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THE COLLECTED

SCIENTIFIC PAPERS

OF THE LATE

WILLIAM ALEXANDER FORBES, M.A.,

FELLOW OF ST. JOHN'S COLLEGE, CAMBRIDGE; LECTURER ON COMPARATIVE ANATOMY AT CHARING CROSS HOSPITAL; PROSECTOR TO THE ZOOLOGICAL SOCIETY OF LONDON.

EDITED

BY

F. E. BEDDARD, M.A.,

PROSECTOR TO THE ZOOLOGICAL SOCIETY OF LONDON.

WITH A PREFACE

BY

P. L. SCLATER, M.A., Ph.D., F.R.S.,

SECRETARY TO THE ZOOLOGICAL SOCIETY OF LONDON.

UNIV. OF CALIFORNIA

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PAGE

PREFACE v

LIST OF SUBSCRIBERS ix

TABLE OF CONTENTS xi

LIST OF PLATES xv

SCIENTIFIC PAPERS 1

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H.H. Johnston

PREFACE.

William Alexander Forbes, Fellow of St. John's College, Cambridge, Prosector to the Zoological Society of London, and Lecturer on Comparative Anatomy at Charing Cross Hospital, was born at Cheltenham on June 24, 1855, the second son of Mr. J. S. Forbes, the well-known Railway Director. He was educated at Kensington School and Winchester College, which he entered at the early age of eleven. On leaving Winchester in 1872 Forbes passed a year at Aix-la-Chapelle, studying German, and then became a student of the University of Edinburgh, where he pursued the regular medical course, paying special attention to Zoology and Botany, and commencing collections of insects and plants. In 1875 Forbes transferred his residence to London, and entered himself as a student of University College, with the idea of taking a medical degree in the metropolis. Here he quickly became intimate with other zoologists, who were very soon attracted by the astounding general knowledge of zoology and the acute intelligence of one so young. By the advice of the late Prof. Garrod and other friends Mr. Forbes was induced, in October 1876, to leave London and to enter as an undergraduate at St. John's College, Cambridge, where he was subsequently elected Scholar, and took his B.A. degree with a First Class in the Natural Sciences Tripos in 1879. The post of Prosector to the Zoological Society of London having become vacant in October 1879, by the lamented death of Prof. Garrod, Forbes was appointed (*omnium consensu*) to that office in the January following: indeed Garrod on his death-bed had designated him as his most obvious and proper successor, and appointed him his literary executor.

Forbes entered upon the duties of his office with characteristic energy; and during the three following sessions of the Zoological Society brought before the scientific meetings a series of most interesting and valuable communications, mainly derived from his studies of the animals that came under his examination. He had a happy knack of presenting abstruse points of anatomy in an easily comprehensible form, and especially directed himself to the investigation of the muscular structure and voice-organs of birds, in continuation of the researches of his predecessor Garrod on the same subjects.

In the summer of 1880 Forbes made a short excursion to the province of Pernambuco, Brazil, of which he published an account in 'The Ibis' for 1881; and in the following year passed his holiday in the United States, in order to make the acquaintance of his American brethren in science and their collections. In July 1882 he left England on what promised to be a splendid opportunity of visiting the eastern tropics with every advantage and without risk. Detained at Shonga (a station some 400 miles up the Niger, below Rabba) by the breaking-down of his communications, Forbes fell a victim to dysentery, and died on the 14th of January, 1883, thus adding another name to the long list of martyrs to science in the deservedly dreaded climate of Western Africa.

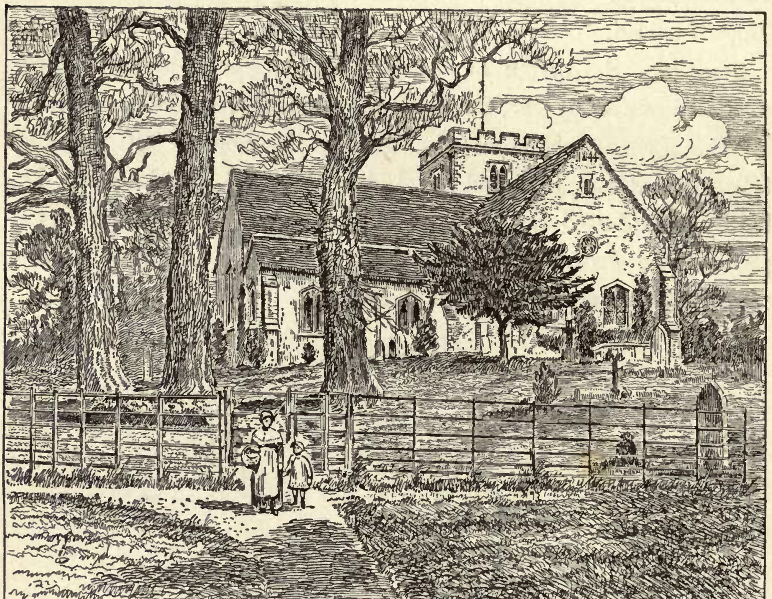
Forbes was carefully nursed, during his last illness, by Mr. Greenshields, agent of the United African Company at Shonga. His remains, deposited at first within the compound of the factory at Shonga, were subsequently disinterred under the kind care of the same excellent friend and brought to England, and buried on April 1st, 1884, in the quiet churchyard of West Wickham in Kent, in the presence of his sorrowing relatives and friends. Forbes's family have specially requested me also to mention the name of Mr. M'Intosh, Manager of the United African Company, as having most kindly assisted them in the somewhat difficult arrangements necessary for this purpose.

At a meeting of the Zoological Club (of which Forbes had been a prominent member) held on the 20th of November, 1883, it was resolved that a Committee, consisting of Prof. Flower, Prof. Bell, Mr. H. H. Johnston, Prof. Mivart, and the writer of this Preface, should be appointed to consider what would be the most appropriate memorial of our much-loved friend and fellow-worker. After some consideration it was unanimously agreed that the best and most enduring memorial would be the republication of Forbes's Contributions to Science in a volume similar to that containing Garrod's Scientific Papers, which Forbes had himself edited.

Such was the origin of the present volume, which has been carefully edited by Mr. Frank Evers Beddard, Forbes's successor in the Prosectorship of the Zoological Society of London. Miss Garrod has prepared the Index, Mr. H. H. Johnston has kindly contributed the life-like etching which forms the Frontispiece, while Prof. Bell has undertaken the task of collecting and expending the necessary subscriptions.

P. L. S.

3 Hanover Square,
May 1st, 1885.



Churchyard of West Wickham, Kent, with Forbes's grave (beneath the two trees).

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CONTENTS.

PAGE

1. Late Appearance of *Cetonia aurata* 1
2. Arrested Development in *Timarcha coriaria* and *Lagria hirta* 1
3. Note on *Chrysomela marginata* 2
4. Note on Mr. Wallace's Distribution of Passerine Birds 3
5. On the Bursa Fabricii in Birds 3
6. Recent Observations on the Parrots of the Genus *Eclectus* 19
7. On the Nesting of the Spoonbill in Holland. (Written in conjunction with P. L. Sclater, M.A., F.R.S., &c.) 26
8. Lepidoptera captured during an Excursion to Switzerland and the Italian Lakes 29
9. Melanism in Lepidoptera 32
10. Reports on the Collections of Birds made during the Voyage of H.M.S. 'Challenger.'—No. VII. On the Birds of Cape York and the neighbouring Islands (Raine, Wednesday, and Booby Islands) 34
11. On a small Collection of Birds from the Samoan Islands and the Island of Rotumah, Central Pacific 43
12. Letter concerning the Locality of *Garrulus lidthi* 45
13. *Staphylinus fulvipes* in the New Forest 46
14. On the Anatomy of the African Elephant (*Elephas africanus*, Blum.) 46
15. On the Systematic Position of the Genus *Lathamus* of Lesson. (Plate I.) ... 62
16. A Synopsis of the Meliphagine Genus *Myzomela*, with Descriptions of two new Species. (Plates II. & III.) 71
17. On the Systematic Position and Scientific Name of "Le Perroquet Mascarin" of Brisson 96
18. Notes on Butterflies observed in the Valais of Switzerland in 1878 100
19. The Glacial Period and Geographical Distribution 104
20. On the External Characters and Anatomy of the Red Uakari Monkey (*Brachyurus rubicundus*); with Remarks on the other Species of that Genus. (Plates IV.–VI.) 105
21. On the Cause of Death of a Leopard 127
22. On *Antilocapra americana* 127

PAGE

23. On some Points in the Structure of *Nasiterna* bearing on its Affinities 131

24. Contributions to the Anatomy of Passerine Birds.—Part I. On the Structure of the Stomach in certain Genera of Tanagers 133

25. Contributions to the Anatomy of Passerine Birds.—Part II. On the Syrinx and other Points in the Anatomy of the *Eurylæmidæ*............................. 138

26. Contributions to the Anatomy of Passerine Birds.—Part III. On some Points in the Structure of *Philepitta*, and its Position amongst the Passeres 144

