures or descriptions of one or more skulls are given by Abel (217), Barkow (90), Bolau (10), Anderson (218), Camper (228), Fick (235), Giebel (241), Hervé (245), Mayer (160), Meyer (58), and Schlegel (193). Concerning the craniology of the orang skull Bischoff (8) and Delisle (258) may be consulted. Certain special points of structure have been studied: the nasal bones by Chudzinski (113), Maggi (255), Mayer (257); the nasal cavities by Seydel (178) and Zuckerkandl (216); the anterior nasal spine by Hamy (35); the sutures of the premaxilla by Maggi (254); the posterior palatine spine by Waldeyer (211); the lachrymo-ethmoidal suture by Regnault (182); the orbito-maxillary-frontal suture by Thomson (205); the cranial capacity by Selenka (277) and Keith (146).

The Skeleton.—There has been no investigation made of a collection of skeletons, most descriptions being of a general nature only, and drawn from a single specimen—see Blainville (223), Owen (264, 175), Huxley (49*b*), Mivart (61*a*, 259), Hervé (245), Duvernoy (22), Vrolik (210), and Hartmann (43). Some information of value may be picked from the accounts or figures of Trinchese (283), Temminck (280), Schlegel (193), Meyer (58), Fick (235, 127), Camper (228), Bolau (10), Blyth (224), and Barkow (90). Certain parts have been specially studied, such as the sacrum by Broca (104) and Paterson (179); the vertebral column by Cunningham (118); the bones of the hands and feet by Lucae (54), Hartmann (138), Lazarus (153), Rosenberg (187*a*), Kehrer (249), Thomson (204), and Trinchese (283); the manubrium sterni by Keith (149). Measurements of the limb bones have been given especially by Rollet (186*a*), Delisle (258), and Temminck (280).

The Teeth.—Topinard's (82) description of the molar and premolar teeth is the most complete given as yet, but the general treatises of Owen, Huxley, Tomes, and the more particular descriptions of Magitot (56, 57), Giebel (240), and Duvernoy (22) are well worthy of reference. Abel (217), Barkow (90), and Fick (127) add minor accounts. No investigation has so far been made of the development of the teeth, but recently Selenka (277) has contributed some valuable data concerning the order of eruption of the dental series. Orangs' teeth are much subject to variation. A form of macrodontia, sometimes almost pathological, is common. Irregular and supernumerary teeth are of frequent occurrence—see Selenka (277), Bateson (91), Brühl (227), Lucas (253), Maggi (256), and Schmidt (195).

The Alimentary System.—The literature on this system is brief and incomplete. The arrangement of papillæ and the structure of the tongue have been subjects of investigation by Fick (235, 127), Mayer (162), Deniker and Boulart (258), Sandifort (271), and Westling (287). The rugæ of the hard palate are figured by Beddard (92) and Gegen-

baur (238). Brief and general descriptions of the alimentary tract are contributed by Chapman (229), Flower (28), Huxley (49*b*), Mayer (160), Owen (261), Camper (228), Sandifort (271), and Barkow (90). Wittmann (288) gives very exact figures, showing the arrangement and distribution of the blood-vessels of the stomach and bowel. Figures or descriptions of the liver are given by Barkow, Chapman, Flower, Camper, and Sandifort (*opp. citt.*), and Fick (235). Chapman also describes the arrangement of the peritoneum.

The Respiratory System.—The laryngeal sacs have frequently been subjected to examination, the result being to show that although at first there are two sacs, one from each ventricle, they may ultimately become one by the absorption of the separating wall—*see* Fick (235, 127), Deniker and Boulart (19, 258), Sandifort (271), Camper (228), Mayer (161), and Chapman (229). Descriptions of the larynx may be found in Koerner (251), Mayer (161), Sandifort (271), Camper (228), Westling (287), Cunningham (118), and Fick (235). Aeby (88*a*) and Chudzinski (230) have given descriptions of the lungs, while nearly all the writers cited in this section have made some observations upon the pulmonary apparatus. Ruge (189) and Tanja (203) have mapped out the limits of the pleural cavity.