27. On the Anatomy of *Leptosoma discolor* 149

28. On two rare Ploceine Birds now or lately Living in the Society's Menagerie. (Plate VII.) 159

29. Note on a Specimen of Denham's Bustard (*Eupodotis denhami*) 162

30. Remarks on Dr. Gadow's Papers on the Digestive System of Birds 163

31. Three Weeks' Butterfly-collecting in the Alps 165

32. On a little-known Cranial Difference between the Catarrhine and Platyrrhine Monkeys 170

33. On the Male Generative Organs of the Sumatran Rhinoceros (*Ceratorhinus sumatrensis*) 170

34. On some Points in the Anatomy of the Koala (*Phascolarctos cinereus*) 173

35. On the Contributions to the Anatomy and Classification of Birds made by the late Prof. Garrod, F.R.S. 189

36. Notes on the Unfinished Work left by the late Prof. Garrod on the Anatomy of Birds 213

37. Note on Mr. Bartlett's Communication on the Habits of the Darter 216

38. Contributions to the Anatomy of Passerine Birds.—Part IV. On some Points in the Anatomy of the Genus *Conopophaga*, and its Systematic Position ... 217

39. Notes on the Anatomy and Systematic Position of the Jaçanás (*Parridæ*)...... 220

40. On the Petrel called *Thalassidroma nereis* by Gould, and its Affinities 229

41. On the Conformation of the Thoracic End of the Trachea in the "Ratite" Birds 232

42. Eleven Weeks in North-eastern Brazil.. 242

43. The Descent of Birds.. 280

44. Note on the Systematic Position of *Eupetes macrocercus* 281

45. Note on the Structure of the Palate in the Trogons (*Trogonidæ*) 282

46. On the Anatomy and Classification of the Petrels, based upon those collected by H.M.S. 'Challenger' 284

47. Observations on the Incubation of the Indian Python (*Python molurus*), with special regard to the alleged Increase of Temperature during that Process 285

48. Observations on the Incubation of the Indian Python (*Python molurus*) 292

49. The Insectarium at the Zoological Gardens 293

50. Remarks upon the Horns of the Prongbuck 295

PAGE

51. On some Points in the Anatomy of the Great Anteater (*Myrmecophaga jubata*). (Plate VIII.) 296

52. Note on an Abnormal Specimen of *Pithecia satanas* 312

53. Supplementary Notes on the Anatomy of the Chinese Water-Deer (*Hydropotes inermis*) 313

54. Notes on the External Characters and Anatomy of the Californian Sea-Lion (*Otaria gillespii*). (Plates IX.–XI.) 316

55. Note on the Gall-bladder, and some other Points in the Anatomy of the Toucans and Barbets (*Capitonidæ*) 323

56. On some Points in the Anatomy of the Indian Darter (*Plotus melanogaster*), and on the Mechanism of the Neck in the Darters (*Plotus*), in connexion with their Habits 326

57. Description of the Pterylosis of *Mesites*, with Remarks on the Position of that Genus 331

58. Note on a Peculiarity in the Trachea of the Twelve-wired Bird-of-Paradise (*Seleucides nigra*) 335

59. On the Convoluted Trachea of two Species of Manucode (*Manucodia atra* and *Phonygama gouldi*); with Remarks on similar Structures in other Birds... 338

60. On some Points in the Anatomy of the Todies (*Todidæ*), and on the Affinities of that Group 345

61. Note on some Points in the Anatomy of an Australian Duck (*Biziura lobata*). 354

62. Contributions to the Anatomy of Passerine Birds.—Part V. On the Structure of the Genus *Orthonyx* 357

63. On the Rudimentary Hallux of Birds 359

64. Contributions to the Anatomy of Passerine Birds.—Part VI. On *Xenicus* and *Acanthisitta* as Types of a new Family (*Xenicidæ*) of Mesomyodian Passeres from New Zealand 360

65. Report on the Anatomy of the Petrels (*Tubinares*) collected during the Voyage of H.M.S. 'Challenger.' (Plates XII.–XXIV.) 363

66. On the Variations from the Normal Structure of the Foot in Birds 440

67. On a new Species of Hemipode from New Britain. (Plate XXV.) 444

68. The last Journal of W. A. Forbes 446

LIST OF PLATES.

			PAGE
Portrait of the late William Alexander Forbes			*Frontispiece*
Plate	I.	Structure of *Lathamus*	62
„	II.	Fig. 1. *Myzomela chloroptera.* Fig. 2. *M. rubrobrunnea.* Fig. 3. *M. adolphinæ*	71
„	III.	Fig. 1. *Myzomela chermesina.* Fig. 2. *M. sclateri*	
„	IV.	*Brachyurus rubicundus*	
„	V.	Head of *Brachyurus rubicundus* (nat. size)	105
„	VI.	*Brachyurus melanocephalus*	
„	VII.	Fig. 1. *Vidua splendens.* Fig. 2. *Pytelia wieneri*	159
„	VIII.	Anatomy of *Myrmecophaga*	296
„	IX.	*Otaria gillespii*	
„	X.	Head of male *Otaria gillespii* (one fourth the size of nature)	316
„	XI.	Anatomy of *Otaria gillespii*	
„ „	XII. XIII.	External characters of Petrels	
„ „	XIV. XV.	Alimentary Canal, Tongue, and Palate of Petrels	
„ „	XVI. XVII.	Myology of Petrels. Anterior extremity	
„ „	XVIII. XIX.	„ „ Tensor patagii muscles	363
„	XX.	„ „ Hinder extremity	
„	XXI.	Osteology of Petrels. Skull and limb-bones	
„	XXII.	„ „ Skull, pelvis, and limb-bones	
„ „	XXIII. XXIV.	„ „ Sterna	
„	XXV.	*Turnix saturata*	444

SCIENTIFIC PAPERS

OF

WILLIAM ALEXANDER FORBES.

1. LATE APPEARANCE OF *CETONIA AURATA*.* Ent. M. M. xi. p. 208 (1875).

At p. 178, vol. x. of the 'Entomologist's Monthly Magazine,' Mr. Scott records the appearance of *Cetonia aurata* on the 15th October. I have now to chronicle an even later date for that species, as I found a specimen of it at ivy-bloom, in the daytime, on the 29th October last year, in a garden at West Wickham. This specimen was unusually small, but otherwise in an excellent condition, and seemed to have but just entered into the imago state.

[These exceptional appearances are no doubt due to the fact that the *Cetonia* (like *Lucanus cervus*, and some other beetles) assumes the perfect state late in the autumn, but remains ordinarily in the cocoon till the following summer. Hence these abnormal specimens should rather be regarded as "early," not "late," their appearance being perhaps due to sudden rise of temperature combined with individual precocity.—Eds.]

2. ARRESTED DEVELOPMENT IN *TIMARCHA CORIARIA* AND *LAGRIA HIRTA*.† Ent. M. M. xi. p. 279 (1875).

The following instances of arrested development, causing a want of symmetry in the legs of insects, are interesting, and seem to me to be worth publishing, insomuch as, so far as I know, no similar instance has been recorded. In a ♀ specimen of *Timarcha coriaria* taken last autumn in Switzerland, this want of development occurs in the right middle leg, all the others being of normal size. The following are the dimensions of the stunted right leg, and its normal fellow on the left

* Ent. Month. Mag. xi. p. 208 (1875).

† Ibid. xi. p. 279 (1875).

side:—Femur, L. 3 millim., R. very slightly shorter; tibia, L. 3 millim., R. 1·75 millim.; tarsi, L. 2 millim., R. 1 millim.: the claws being exceedingly minute, and barely projecting beyond the last tarsal joint, all of which are present and equally developed, though not attaining the normal size.

In a specimen of *Lagria hirta*, the dwarfing occurs in the posterior pair of legs, and in this case, again, the right leg is the stunted member. The measurements of this specimen are:—Femur, about 2 millim. in both legs; tibia, L. 2 millim., R. 1·75 millim.; tarsi, L. 1·50 millim. (last joint wanting), R. 1 millim.

In both cases the want of symmetry caused by the arrested growth is more conspicuous than would appear from the above figures.

Ent. M. M. xii. p. 135 (1875).

3. NOTE ON *CHRYSOMELA MARGINATA*.*

This species, originally found, I believe, near Pegwell Bay, near Ramsgate, seems decidedly scarce on this side of the border, though not so uncommon in Scotland, where it has been found by Dr. Syme in Orkney (on *Plantago maritima*), and by Mr. Champion at Braemar, by sweeping alongside the Dee. Near Edinburgh it is not uncommon, though very local. As far as I know, it is confined to one particular spot on Arthur's Seat, a much exposed valley between the summit of the hill and a lesser peak known as the Lion's Haunch, about 700 feet above the sea, where the grass forms a short velvety turf, and the surface of the ground is covered with scattered fragments of the neighbouring basalt rocks. Beneath these fragments *Chrysomela marginata* is to be found, singly, or in twos and threes. When disturbed, it persistently feigns death. It begins to appear about the middle of June, and is most common about the first week in July, when I have taken as many as thirty specimens in the course of an afternoon's work, by assiduously turning over stones &c. in its locality. I have never seen the larva or pupa, and do not know for certain what its food-plant at Edinburgh is, as no *Plantago maritima* grows near. The short turf of the hill is composed in great part of millefoil (*Achillea millefolium*), and on that the beetles may feed, as some I kept in captivity fed voraciously on this by night, returning to their shelter at the bottom of the plants by day. I have never seen it moving about in the daytime like its congeners *C. menthastri* and (according to Mr. Champion) *cerealis*, but only found it under the stones. In Wilson's 'Entomologia Edinensis,' the Calton Hill is also given as a locality; but I have never found it there, chiefly, no doubt, owing to my not having looked there at the right time.