The Circulatory System.—The only observations upon the form and size of the heart are those of Sandifort (271), Fick (235), and Chapman (228). The arteries and veins have been done in part only. Barkow (90) gives figures of the circle of Willis and of many vessels of the extremities. Popowsky (265) has described the arteries of the lower extremities; Wittmann (288) the vessels of the alimentary tract; Keith (147) the arrangement of the arterial trunks from the aortic arch; Fick (235), Westling (287), Camper (228), and Sandifort (271) record some observations on the arterial system. Gulliver (135) gives measurements of the red blood corpuscles, and Ruge (189) describes the position of the heart.

The Genito-Urinary System.—The best description of the male genital organs is given by Pousargues (258), less full accounts being those of Sandifort (271), Barkow (90), Chapman (229), Fick (127, 235), Mayer (160), Camper (228), and Crisp (114). Trinchesi (283), Bischoff (6), Camper and Barkow (*opp. citt.*) describe very briefly the genitals of the female. Slight references to the urinary organs may be found in Sandifort (271), Huxley (49*b*), Chapman (229), and Barkow (90).

Psychology.—The motor centres have been localised by Beevor and Horsley (220). The habits of the orang have been studied in the jungle by Wallace (285), Müller (272), Hornaday (247, 248), St. John (270), Mohnike (260), and Wenckstern (286); in captivity by Darwin (120), Bolau (225), Deniker (121), Fick (127, 235), Delisle (231*b*), Friedel (129), Hermes (139*a*), Martin (159), Reuvers (184), Grant (242), Camper (228), Brehm (225*a*), and Sclater (276*a*).

Organs of Sense.—The circumvallate papillæ have been

examined by Mayer (162); the olfactory organ by Zuckerkandl (216), and the touch papillæ of the hands and feet by Kollmann (150).

External Characters, Configuration, and Measurements.—

There are quite a large number of very fine drawings of the orang, such as those of Fick (235), Milne Edwards (258), Hermes (244), Beddard (93), Schlegel and Müller (272), and a photograph of a fœtus by Trinchese (283). Among those that have given particular attention to the characters of the hands and feet are, Abel (217), Alix (89), Barkow (90), Beddard (93), Fick (235), Harwood (243), Hepburn (46), Kollmann (150), Lucae (54), Trinchese (283), Temminck (280), and Camper (228). The curious cheek-pads that stand out as stiff flaps from the cheeks of some orangs have been specially dealt with by Fick (235), Deniker and Boulart (258), Temminck (280), Brooke (226), Selenka (277), and Möbius (259a). Numerous other writers give the cheek-pads a passing notice, but even yet their use, constancy, and significance are unknown. The hair, its colour and arrangement, has been described by most of the observers just cited, and to make the list more complete one must add Bolau (225), Chapman (229), Delisle (231b), Deniker (121), Fitzinger (236), Friedel (129), Hartmann (40, 43), Geoffroy St. Hilaire (239), Hornaday (247, 248), Meyer (58), Martin (159), Meijere (163), Reuvens (184), Schlegel (193), Wallace (284, 285), Grant (142), Möbius (259a), and Wenckstern (286). The peculiar arrangement of the hair is due to the fact, that when the animal lies on its side, as it does in sleep, the hair acts the part of a natural thatch. The external ear, which is in a more degenerate condition than the ear of any other primate, man included, has been described or figured by Schwalbe (275a), Barkow (90), Beddard (93), and Trinchese (283). Most of the authors I have cited in this section give measurements of the length of limbs and trunk, but Rollet (186a), Wallace (284, 285), and Blyth (224) enter most fully into this matter.

Distribution.—The orang, as is well known, is confined to the islands of Borneo and Sumatra, and to certain parts only of these islands. Its distribution is limited to the swampy mangrove forests along the coast, especially along the estuaries of rivers. It is most abundant in Borneo. Its exact distribution in that island has never been worked out, but the great majority of specimens come from the south-west corner, especially along the Kapuas River—see Selenka (277), Wallace (284, 285), Brooke (226), Hartmann (43), Hornaday (247), Mohnike (260), Schlegel and Müller (272), Rosenberg (267), and Trinchese (283). The orang is a much rarer animal in Sumatra, few specimens ever coming from there, and is confined chiefly to the north end of the island. Our information, however, is limited, what we have being due to Abel (217), Rosenberg (267), Veth (279), Wenckstern (286), and Schlegel and Müller (272).

Pathology.—Owen (261, 263) records the lesions found in two animals; Rollet (186) and Topinard (282) found cases of bone disease;

Schmidt (195) deals with their diseases in captivity. Of two young animals that I kept in captivity while in Siam, one died of ulcer of the stomach, the other of pneumonia, both lesions being exactly of the type found in corresponding human diseases. The subcutaneous tissue of these two animals contained a large number of thread-worms belonging to several species.

Classification.—It cannot be said even yet that the question as to the number of orang species is finally settled, but all the evidence at our disposal leads to the conclusion that there is but one species. This has been the opinion of Dutch naturalists all along. The great amount of structural variation—in the shape of the skull, presence or absence of temporal crests, of cheek-pads, or of great toe-nails, in the form of the teeth or colour of the hair, which was by some regarded as indicating a difference of species, is now generally looked upon as due to individual age or sex peculiarities. Brooke (226), Owen (262, 264), Blyth (224), and Wallace (284, 285) distinguished several species, but as pointed out in the section on the cranium, the specific differences were really age characters. Selenka (277), who more than anyone has had the advantage of studying abundance of material as well as the animal in its native haunts, regards the orang as forming one species, but distinguishes six local varieties in Borneo and two in Sumatra. From the characters he assigns to these, however, it may be doubted if these varieties could be distinguished from each other with any certainty. Lucas (253), who studied the material brought home by Hornaday, came to the conclusion there was but one species, and Temminck (280), Schlegel (193), Schlegel and Müller (273), Milne Edwards (258), Beddard (93), Brühl (227), Dumortier (232, 233), and Lucae (252) were of a similar opinion. Giglioli (31) distinguishes two species of Bornean orang, Fitzinger (236) distinguished four, while Gray (134) gives a full list of the species, with their characters, enumerated in his time. It is generally held that no line of demarcation can be drawn between the orang of Borneo and that of Sumatra, but our knowledge of the Sumatran animal is extremely scanty. I was able to find in London only five skulls of the Sumatran orang, and, working over these very minutely, could find no mark to distinguish them from Bornean skulls. Still, a further study of the anatomy of the whole animal might reveal permanent points of difference. Our knowledge of the Sumatran orang is due principally to Abel (217), Möbius (259*a*), Snelleman (279), Schlegel and Müller (273), and Wenckstern (286), who distinguishes two kinds of Sumatran orangs.

There is a concurrence of opinion in regarding the orang as much more closely allied to the gorilla and chimpanzee, than to the gibbon on the one hand or to man on the other. Meyer even proposed to place the three in one genus. There has been a great deal written upon the affinities of this genus, principally by Broca (104*a*), Duvernoy (22), Geoffroy St. Hilaire (239), Owen (264, 175), Huxley (49*b*), Mivart (61*a*), and Hartmann (138, 43).

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ORANG-OUTANG OR ORANG-OUTAN.