---

* Ent. Month. Mag. xii. p. 135 (1875).

4. NOTE ON MR. WALLACE'S DISTRIBUTION OF PASSERINE BIRDS.*

'Nature,' xv. p. 58 (1876).

In Mr. Wallace's recently published work on Geographical Distribution, in more than one place the results arrived at from an inspection of his elaborate tables of genera and families do not agree with the numbers he uses considering the general bearing of the facts adduced. Thus, in his "General Remarks on the Distribution of the Passeres," vol. ii. pp. 299–302, he says (*l. c.* p. 300):—"The families that are confined to single regions are not very numerous, except in the case of the Neotropical region, which has *five*, the Australian has only *three*, the Oriental one, Ethiopian one, and the other regions have no peculiar families."

Adopting his tables of the families of the Passeres, I find the numbers should be really as follows:—

Neotropical 7	Fams. Nos.	39*a*, 40, 41, 42, 44, 45, 46.
Australian 5	,, ,,	21, 22, 25, 49, 50.
Oriental 3	,, ,,	11, 12, 43.

The Nearctic region should also be mentioned as possessing one peculiar family, *i. e.* Chamæidæ. The statement that none of the turdoid Passerine families are exclusively American must also be modified to meet this fact. There are three families (*i. e.* Paictidæ, Pittidæ, Eurylæmidæ) instead of two of the Formicaroid Passeres in the Old World, of which the Pittidæ can hardly be said to have only a "very restricted distribution."

The Australian genus *Struthidea*, of doubtful position, seems omitted altogether.

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5. ON THE BURSA FABRICII IN BIRDS.†

P. Z. S. 1877, p. 304.

Prof. Garrod, in his paper on *Plotus anhinga* (P. Z. S. 1876, p. 344) says:—"In the urino-genital system of *Plotus anhinga*, in both sexes, the ducts open in the normal manner into the cloaca, just above its lower orifice. This orifice, however, is not on the surface, but is into a cavity behind the cloaca, which opens externally quite close to the place where the two communicate. Except for the nearly marginal orifice, the second cavity is a cæcal sac, oval in shape, and about 1½ inch high, covered at its blind

---

* 'Nature,' xv. p. 58 (1876).

† Proc. Zool. Soc. 1877, pp. 304–318. Read April 17, 1877

end with the crypts of shallow glands, which also run down its sides. That it is a modification of the *bursa Fabricii* cannot be doubted."

The disposition of the parts described above seemed peculiar enough to be worthy of further investigation; with that end my kind friend Prof. Garrod requested me to undertake a series of observations on the bursa in other birds, in order to throw further light on the structure of this organ, and to discover what characters, if any, it afforded for classi-
P. Z. S. 1877, p. 305. ficational purposes. The ample materials of the Prosector's department have given me opportunities for examining this organ in a considerable number of species of birds of various orders; and though I regret to say my investigations have not turned out so satisfactorily as regards taxonomic characters as I had hoped, I venture to bring such results as I have obtained before the Society this evening. As the subject of the bursa Fabricii has hardly attracted any notice in this country since the days of Harvey, I have added to my own notes a brief résumé of the most important observations and opinions as regards its structure and functions that have been brought forward by foreign anatomists.

The organ in question seems first to have been noticed by the naturalist whose name it bears, Fabricius of Acquapendente. In his treatise 'De formatione ovi et pulli' *, p. 5, he says:—"Tertium quod in podice est adnotandum est duplex vesicula quæ in ima ejus parte ad os pubis supereminet, et conspicua exteriorque apparet, simulatque uterus jam propositus conspectui sese offert: quæ cum sit pervia, ita ut ab ano ad ipsum uterum et ab utero in ipsam, ut puta superius, infra foramen pateat, ex altero autem extremo clausa sit, hunc existimavimus esse locum, in quem gallus semen immittit porrigitque ut inibi servetur." From this and other passages in his works it is clear that he considered its function that of a *receptaculum seminis* in the female; its use in the male, on such a theory, he does not explain. Harvey, in his work 'De Generatione Animalium' (London, 1651), as quoted in the Sydenham Society's translation of his works (1847, p. 183), refutes Fabricius's ideas on this point. "The foramen into which Fabricius believes the Cock to inject his fluid, is discovered between the orifices of the vulva and the rump. I, however, deny any such use to this foramen; for in young chickens it is scarcely to be seen, and in adults it is present indifferently in males and females. It is obvious therefore that it is both an extremely small and obscure orifice, and can have no such important function to fulfil; it will scarcely admit a fine bristle and needle, and it ends in a blind cavity; neither have I ever been able to discover any spermatic fluid within it, although Fabricius asserts that this fluid is stored up there even for a whole year, and that all the eggs contained in the ovary may be thence fecundated, as it is afterwards stated." Harvey, however, fell into error in asserting

* Hieronymi Fabricii ab Aquapendente opera anatomica. Patavii, 1625.

that in "young chickens it was scarcely to be seen;" as we shall afterwards see, it is developed more in young than adult birds. This fact was first pointed out by Tannenberg in 1789, in his disquisition 'Circa genitales partes mascularum avium' (Gottingæ), and has subsequently been recognized by most authors who have written on the subject (*vide* Cuvier *, Milne-Edwards †, and Gegenbaur ‡). Barkow, in a paper "On the Cloaca of birds" in Meckel's 'Archiv' §, describes its condition in specimens he had examined of the Fowl, Duck, Hooded Crow, Jackdaw, Bittern, Eared Owl (*Ohrkauze*), Honey-Buzzard, and Coot, showing that it is fully developed in young birds, but absent in old ones. He figures the bursa, together with the arteries supplying it (derived from the left pudendal), in both sexes of *Gallus domesticus* and *Fulica atra* (*op. cit.* tab. ix. fig. 13, 15, 19, 22–24, and t. x. f. 26). Berthold devotes a special memoir to it ‖, in which he describes its nervous and vascular supply. Emil Huschke ¶ describes its development, showing that it arises in the superior part of the cloaca, in which it is differentiated in the embryo of the Fowl from the 8th to the 9th day of incubation, acquiring by degrees a more perfect form, but that after a time it increases but slowly in comparison with the other parts of the embryo. M. Martin St.-Ange, in his fine paper "Etudes sur l'appareil reproducteur dans les cinq classes des vertébrés" **, figures and describes the bursa in the Common Pigeon. In one adult two-year-old Pigeon he found the interior of the bursa filled up with a sort of calculus, forming a complete cast of its interior. In all others of both sexes, it was reduced to about half its size, and the cavity entirely obliterated. He found that in the egg it was better developed in proportion than other organs, but that after the age of about six months in Pigeons, and eight in Fowls, it began to lose its functional activity, and to become reduced in size. Lastly, in a paper published in the 'Atti della Società Italiana di Scienze Naturali,' 1875, vol. xviii. pp. 133–169 (for calling my attention to which I am indebted to Mr. Salvin), Signor Vincenzo Alesi, of Naples, has published an exhaustive essay on the structure and development of this organ, accompanied by two plates of histological details. His observations have been made on specimens of *Meleagris mexicana*, *Anser cinereus*, *Anas boschas*, *Columba livia*, *Turtur auritus*, *Corvus monedula*, *Turdus merula*, and *Coturnix communis*; and he has also examined the cloaca of a female *Rhea americana*, preserved in the Naples Museum. To his observations

P. Z. S. 1877, p. 306.

* Leçons d'Anatomie comparée, 2nd ed. vol. viii. p. 276.

† Physiologie et Anatomie comparée, vol. viii. p. 514, and vol. vii. p. 347.

‡ Vergleichende Anatomie, p. 799, note.

§ Archiv, 1829, p. 443 *et seq.*

‖ Acad. Cæs.-Leop. Nova Acta, 1828. xiv. pp. 913–918.

¶ De Bursæ Fabricii origine. Jenæ, 1838.

** Mém. prés. Ac. Sc. Franç. par savants divers, 1856, pp. 1–232.

on the histological structure and process of atrophy of the bursa I will return after having briefly described the ordinary form and relations of this organ in the birds I have examined. These are 90 in number; and of many of them I have examined more than one specimen.

PASSERES.

Oriolus galbula.
Garrulax chinensis.
Citta thalassina.
Fregilus graculus.
Amblyrhamphus holosericeus.
Cissopis leveriana.

COCCYGOMORPHÆ.

Podargus cuvieri.
Dacelo gigantea.
Colius castanonotus.
Momotus lessonii.
Merops, sp.
Megalæma, sp.
Rhamphastos ariel.
Pteroglossus wiedi.
Trogon puella.
Cuculus canorus.
Cacomantis, sp.
P. Z. S. 1877, p. 307. *Chrysococcyx*, sp.
Geococcyx affinis.
Guira piririgua.

PSITTACI.

Stringops habroptilus.
Psittacus erithacus.
Pionus violaceus.
Tanygnathus muelleri.
Pyrrhulopsis splendens.
Platycercus icterotis.

ACCIPITRES.

Gyparchus papa.
Buteo jackal.
Archibuteo lagopus.
Geranoaëtus aquila.
Spizaëtus coronatus.
Haliaëtus vocifer.
Strix flammea.