DR. ARTHUR KEITH remarks in his valuable paper on Anthropoid Apes, vol. ix., p. 316, note, "Temminck gives Orang-Outan as the correct spelling; Sal. Müller, who was familiar with the Malay language, rendered it Orang-Oetan, but Orang-Outang is the form in most common use." If Orang-Outang really is the form still in most common use, it only proves how difficult it is to remove an inaccuracy which has once crept into literature. *Orang utan* means "man of the forest," *Orang utang* would mean "a man who has debts." As far back as 1877 (*Mitth. Zool. Mus.*, II., p. 225, note) I showed this to be the case, and, more recently (*Abh. Mus. Dresden*, 1894-5, No. 14, p. 6, note) I recurred to the question with the following words, which I beg permission to quote translated: "With what difficulty even small faults get out of books, is proved by the spelling of the word Orang utan. Mostly one still finds Orang utang, though Müller and Schlegel so early as the year 1840 drew attention to the falseness of this spelling (*Verh. Nat. gesch. overz. bez.*, p. 11); later, in 1866, Gratiolet and Alix censured it (*N. Arch. Mus. Paris*, II., p. 4, note 1). In 1877 I remarked thereon (*l.c.*), and recently Jentink recurred to the incorrect 'g' (*Notes Leyden Mus.*, 1895, p. 17, note)." "Oe" in outan is the Dutch spelling; "ou," the English and French; and "u," the German, according to the pronunciation of the respective languages.

R. Zoological Museum, Dresden,
9 Dec., 1896.

A. B. MEYER.

IV. The Gibbon.

THE greater part of the literature on the gibbon is devoted to a consideration of its specific and generic characters. Our knowledge of its anatomy is based upon a very small amount of material. Until five years ago, when Kohlbrügge published dissections of four specimens, our information was confined to incomplete descriptions of the anatomy of five animals. The paucity of research upon this animal, which, for many reasons, is the most interesting of the anthropoids, is not due to lack of material, for within a recent period there have been thirty-five specimens, belonging to various species, in the Zoological Gardens at London. After their arrival in Europe, they are soon at the disposal of the dissector, for unfortunately they do not live long in confinement, few of them more than a year. Of three gibbons that were in the Rotterdam gardens, two lived for about a month, the other died after a sojourn of eight days.

The Nervous System.—The brain of the gibbon is comparatively small and simple, resembling in its form and topography much more the brains of cynomorphous monkeys than those of the three great anthropoids. Recently it has received a great deal of attention. Kohlbrügge had at his disposal the brains of twelve specimens (eight of *Hylobates syndactylus*, two of *H. leuciscus*, one of *H. lar*, and one of *H. agilis*), but his observations refer mostly to weight and measurement, and only slightly to the convolutions and fissures. Waldeyer (326, 327) has given a very full account of the fissures and sulci of three brains (*H. syndactylus*, *H. leuciscus*, and *H. lar*), with accompanying figures. The figures which Bischoff (293) gives of the brain of *H. leuciscus* are extremely good. Deniker (17) has given a clear account, accompanied with figures, of the brain of a foetus of about full time. Figures of the brain of *H. syndactylus* are given by Sandifort (271). Kükenthal and Ziehen describe the fissures of the brains of *H. hoolock*, *H. lar*, and *H. leucogenys*, Ziehen of *H. muelleri*, and other references to the surface anatomy of the brain will be found in papers by Broca (103), Hervé (48), and Eberstaller (298a). Flower (301) and Cunningham (118) have examined the relationship of the cerebrum to the cerebellum, and of these to the skull-wall. The brain-weight and ratio has been estimated by Keith (146). The nerves have received a con-

siderable amount of attention, those of the limbs from Hepburn (45), Kohlbrügge (313), and Ruge (316), while the two anatomists named last, Jhering (143), and Utschneider (209) have described the arrangement of the trunk plexuses. From the above list it will be noticed that there is a complete absence of any inquiry into the more minute anatomy of the nervous system.

The Muscular System.—Kohlbrügge (313) and Deniker (17) have given very complete descriptions of the muscles—in fact, the most complete accounts we have of the muscular system of any of the anthropoids. Bischoff (293) also investigated this system in detail, while Hepburn's (45) account refers to the muscles of the limbs only. The muscles of the face and of the trunk have been very exactly described and figured by Ruge (70, 190, 316). Other facts may be gleaned from the dissections of Sandifort (271) and Vrolik (210). There are a number of special papers, mostly dealing with muscles of the toes or fingers, by Bischoff (100), St. John Brooks (106, 107), Schulze (318), Testut (321a), and Keith (148, 311a).