STEGANOPODES.

Sula bassana.
Plotus anhinga.
Phalacrocorax carbo.
P. brasiliensis.

HERODIONES.

Ciconia alba.
C. boyciana.
Abdimia sphenorhyncha.
Xenorhynchus australis.
Ibis falcinellus.
I. rubra.
Ardea cocoi.
Cancroma cochlearia

PALAMEDEÆ.

Chauna derbiana.

ANSERES.

Cygnus olor.
Tadorna rutila.
Fulica rufigula.

COLUMBÆ.

Pterocles arenarius.
Phaps chalcoptera.
Goura coronata.

GALLINÆ.

Crax sclateri.
Tetrao urogallus.
Lagopus scoticus.
Ortyx virginianus.
Odontophorus guianensis.
Callipepla gambeli.
Arboricola torqueola.
Caccabis chukar.
C. melanocephala.
C. saxatilis.

Francolinus vulgaris.
F. bicalcaratus.
Euplocamus cristatus.
Argus giganteus.
Meleagris mexicana.

ALECTORIDES.

Otis tarda.
Grus carunculata.
Serpentarius reptilivorus.
Ocydromus australis.
Porphyrio alleni.
P. martinicus.
P. poliocephalus.
Hydrophasianus chirurgus.

GRALLÆ.

Œdicnemus crepitans.
Attagis, sp.

GAVIÆ.

Larus ridibundus.

PYGOPODES.

Uria troile.
Alca torda.

TINAMI.

Rhynchotus rufescens.
Crypturus tatupa.

STRŪTHIONES.

Struthio camelus.
Rhea americana.
Dromæus novæ-hollandiæ.
Casuarius beccarii.
C. picticollis.
C. uniappendiculatus.
Apteryx mantelli.
A. oweni.

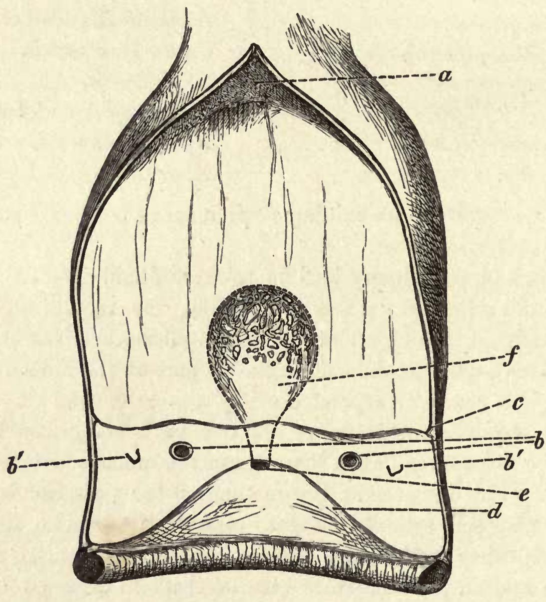
For an opportunity of examining a specimen of the last I am indebted to Prof. Newton's kindness.

If the cloaca of an ordinary bird be taken and laid open in front (*i. e.* on the ventral surface) along the middle line, the rectum will be seen to terminate at the top of a more or less well-marked chamber, which usually is more capacious than the terminal part of the alimentary tract, from which it is generally separated off by a more or less plain valvular constriction, the different nature of the two parts being also frequently shown by the differences in the character of the mucous membrane lining them. Below the entrance of the rectum, on the posterior wall of the cloaca, and disposed symmetrically as regards the median line on the sides of which they lie, are the openings of the uro-genital ducts, frequently elevated on papillæ, which vary in shape in different birds. Of these the ureters open nearest the middle line; externally to them are the openings or opening of the vasa deferentia or oviduct, which latter is fully developed only on one side, though sometimes a trace of it may be seen on the other also. Above the uro-genital papillæ in many birds (e. g. *Meleagris mexicana* and *Tetrao urogallus*) is a well-marked valvular fold of mucous membrane, which thus separates off the upper portion of this "cloaca" from that part into which the urino-genital ducts open. Below these, again, is a similar, but usually better-marked fold (the vesical sphincter of St.-Ange), which is present in all the birds I have examined, in a more or less developed state. Below this in the middle line, and also on the posterior wall, is seen (if the specimen be not too old) a circular hole of varying dimensions. This is the opening of the

P. Z. S. 1877, p. 308.

"bursa Fabricii." This third part of the "cloaca" is bounded below by the external sphincter muscles, which often form in birds a great thick fleshy mass; this chamber, from lodging the penis or clitoris, is denominated "loge copulatrice" by M. St.-Ange. In many birds additional glands, opening by large pores, or forming irregular arborescent patches, are developed in the walls of the cloaca in this region. It results therefore from the above-described disposition of parts that, in its most developed form, a bird's "cloaca" is divided into three chambers communicating with each other, and into which open respectively (from above downwards), first the rectum, secondly the urino-genital ducts, thirdly the bursa Fabricii *. This disposition of parts is seen in fig. 1. The bursa

Fig. 1.



Cloaca of *Chauna derbiana*, laid open from before.

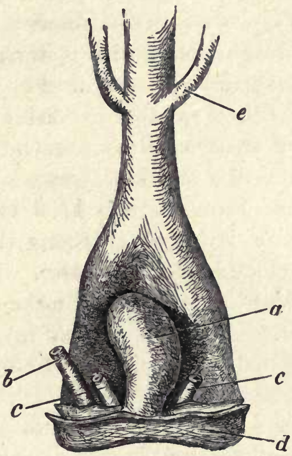
a. Rectum. *b*. Opening of ureters. *b′*. Genital papillæ. *c*. Fold of mucous membrane *d*. "Vesical sphincter" of M. St.-Ange. *e*. Opening of bursa Fabricii. *f*. Bursa Fabricii (supposed to be seen through the posterior wall of the cloaca).

Fabricii, when well developed, consists of a sac-like pouch, usually with thick glandular walls: it is blind above and constricted below, and

* Prof. Huxley describes it ('Anatomy of Vertebrate Animals,' p. 308) as opening into the "*anterior* and dorsal region of the cloaca." If "anterior" mean here, as I suppose it does, "anterior" as regards the whole length of the digestive tract, this is an error; for, as I have above stated, the opening of the bursa is in the lowest chamber of the cloaca (*i. e.* that nearest the vent), and therefore into the most "posterior" one as regards the general direction of the alimentary canal.

opens by a simple rounded orifice without any valve* into the cloaca at the point already indicated. The bursa lies on the posterior wall of the cloaca (to which it is usually attached by a kind of aponeurosis) in the space between the cloaca and the pelvis. This disposition of parts, as seen from behind, is shown in fig. 2, in the common Guillemot. The P. Z. S. 1877, p. 309.

Fig. 2.



Back view of Cloaca of *Uria troile*.

a. Bursa Fabricii. *b*. Oviduct. *c, c*. Ureters. *d*. Sphincter muscles. *e*. Cæca.

bursa when laid open frequently contains fæcal matter, more or less hard, or may be empty. The walls may be thin, as in the Passeres, Parrots, &c., or thick and markedly glandular, as in the Gallinæ, Herodiones, &c. The bursa is usually constricted below into a narrow peduncle, with a narrow central channel; above, the contained cavity is more considerable but of varying dimensions.

Signor Alesi, in the paper already referred to, has described at great length the minute structure of the bursa Fabricii in the common Fowl and some other birds. I must here content myself with giving a brief résumé of his conclusions as regards the histological structure of the organ in question. A transverse section of the wall in the neighbourhood of one of the ridges into which, in the Fowl and allied forms, the

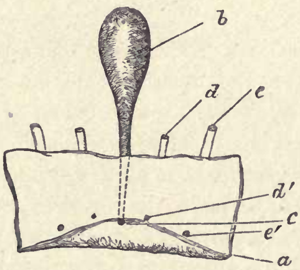
* Barkow, *l. s. c.*, describes the lower part of the peduncle of the bursa as projecting into the cloaca in the common Fowl, and there forming a conical sort of flap (*Zipfel*) over the opening. I have never myself seen any thing like this "Zipfel" in any bird I have examined; and all other writers are equally silent on the point. Most, indeed, say expressly that there is no valve or flap of any kind.

P. Z. S. 1877, p. 310. interior of the bursa is raised shows the following constituent parts:—(1) an external layer of connective tissue, covering (2) a thick layer of elastic membrane; inside this is (3) a thin layer of mucous membrane, which unites together and connects the "lymphatic follicles." These "lymphatic follicles" consist of masses of minute rounded cells, on an average 0·04 millim. in diam., enclosed in capsules of connective tissue, in which ramify their nutrient vessels &c. The lymphatic follicles are bound together by processes of the connective mucous membrane into raised processes, which project on the interior of the bursa, forming ridge-like "crests," and are covered with epithelium internally, the cells of the latter being lanceolate with oval nuclei. In *Rhea*, however, the follicles are not closely bound together in masses forming ridges, but are attached by peduncles of elastic tissue to a central stem, the whole having somewhat the appearance of a bunch of grapes with a few berries on it. As we have already seen, Tannenberg in 1789 was the first to point out that the bursa was more developed in young than old birds, it being gradually reduced and obliterated in the latter. This process of atrophy seems to obtain in all birds, so far as I can make out, though the periods of final disappearance seem to vary much in different groups. M. Martin St.-Ange found that the bursa began to lose its functional activity in Pigeons after six months, and in Fowls after eight; as a rule it seems to atrophy at about the period of full growth. On the other hand, in some cases it persists for long periods, and probably throughout life; for I found it well developed and quite open in a specimen of *Platycercus*
P. Z. S. 1877, p. 311. *icterotis* that had lived in the Society's Gardens for eleven years. As a rule, the central cavity of the bursa becomes diminished and the communication with the cloaca obliterated in the process of atrophy; and finally, in some cases at least, the whole organ completely disappears, losing its characteristic form and structure, and becoming fused with the tract of abdominal aponeurosis that covers the back wall of the alimentary canal, ultimately forming a flat riband-like, or round cord-like, ligamentous structure. Spangenberg observed the conversion of the bursa Fabricii into a round cord-like ligament in the Duck; and Alesi has observed it (and described it minutely, with figures showing the histological changes that go on) in the Fowl. He sums up the process of atrophy in the last-named bird as follows:—The epithelium which covers the internal surface of the bursa becomes, as it were, invaginated into the thickness of the mucous layer, becoming pressed in between the lymphatic follicles. The connective tissue between the latter increases rapidly in bulk, and becomes full of numerous small oval corpuscles; at the same time the follicles become absorbed, and the whole of the bursa becomes obliterated and fused with part of the abdominal aponeurosis. The epithelium gradually becomes confined to certain irregular tracts in the thickness of the mass of connective tissue; but

even these disappear finally. The process of atrophy in the other species which he observed is essentially the same as that in the Fowl.

I now proceed to describe the general characters of the bursa Fabricii in the groups of birds I have examined. In the Passeres it is usually small, pyriform, with a small opening and glandular walls without ridge-like elevations on the interior. It seems to disappear completely in adult birds. In the Rhamphastidæ it disappears in the adult, only leaving a small pore to mark its place of opening. In the Cuculidæ it presents a very characteristic shape, the peduncle being long and thin, and the extremity club-shaped, giving the whole somewhat the appearance of a shortened and clumsy antenna of a butterfly (see fig. 3). It disappears P. Z. S. 1877, p. 312.

Fig. 3.



Cloaca and Bursa of *Geococcyx affinis.*

The cloaca is cut short and laid open from before. The narrow peduncle of the bursa is supposed to be seen through the cloaca. *a.* "Vesical sphincter.' *b.* Bursa. *c.* Opening of same. *d, d′.* Ureter and opening. *e, e′.* Vas deferens and opening.

completely in adult birds. In specimens of *Dacelo gigantea*, *Merops*, and *Momotus lessoni* it was sac-like and of considerable size. In the Parrots it is well marked and bag-like, opening by a small pore. As already mentioned, in an old specimen of *Platycercus icterotis* I found the bursa well marked, though its opening into the cloaca was nearly obliterated. In a specimen of *Stringops* I found *no* bursa. In the Accipitres it forms a moderate-sized pyriform sac; in old birds this becomes reduced to a sort of small conical pouch in the substance of the back wall of the cloaca at the place of aperture. Of the Steganopodes, in *Phalacrocorax* (2 species) and *Sula bassana* the bursa is a large sac, $1\frac{1}{2}$–2 inches in length, which opens by a small pore in the usual places. The walls of the bursa are very thick; they are traversed by about seven rows of large, irregular, crypt-like pores, separated by smooth, narrowed, raised ridges. The ridges and pores disappear towards the base of the bursa; but the upper part has a curious honeycomb-like appearance, somewhat like that of the Ruminant *reticulum.* The internal surface is covered with numerous, small, opaque, granular-looking corpuscles, especially towards the apex. In a young specimen of *Plotus anhinga* (♀) that I dissected, the appearance and disposition of the parts agreed very well with Prof. Garrod's description. I noticed, however, that the opening of the bursa was very *slightly constricted* by a slight fold of mucous membrane on each side, so that the bursa hardly opened by its entire width into the cloacal chamber. In other respects it showed a strong approximation to the disposition of these parts that I shall presently describe in the Ostrich and its allies.

In the Herodiones the bursa is large and sac-like, with a small or moderate opening; its interior surface has no ridges or sulci, but large crypt-like pores collected in patches. In aged birds it seems to disappear, though in a specimen of *Abdimia* that had lived in the Gardens more than three years it was still present, ½ inch long, with the opening still unobliterated.

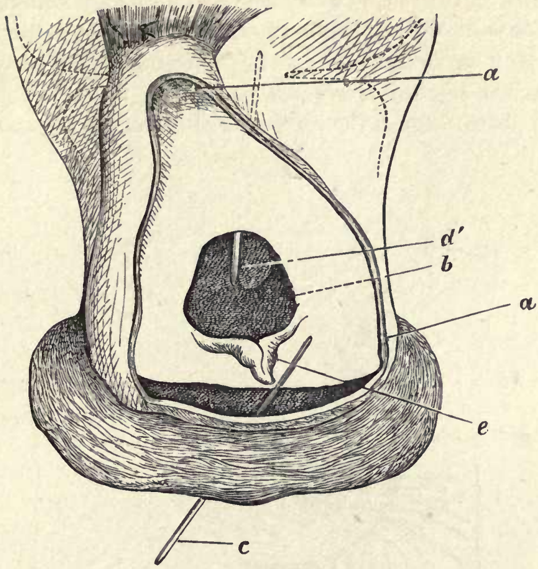
In *Chauna* the bursa is a glandular pyriform sac, about 1 inch in length, with a moderate-sized opening (see fig. 1, p. 8). It seems to disappear entirely in old birds. In a specimen of *Cygnus olor* it was a large conical sac, 1½ inch long, with a wide mouth, but slightly constricted off, and with no large glands. In aged specimens of *Fuligula rufina*, which had lived sixteen years in the Gardens, and of *Tadorna rutila*, which was nearly eighteen years old, the bursa had disappeared, in the former having assumed the appearance of a round cord-like ligament, in the latter having become fused with the abdominal aponeurosis. In each case a small pore marked the place of aperture.

In *Pterocles*, *Goura* (in a nine-months-old bird), and *Phaps* I have never found any thing more than a small blind pore in the usual place of the opening; as we know from M. St.-Ange, the bursa disappears very early in *Columba livia* as well.

P. Z. S. 1877, p. 313.

In the Gallinæ the bursa has a tubular or pyriform shape, with numerous well-marked alternating ridges and furrows, the latter highly glandular, on its internal surface. These ridges are most marked towards the superior (blind) end, and are formed by the projection into the interior of collections of lymphatic follicles. These last do *not* open by distinct pores into the cavity of the bursa, but are entirely closed, as shown by Signor Alesi and Leydig. In the process of atrophy the peduncle becomes sclid; also the cavity of the bursa becomes shut off from the cloaca and persists in this state for some time. Finally, however, the bursa seems to become reduced to a ligament-like structure, or to become fused with the general aponeurosis. In the Turkey the bursa is a long tubular sac, 2 inches long, with very well marked ridges and sulci. In all a pore marks the opening of the atrophied bursa. In *Serpentarius* the bursa is a large globular sac, with the glandular area confined to the apical region and a small aperture into the cloaca. In these respects it resembles *Otis* and *Grus*. In *Porphyrio* and *Ocydromus* it assumes the form of a long,

Fig. 4.



Cloaca of *Casuarius uniappendiculatus*, viewed from behind.

a, a. Cut surface of posterior wall of bursa. *b.* Opening of cloacal chamber into bursa. *c.* Pointer passing from cavity of bursa to exterior. *d′.* Pointer passed from cloaca into bursa through opening *b*; the upper part is supposed to be seen through the wall of cloaca. *e.* Clitoris.

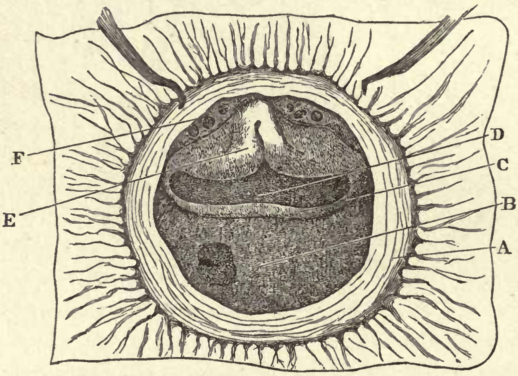
narrow, cylindrical tube, the central cavity of which becomes closed up as atrophy advances. In *Œdicnemus* there is a similar form of bursa. In *Attagis*, on the other hand, the form is pyriform, more like that of the Passeres and Gallinæ.

In *Larus* I found the bursa represented by a small pouch. In the young *Uria troile* it is large and sac-like, and slightly curved from side to side (see fig. 2, p. 9). The walls are very glandular, and so thick that the central cavity is but small. There are no crests. In an adult *Alca torda* it was reduced to a pore-like opening. P. Z. S. 1877, p. 314.

In none of the *Tinami* that I have dissected have I found any bursa; on the other hand, the posterior wall of the third cloacal chamber is covered with numerous glands arranged in a tree-like manner.