The Joints and Ligaments.—The ligamentous structures have been described, but not very fully, by Deniker (17), Kohlbrügge (313), and Keith (250).

The Skull.—Most of the literature on the skull of the gibbon is of a general and unsatisfactory nature. No attempt has been made, upon a sufficiency of material, to determine either the specific or generic cranial characters. It is true that Giebel (305) and Anderson (291) pointed out certain features of the skull which they thought characteristic of certain species, but they had too few skulls at hand to draw conclusions with any degree of security. In a collection of gibbon skulls, the only one which is distinguished from the rest with facility is that of the Siamang (*H. syndactylus*); all the others, with perhaps the exception of that of *H. agilis*, being recognisable from each other only by their labels. It is possible that an examination of a much larger collection than thirty-five skulls, which is the number I had for study, might lead to more positive conclusions, but as yet there is not material enough collected for such an investigation. Descriptions of the cranial characters may be found in Duvernoy (22), Bischoff (293), Fry (302), Schlegel (193), Huxley (49b), and in most text-books or general works on mammalian osteology. There are some papers dealing with special features, such as those of Albrecht (290) and Morselli (169) with the vermian fossa; of Gegenbaur (303) with the lachrymal bone; of Hamy (35) with the anterior nasal spine; of Regnault (182) with the sutures surrounding that bone; of Seydel (278) with the nasal cavities; of Keith (311a) with the temporal ridges; and of Waldeyer (211) with the posterior palatal spine.

The Skeleton.—Descriptions of the skeletal characters are given by Blainville (223), Duvernoy (22), Bischoff (293), Meyer (58), Mivart (61, 61a), Fry (302), Schlegel (193), and Vrolik (210). For observations on the bones of the hand and foot, one may consult Lucae (54),

Rosenberg (187a), Lazarus (153), Kohlbrügge (313), and Deniker (17); regarding the vertebral column, Cunningham (118) and Kohlbrügge (313); for the sacrum, Broca (104) and Paterson (179); as to the sternum and ribs, Ruge (316) and Keith (149).

The Teeth.—The general characters of the teeth have been described by Owen, Huxley, and Tomes, and more minutely by Topinard (82), Magitot (56, 57), and Giebel (240, 305); Kohlbrügge (313) and Duvernoy (22) have also made passing observations concerning them. Bateson (92) and Lessona (314) have dealt with the anomalies of the dental series. No one, with perhaps the exception of Giebel, has worked out in any detail the dental characters of the species; but, speaking from my own experience, only the teeth of *H. syndactylus* present features at all distinctive, but, as I had occasion to remark when dealing with the skull, the material to which I had access was too small to allow of a positive statement being made.

The Alimentary System.—The alimentary tract has been examined from end to end by Deniker (17) and Kohlbrügge (313). Smaller and more general communications have been made by Bennet (292), Bischoff (293), Flower (28), Hunter (310), Yarrel (329), and Keith (311a). All, with the exception of the two last-named, have given descriptions of the liver. [See also Huxley, 49b.]

The Respiratory System.—Deniker (17) and Kohlbrügge (313) give full descriptions of this system. Only the Siamang possesses air-sacs prolonged from the ventricles of the larynx—see Sandifort (271), Bennet (292), and Kohlbrügge (313). The last-named and Eschricht (299) give full descriptions of the muscles of the larynx. Some details concerning this system may be obtained from the writings of Bischoff (293), Hunter (310), Sandifort (271), and Duvernoy (22). Ruge (189) has investigated the relationships of the pleural and pericardial cavities to the chest-wall.

The Circulatory System.—It is much to be regretted that only very incomplete descriptions of the arterial and venous systems have been published. Deniker's (17) is the best, but a good deal may be learned from the accounts of Bischoff (293), Kohlbrügge (313), and Hunter (310). Keith (147, 311) has pointed out the arrangement of the trunks of the aortic arch and abnormalities of the inferior vena cava. The dimensions of red blood-corpuscles are given by Gulliver (135), and the position of the heart by Ruge (189).