In all the birds hitherto mentioned (with the exception of *Plotus*) the bursa, as we have seen, opens by a more or less constricted aperture into the general cavity of the cloaca. In the Struthious birds, however, the very opposite is the case. The cloaca (or at least as much of it as corresponds to the first and second chambers) *opens into the* bursa Fabricii. This will perhaps be best explained by looking at fig. 4, representing the cloaca and bursa of a not full-grown Cassowary (*Casuarius* *uniappendiculatus*) from behind. The bursa is, as one sees, a large, somewhat triangular sac, attached above by a broad riband-like muscle to the posterior wall of the alimentary canal. Most of the back wall of the bursa has been cut away (*a*), to show the opening into its cavity of the cloacal chamber (*b*), out of which a pointer (*d'*) is seen passing up into the rectum above through the recto-cloacal valve. From this, I think, it

Fig. 5.



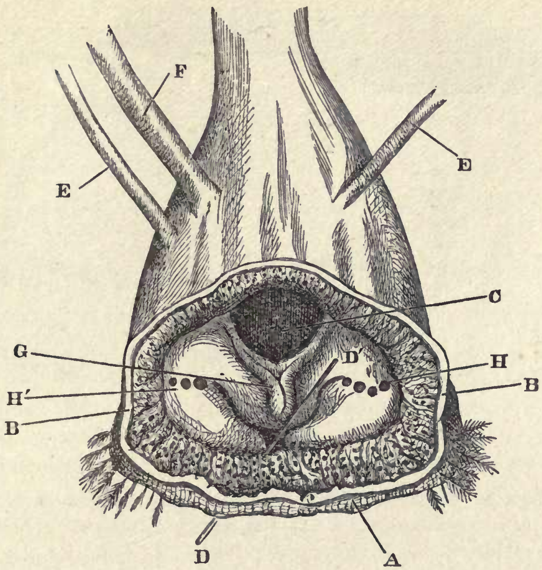
Vent of young Emu (*Dromæus novæ-hollandiæ*) with the parts still *in situ*, viewed from the outside.

A. External sphincter. B. Cavity of bursa. C. Wall of cloaca. D. Opening of cloaca into the bursa. E. Clitoris. F. Glandular pores.

will at once be evident that the cloaca does *not* open directly to the outer surface, but *indirectly through* the bursa by means of its large posterior and inferior aperture *b*. A similar condition of things is seen in fig. 5, in a young Emu (*Dromæus novæ-hollandiæ*)—where the parts are undisturbed and *in situ*,—and in fig. 6, in an Ostrich (*Struthio camelus*, immature female)—where the bursa has been nearly all removed to show the posterior opening of the cloaca into its cavity, and the communication of the latter with the exterior, as indicated by the direction of the pointer (D D'). The same is the case in the young Nandou (*Rhea americana*). In all these birds the walls of the bursa are thickly glandular; there are no regular crests and sulci, however, but the glands are arranged in patches, the whole having a honeycomb-like or dendritic appearance. This disposition of parts, however, is not permanent. As the birds grow older, the size of the bursa gradually diminishes and its walls become less glandular; its mouth is no longer equal in extent to the whole width of the outermost chamber, but becomes narrowed; and finally the whole bursa disappears, its remains becoming lost in the muscles of the back of the cloaca. This state of atrophy of the bursa is represented

P. Z. S. 1877, p. 315.

Fig. 6.



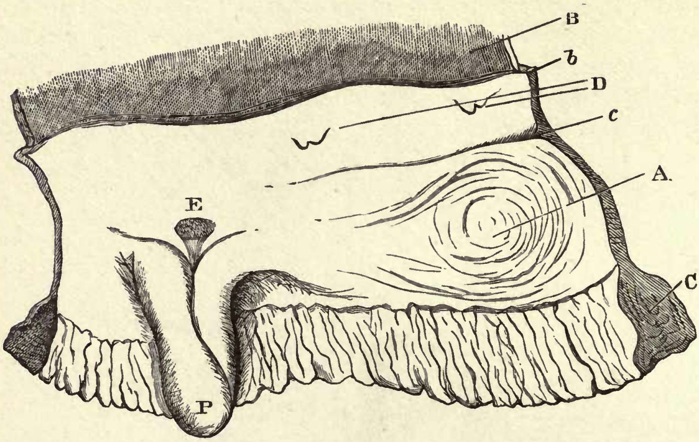
Cloaca and Bursa of young Ostrich (female), viewed from behind. Most of the posterior wall of the bursa has been removed.

A. External sphincter muscle. B. Cut surface of bursa. C. Opening of cloaca into bursa. D, D′. Pointer passing from bursa to exterior. E, E. Ureters. F. Oviduct. G. Clitoris. H, H′. Pores; beneath them the smooth, non-glandular part of the bursa.

in *Casuarius picticollis* in fig. 7 (p. 16), the only remains of its existence being seen in the few irregular circular folds on the mucous membrane at A. At what age this change supervenes is not yet quite clear. The specimen of *C. beccarii* that died in the Society's Gardens last year, apparently an adult female, corresponded entirely in the disposition of these parts with the specimen of *C. uniappendiculatus* above described, which died shortly before, and was quite a young bird when received in 1874. On the other hand, in *C. picticollis* the bursa was entirely atrophied. This specimen, which also arrived in 1874, was then not quite adult; so that at the period of its death it must have been about three years old. Whether *Apteryx* agrees in these points also with the other *Struthiones* I am unable to say, as both the specimens I have dissected presented no trace of a bursa. Probably therefore in this, too, when adult the bursa disappears almost completely. I have mentioned above the singular differences shown by Signor Alesi to exist in the structure of the lymphatic follicles of the bursa of *Rhea* as compared with other birds.

P. Z. S. 1877, p. 316.

Fig. 7.



Cloaca of *Casuarius picticollis*, adult male; viewed from before.

A. Circular folds of mucous membrane, being the last remains of the Bursa. B. Rectum. *b.* Recto-cloacal valve. C. Cut surface of external sphincter muscle. *c.* Vesical sphincter. D. Urino-genital papillæ. E. Glandular pore. P. Penis.

Although at first sight the relation of these parts in *Rhea*, *Struthio*, &c. seems so different from that which obtains in other birds, yet a little reflection will, I think, convince one that it is not so in reality. I have represented diagrammatically (figs. 8 and 9) what I conceive to be the true relations of the parts in question, denoting the homologous regions in the two forms (*Serpentarius* as illustrating the normal type, *Casuarius* the abnormal one) by similar letters. If we imagine B in fig. 8 to lose the constriction at its aperture into D, and D to become proportionately deeper, we should have a form corresponding to fig. 9, in which B passes uninterruptedly and without constriction into D, the cavity B D thus formed receiving the aperture of C. In such a form as *Plotus*, where the opening is but very slightly constricted, we have a type connecting the two extremes; and I have seen *Rhea* in a stage very similar to that mentioned above in *Cygnus olor*. In confirmation of this view as to the true relation of these parts, in the Ostrich &c. the lower part of the bursa, in the region corresponding to D in figs. 8 and 9, is not glandular (*vide* fig. 6, p. 15, where the non-glandular part of the bursa is seen beneath the pores H H′).

P. Z. S. 1877, p. 317.

With regard to the function and homologies of the bursa Fabricii, great differences have prevailed amongst authors. Thus Milne-Edwards says*, " Fabrice d'Acquapendente, à qui l'on doit la découverte de cette

* Phys. et Anat. Comp. vol. viii. p. 514.

Fig. 8. Fig. 9.

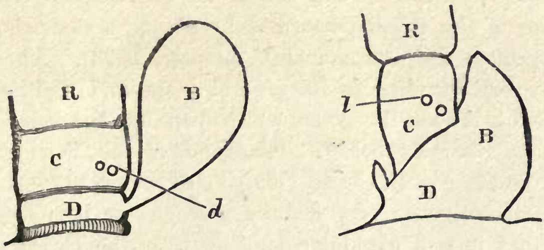


Diagram showing two chief Types of Development of the Bursa Fabricii.
R. Rectum. B. Bursa. C. Cloacal chamber. D. Lowest chamber of "cloaca."
d. Openings of urino-genital ducts.

bourse, la considérait comme un réservoir séminal, tandis que d'autres naturalistes * la regardent comme une vessie urinaire. Perrault et quelques auteurs modernes † y voient l'analogue des glandes anales des Mammifères, et Geoffr. St.-Hilaire l'assimile aux glandes du Cowper ‡; enfin, M. Martin St.-Ange la compare à la prostate." Emil Huschke, in the paper mentioned above, has studied its development, and, after a comparison of the organs of similar appearance, is inclined to consider it as the primitive urinary vesicle of the Wolfian bodies, from the fact that the ducts of this gland take origin from just that part of the cloaca which afterwards assumes the form of the bursa. Harvey and others have sufficiently disproved Fabricius's ideas as to its serving as a spermotheca; nor can the bursa be regarded as a urinary bladder,—first, because it is not devoted to containing the urine; secondly, because in other Sauropsida and also in the Mammalia the urinary bladder is ventral, not dorsal, in position. For a similar reason, as well as from the fact that they are *paired* organs, the "*bursæ anales*" of the Testudinata can be in no way related to that under discussion. The anal glands of Mammals, again, open externally on the skin, and are in fact cutaneous glands. The prostate and glands of Cowper are purely male glands, and probably play some important function in the act of reproduction; so that they can hardly well correspond to an organ that is common to both sexes, and only proportionally developed in the young. It would be premature to accept Huschke's views without further observations on the subject. On the other hand, as pointed out by Signor Alesi, a lymphatic organ, constructed on a similar principle, but in a simpler form, exists in the

P. Z. S. 1877, p. 318.

* *E.g.* Berthold, Acad. Cæs.-Leop. Nova Acta, xiv. p. 917 (1828 and Geoffroy St.-Hilaire, Mém. du Muséum, 1823, t. ix. p. 394.

† *E.g.* Carus, 'Zootomia.'

‡ Tiedemann, 'Anat. der Vögel,' 1810.

patches of lymphatic follicles (which do not, however, in this instance project outside the mucous membrane of the intestine) in the appendix to the cæcum of the rabbit (described by Frey, 'Untersuchungen über die Lymphgefässe des Darmkanales,' Leipzig, 1863). An organ still more closely corresponding in its general shape and position with the bursa Fabricii is the sac-like pouch which opens into the *dorsal* wall of the cloaca in many Elasmobranchs*. The glands of this, however, differ in structure from those of the bursa Fabricii; so that at present it seems to me that we can assign no very definite analogue or homologue for the latter, but that it is a glandular outgrowth of the cloaca peculiar to birds.

In conclusion, I may briefly recapitulate the chief conclusions arrived at in this paper :—

(1) That the bursa Fabricii exists in both sexes, and probably in all species, of birds.

(2) That it is most developed in young birds, but becomes atrophied and more or less obliterated in adults, the period, however, of the commencement and conclusion of this process differing greatly in various birds. In some it probably persists, though in a state of functional inactivity, throughout life.

(3) That in the majority of birds the bursa is a moderate-sized or small sac, that opens by a narrow aperture on the dorsal wall of the cloaca into the lowest "chamber" of that organ.

(4) That in the Struthious birds, on the contrary (the state of *Apteryx* as regards these points being doubtful), the cloaca opens into the bursa by a posterior aperture, owing to the fact that the bursa is not constricted off at the neck, but is commensurate in extent with the third or outer chamber of the cloaca, the two being united into one. This condition, however, is only to be found in young birds.

(5) That the bursa is a glandular organ, of which lymphatic follicles are the essential constituents, but has no exact homologue in other classes of Vertebrata.

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* Signor Alesi, in his paper, *s. c.*, alludes to this pouch as being *ventral* in position, which it certainly is not. It is figured in *Squatina vulgaris* by Gegenbaur (Vergl. Anatomie, fig. 267 *c*, & p. 798). It is absent in *Chimæra*. Leydig has described its structure ('Beiträge z. microscop. Anat. u. Entwickel. der Rochen u. Haie,' Leipzig, 1852), and found that it consisted of collections of glands similar to the glands of Brunner.

6. RECENT OBSERVATIONS ON THE PARROTS OF THE GENUS *ECLECTUS*.*

Ibis, 1877, p. 274.

The large red and green Parrots forming the genus *Eclectus* of Wagler have long been well known to naturalists, who have, until recently, entertained no sort of doubt that the red species were perfectly distinct from the green ones. So much was this the case, that a subgenus, denominated *Polychlorus* in 1857 by Sclater †, has been formed for the reception of the green species, the red ones being retained under *Eclectus* proper. Dr. Finsch, whose excellent work, 'Die Papageien,' must be regarded as our "Standpunkt" in all matters concerning Parrots, recognizes (*l. c.* vol. ii. p. 332) seven species of the genus (as restricted by Wagler), and gives the following table of them :—

Ibis, 1877, p. 275.

a. *Green Eclecti.*

1. *polychlorus*, Scop. Under wing-coverts and sides red. Wing 10″ 5‴.
2. *intermedius*, Bp. Like the last, but green darker and size smaller. Wing 8″ 9‴.
3. *westermanni*, Bp. Like the last, but without red on sides.

b. *Red Eclecti.*

4. *grandis*, Gm. Band over the upper back and the under surface violet-blue; tail-feathers and under tail-coverts yellow. Wing 10″ 3‴.
5. *cardinalis*, Bodd. Like the last, but darker red; under tail-coverts orange-red. Wing 8″ 5‴.
6. *linnæi*, Wagl. Like the last, but with a narrow blue ring round the eye; under tail-coverts red.
7. *corneliæ*, Bp. Without any blue at all.

The distribution of the species (as given by Finsch) is represented in the following table, the habitat of two species (*E. westermanni* and *E. corneliæ*), both originally described by Bonaparte from specimens living in the "Natura-Artis-Magistra" Gardens at Amsterdam, being still unknown.

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* Ibis, 1877, pp. 274–283.

† P.Z.S. 1857, p. 226.

	Ceram.	Bouru.	Amboyna.	Ternate.	Gilolo.	Batchian.	Morotai.	Guebè.	Waigiou.	Mysol.	Gage.	Kaisa Island.	Ke Islands.	Aru Islands.	New Guinea.	N. Ireland, &c.
Eclectus																
polychlorus......	...	...	...	*	*	*	*	*	*	*	...	...	...	...	*	*
intermedius......	*	*	*	...	...	...	...	...	...	...	*	...	...	*		
grandis	...	...	...	*	*	*	*	...	...	...	...	*				
cardinalis	*	*	*													
linnæi	...	...	...	...	...	...	...	*	*	*	*	...	*	*	*	*

Ibis, 1877, p. 276.

This being the case, ornithologists were not a little surprised when Dr. A. B. Meyer announced, on his return to Europe from his adventurous travels in New Guinea and the adjacent islands, that the green species of *Eclectus* were simply the males of the red ones—also that all the so-called species were, in his opinion, referable to one species, and one only, namely *Eclectus polychlorus*. In his paper on the subject in the 'Zoologischer Garten' for May 1874, p. 161, Dr. Meyer says that his attention was first called to this matter by finding that he had determined all the specimens, six in number, of the *E. polychlorus* (green) that he had procured in the Papuan island of Mafoor (in Geelvink Bay) as *males*, whilst nine *E. linnæi* (red) were all *females*. Struck by this curious coincidence, he inquired of his Malay hunters if they knew any thing of the matter. They replied that it was a well-known fact that these green and red Parrots were man and wife. One asserted that he had seen parents of both colours engaged in incubation, one replacing the other. Though Dr. Meyer, warned by former experience, did not trust implicitly to any statements made by his native hunters, these accounts strengthened him in his suspicions; and he determined to investigate the matter thoroughly. Three green *Eclecti* he obtained in Jobi were all males, three red all females. These results were afterwards fully confirmed by the examination of a great number of specimens on the mainland of New Guinea. These were too numerous to bring all back to Europe; but he returned with thirty specimens of the genus, four of which were preserved entire in spirits of wine, as well as a living pair of birds (green and red). To place the parallelism in the distribution of the red and green forms (already noted by Finsch, *l. c.*) in a stronger light, he divides the *Eclecti* into three groups, of which *E. corneliæ* and *westermanni* (the habitats of which are, as already remarked, unknown) constitute one. The other two are:—

polychlorus (green) *linnæi* (red) *grandis* (red)	New Guinea, Waigu, Mysol, Gebè, Gilolo, Batjan, Morotai.

intermedius (green) } Ceram, Amboyna, Buru. Ibis, 1877, p. 277.
cardinalis (red) }

From this it is clear that the range of *one green* form (*E. polychlorus*) corresponds with that of *two red* (*E. linnæi* and *E. grandis*). "As I cannot hesitate a moment," says Dr. Meyer, "in ascribing the conditions found in *E. polychlorus* and *E. linnæi* from New Guinea, Mafoor, and Jobi to the other allied form (namely, that the green are the males and the red the females of one and the same species), the interesting fact comes out (unparalleled, so far as I know, in the ornis of the whole world), that *differently coloured females correspond to one and the same male in different localities*; for *E. linnæi* and *E. grandis* show at first sight such differences, that, so long as we did not know their true relations to *E. polychlorus*, they were universally considered different species. Thus, therefore, the male remains constant, whilst the female varies." Dr. Meyer then proceeds to show that no theories of "sexual" or "natural selection" can account for these facts, of the causes of which we are completely ignorant. Schlegel (Ned. Tijd. v. d. Dierk. iii. p. 332, 1866), he observes, has already united *E. intermedius* and *E. polychlorus* into one species, the examples from Gebè and Waigiou being intermediate in their characters between these two forms. Moreover an authentic specimen of *E. intermedius* from Ceram, received from the Leyden Museum, and now in the Imperial Cabinet at Vienna, quite agrees with Dr. Meyer's series from New Guinea, Mafoor, and Jobi. Hence *E. polychlorus* (including under this term *E. intermedius*) possesses in different islands three females, differently coloured according to the locality, viz.:—

(1) *linnæi*, in New Guinea, Mysol, Waigiou, and Gebè;
(2) *grandis*, in Gilolo, Batjan, and Morotai;
(3) *cardinalis*, in Ceram, Buru, and Amboyna.

Dr. Meyer then goes on to argue that *E. westermanni* and *E. corneliæ*, both remarkable for being nearly uniform in colour, must also be regarded as forms of *E. polychlorus*. He urges that *E. corneliæ* may well be a fourth female of *E. polychlorus*, as we already know that the females of this species are variable, whilst *E. westermanni*, he considers, is probably an individual that has retained its juvenile plumage and has been unable to assume its adult colouring owing to captivity. Ibis, 1877, p. 278.