The Ductless Glands.—The thyroid, thymus, and spleen are described by Deniker (17), and Kohlbrügge (313). Keith (311a) observed that the spleen did not become enlarged even in gibbons inhabiting very malarious districts.

The Genito-Urinary System.—Harlan (307) described a specimen which, according to him, was one of those extreme mammalian rarities, a true hermaphrodite possessing both ovaries and testicles. No microscopic examination of these organs was made, the testicles having been taken away in the removal of the skin. The greater part

of his description of the genital organs agrees with the parts of a normal female. Both the male and female organs of the gibbon are somewhat peculiar, and no good description has yet been given of them. Bischoff (6, 293) and Deniker (17) give descriptions of the female; and Hunter (310) and Kohlbrügge (313) of both male and female organs. Harlan (307) observed regular menstruation in the female, but I have never observed a uterine discharge in animals shot in the jungle. Deniker (17) and Kohlbrügge (313) are the only writers that describe the urinary apparatus.

Psychology.—The gibbon is extremely difficult to get under observation in the jungle, owing to its timidity and wildness. Jungle notes refer only to its curious vocalisation and agile method of locomotion—see Theobald (314a), Blanford (294), Anderson (291), Tickell (323), Müller (272), and Mohnike (260). Observations of its habits in captivity have been made by Darwin (120), Bennet (292), Hermes (139a), Klein (312), and Schmidt (317).

Organs of Sense.—The arrangement of the touch-papillæ on the hands and feet has been described by Kollmann (150), and the organs of smell by Zuckerkandl (216).

External Characters.—The young of a great number, if not all species of gibbon, are born with hair of a fulvous or greyish tint, as are also the young of *Semnopithecus*, monkeys with which gibbons have structurally much in common. Between their third and fifth years, however, the fulvous or grey hair of the young gibbon is replaced by hair of a lighter colour—a dun, light or dark brown, or even black, although many individuals retain the hair of youth throughout life; so that in nearly all species of gibbon, the hair varies in different specimens from a light fulvous colour to black. A curious feature is the tendency of white hair to appear in a ring round the face and on the backs of the hands and feet. In *H. lar*, *H. pileatus*, and *H. agilis*, the white circumfacial ring is complete; in *H. leuciscus* and *H. muelleri* approximately complete; in *H. hoolock* it is represented only by a supraorbital band; and in *H. leucogenys* by an inframarginal stripe; while in *H. syndactylus* and *H. hainanus* it is quite absent. Good figures, showing well the external characters of *H. lar*, *H. hoolock*, and *H. leucogenys*, are given in the *Proceedings* of the Zoological Society of London (319, 319a). Hermes (139a) also gives a very good drawing of *H. lar*, and Bischoff (293) a photogravure of a young specimen of *H. leuciscus*. Bennet (292) and Horsfield (309) give descriptions of *H. syndactylus*, and most of the authors mentioned in the section dealing with classification have entered into this subject. The lines on the hands and feet have been depicted by Hepburn (46) and Alix (89); the tufted arrangement of the hair by Meijere (163); the external ear by Keith (311a). Measurements are given by Duvernoy (22), Lucae (54), Meyer (58), Hermes (139a), Tickell (323), Schmidt (317), Deniker (17), Cunningham (118), and Bischoff (293).

Distribution.—The areas occupied by the several species of

gibbons have not been defined with any degree of exactitude. The genus is restricted to Further India and the Malay Archipelago. The N.W. corner of this region, Assam and the region to the west of the Irawadi, reaching right up to the base of the Eastern Himalayas, is occupied by *H. hoolock*—Anderson (291), Blyth (295, 296), Blanford (294), and Theobald (314a). Next to it, occupying the greater part of Burmah and stretching southwards in the Malay Peninsula to an uncertain extent, is found *H. lar*—see the authorities quoted above, Tickell (323) and Cantor (297). It is the only species found in the Siamese province of Bangtaphan at the base of the Malay Peninsula, where the writer has shot and dissected six specimens. To the South of the Malay Peninsula, *H. agilis* is said to occur (Cantor). *H. leucogenys* occurs in Siam (Sclater, 319a) probably in the Menam valley; at any rate, the writer never saw it in either the provinces to the S.E. or to the S.W. of that country. In the S.W. provinces of Siam, and in Cambodia, occurs *H. pileatus*, Gray (306), but how far northwards it extends is not known; Swinhoe (320) reports the occurrence of a gibbon in China south of the Yangtze. *H. hainanus* (Thomas, 322) occurs in the island of Hainan. In Borneo two species occur, *H. muelleri* and *H. leuciscus*, Everett (300), Müller (272), Thomas (322a); in Java, *H. leuciscus*, and in Sumatra, *H. agilis* and *H. syndactylus*, which latter is also said to occur on the Malay Peninsula, but this is very doubtful. Besides the authorities quoted above, Geoffroy St. Hilaire (304), Rosenberg (267), Trouessart (324), Hartmann (43), and Mohnike (260) may be profitably consulted.

Classification.—There are three questions pertaining to the classification of gibbons that wait an answer. The first is: What is their position among the primates? The second: Should the Siamang (*H. syndactylus*) be separated from the genus *Hylobates*? And the third: How many species are there?

As to the position of the gibbons in the series of primates, there is a tendency at present, with which the writer is in sympathy, to remove the gibbons altogether from the company of the anthropoids and place them in a position intermediate between the great apes and the cynomorphous monkeys—Kohlbrügge (313), Ruge (316), and Vrolik (325). They are really cynomorphous monkeys adapted to locomotion in an upright posture. In the prevailing systems of classification, of which there are too many to make mention, the gibbon is arranged with the great anthropoids in a family commonly called Simiidae or Anthropomorpha—Huxley (49a, 49b), Geoffroy St. Hilaire (304), Duvernoy (22), Flower and Lydekker (301a), and Broca (104a).

As to the position of the Siamang, Gray seems to me to have made a move in the right direction in placing it in a separate genus—*Siamanga*, including it with the common gibbon—*Hylobates*—in the tribe Hylobatina. Its skull, teeth, and laryngeal sacs are strongly

marked characters. Its nerves, arteries, muscles, brain, and viscera have, when only one animal is examined, nothing very peculiar about them; but when a larger number is examined, the sum of the Siamang's variations will be found to be strikingly different from those of ordinary gibbons.

There is still much doubt as to the number of species of gibbon. An extraordinary number of species has been named, and the list of synonyms is appalling—see Gray (134), Anderson (291), Blyth (295), Cantor (297), and Blanford (294). Some writers have been inclined to regard many, if not all, of the named species, excepting the Siamang, as mere varieties of one species—Gray (134), Kohlbrügge (313), and Schlegel (193). But there can be no doubt that all the species named in the paragraph on distribution are quite as well marked anatomically as the received species of *Semnopithecus* or *Cerco-pithecus*. Dahlbom (298) was in error in ascribing to species distinctive marks on the clavicles. It is true, as I have observed for myself in the dissection of six specimens of *H. lar* and three of *H. pileatus*, that it is impossible to draw an anatomical distinction between these species, but the series dissected is too small to allow of a final conclusion being drawn. Whether the species maintain their individuality through geographical segregation, or whether, if they were to meet and mix, sexual and social instincts would still maintain the present arrangement of species, are matters upon which no information has as yet been given. But the fact that certain of these species (*H. lar*, *H. pileatus*, and *H. hoolock*), if not all, have voices which can be distinguished, tends to show there is a physiological differentiation, and the colour markings are very constant. Gray (134) and Schlegel (193) give the most useful information regarding the number of species and the specific characters, and to bring these lists up to date I need but mention the more recent contributions on *H. hainanus*, Thomas (322), *H. leucogenys*, Sclater (319a), *H. entelloides*, Wunderlich (328), *H. leuciscus* (probably *lar*), Schmidt (317), and *H. concolor*, Everett (300).

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