Here I must join issue with Dr. Meyer on several grounds. First of all, several examples of each of these condemned species have lived at various times in the Zoological Gardens of London and Amsterdam, and no noteworthy difference has been detected in these specimens. Again, specimens of both species have lived for considerable periods at Amsterdam without undergoing any change in coloration (*vide* Finsch, *l. s. c.*). Moreover Parrots, as a rule, including those of the present genus, do remarkably well in captivity, and show no tendency to lose or to fail to acquire their brilliant colours or to retain their immature dress. *Eclectus corneliæ* and

E. westermanni can hardly be man and wife, owing to their disparity in size (the wing of the former being given by Finsch as 9″ 5‴, of the latter 7″ 8‴ to 8″ 5‴, and other measurements in proportion). Hence we may conclude that in the former case the *male*, in the latter the *female*, remains to be discovered, as well as the exact habitat of each. When we reflect on the little knowledge we still have of the great mass of New Guinea, as well as of some of the neighbouring islands, it is evident that ample area for such a discovery is still left. This conclusion is strengthened by the fact that certain other Parrots belonging to the same region, likewise first described from captive specimens, and undoubtedly distinct (e. g. *Lorius tibialis*, Scl. P. Z. S. 1871, p. 449, and *Trichoglossus mitchelli*, G. R. Gray), have their exact habitat still unascertained. The recent discovery of Loriinæ (a group of which the geographical range coincides remarkably with that of *Eclectus*, as has been pointed out by Mr. Wallace) in such unexpected localities as Ponapé (in the Caroline group), where *Chalcopsitta rubiginosa* occurs*, and Fanning Island, in the mid Pacific†, renders it even possible that an *Eclectus* may turn up in some equally "unlikely" locality‡.

Ibis, 1877, p. 279. Dr. Meyer then goes on to show that Bernstein's determinations of the sexes of the specimens he forwarded to the Leyden Museum are probably erroneous, as in his three years' experience he found the sexes about equally numerous, whereas Bernstein's determinations would show great disparity in their relative abundance (in one case six males to one female, in the other twelve females to two males). The juvenile plumage of *Eclectus* is unfortunately still unknown; but Dr. Meyer concludes that it is probably green, from the fact that twelve out of fourteen of his red specimens still preserve evident traces of green feathers.

In reply to these arguments Prof. Schlegel § not unnaturally hesitates to accept Dr. Meyer's conclusions, because, of 72 specimens of red *Eclecti* in the Leyden Museum, 20 have been determined by the collectors as *males*, and the remainder (52) as females, and, on the other hand, of 77 green specimens in the same museum, 56 are marked as males and 21 as *females*. Hence, if Dr. Meyer be right, a considerable proportion of these specimens must have been wrongly sexed by the four travellers by whom they were collected, viz. Salomon Müller, Bernstein, Hoedt, and Von Rosenberg.

Dr. Meyer returns to the charge in a paper in the 'Mittheilungen aus

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* *Vide* Finsch, 'Journal des Museum Godeffroy,' Heft xii. 1876.

† *Coriphilus kuhli*, P. Z. S. 1876, p. 421.

‡ Prof. Rietmann's "shining-red Parrots" in Guadalcanar (P. Z. S. 1869, p. 127) might well be *E. corneliæ*.

§ Mus. Pays-Bas, Psittacidæ, 1874, p. 17.

dem k.-k. zoologischen Museum zu Dresden' (*l. c.* pp. 11–13). He repeats his former observations, and gives some additional ones, amongst which are some remarks on a living pair of *Eclectus* in his possession, green and red, the green bird on being introduced to the red at once having become friendly with the latter. A green *Eclectus* that died soon after it came into his possession was dissected and turned out to be a male. As regards the specimens in the Leyden Museum, Dr. Meyer disposes of them by saying that those collected by S. Müller have been long in the Museum, and may very probably have had their labels transposed—that Bernstein, during the latter part of his residence in the Malay archipelago (as he himself learned from one of his hunters, who had also collected for Bernstein, and knew the latter well), suffered severely from illness, and therefore may well have made mistakes in the deter- Ibis, 1877, p. 280. mination of the sexes of his specimens—that Hoedt had no pretensions to any scientific knowledge—and that Rosenberg has in other instances made blunders of a similar kind—so that their evidence counts for little. Dr. Meyer adds some mathematical calculations showing that the chances are 32,700 to 1 against his having killed six all males of the green *Eclectus*, and nine all females of the red one in the same island, if they really were distinct species.

So far Dr. Meyer. Important evidence in corroboration of part of his theory is given by the Italian naturalists who have lately visited New Guinea. Beccari, in his Ornithological Letters to Count Salvadori *, says, "Though it seems strange, it is nevertheless true that the green *Eclecti* are males of the red ones. I learnt this at Aru from my hunters; and the young have the same differences." Salvadori says again (*l. c.* pp. 756, 757), speaking of the sexual differences in *E. grandis*, that there is "no longer any doubt on this subject. D'Albertis has assured me that it is a well-known fact amongst the natives of the Moluccas and New Guinea." In his various papers on Papuan ornithology in the same journal, the green specimens of *Eclectus* are always determined as males, the red as females.

Prof. Garrod also tells me that during his prosectorship the only two *Eclecti* that have died in the Zoological Society's Gardens were one *E. polychlorus* and one *E. grandis*, respectively male and female. On the other hand, the Rev. George Brown, C.M.Z.S., who has lately sent over to this country such interesting collections from New Britain and the adjacent islands, says, in a letter to Mr. Sclater, dated Sydney, October 22, 1876, "This" (*i. e.* the green and red *Eclecti* being specifically identical) "is a *gross error*. Our attention was directed to this subject; and I am quite sure they are two different birds. We shot the green

* Ann. Mus. Civ. Storia Natur. Genova, vol. vii. p. 704 (1875), and Ibis, 1876, p. 253.

ones, both male and female." Two skins in the collection are referable to *E. polychlorus* and *linnæi*; the latter is marked female. It is to be hoped Mr. Brown will renew his investigations into this subject, as the determination of the sexes is not always very easy without careful dissection, the suprarenal bodies in birds being particularly liable to be mistaken for the testes when the latter are not developed to the extent that they are during the breeding-season. On the whole, I think, we must conclude, in company with Dr. Meyer and Count Salvadori, that the green *Eclecti* are really males, the red females.

Ibis, 1877, p. 281.

With regard to Dr. Meyer's conclusion that all the species hitherto described must be regarded simply as forms of *one* species (*E. polychlorus*), I have already adduced reasons for believing that *E. westermanni* and *E. corneliæ* are good species. As regards the other five, a careful examination of a large series of skins from different localities (we now know that *Eclectus* extends east as far as Yule Island and Duke-of-York Island) will be necessary before coming to any definite conclusion on the subject. Count Salvadori, however, who has probably had as large a series of specimens from different Papuan islands of this genus as anybody, recognizes three distinct species (besides the two of unknown habitat), which he says may always be recognized as distinct at any age or in either sex. He gives the following table of these species as understood by him (*l. c.* p. 756):—

1. Virides: lateribus rubro-puniceis. (Mares.)
   - *a.* Majores.
     - *a'*. Viridis, colore obscuriore, cauda minus cærulea .... 1. *polychlorus.*
     - *b'*. Viridis, colore lætiore, cauda magis cærulea .... 2. *cardinalis**.
   - *b.* Minores. Cauda vix cærulea .... 3. *grandis**.
2. Rubræ: fascia interscapulari et abdomine cyaneo vel violaceo. (Feminæ.)
   - *a.* Annulo periophthalmico cyaneo .... 1. *polychlorus.*
   - *b.* Annulo periophthalmico nullo
     - *a'*. Subcaudalibus auroreis vel rubro-flavis............................ 2. *cardinalis.*
     - *b'*. Subcaudalibus pure flavis .... 3. *grandis.*

In this table the green *E. cardinalis* is, I suppose, the *intermedius* of most authors, whilst the red *E. polychlorus* is clearly what is usually called *E. linnæi*.

Ibis, 1877, p. 282.

On the whole it seems probable that we must be content with ascribing to *Eclectus* the most marked sexual differences in colour of any Parrots hitherto known. *Aprosmictus* (at least in some species, *e. g. A. scapulatus*) also presents very well-marked sexual differences in coloration, and, as Prof. Garrod has shown (P. Z. S. 1874, p. 494), agrees very closely with

* In the original paper Count Salvadori has accidentally transposed these two names, as I have ascertained from a corrected copy of his paper that he forwarded to Mr. Sclater.

Eclectus in anatomical structure. *Eclectus*, however, differs from all known Parrots in having the female more gaudily coloured than the male. Can it be possible that, as in the few other analogous instances where the female is the more brightly coloured (e. g. *Turnix*, *Rhynchœa*, &c.*), the duties of incubation devolve on the male? If such be the case, we can easily understand the use of the green coloration being retained by the male. Unfortunately we are still totally ignorant of the habits, nidification, and immature plumage of these Parrots. Let us hope that Signor D'Albertis or Mr. Brown will soon throw some light on this, as well as on the other interesting points noted above, which still require further examination.

In conclusion, supposing that we assume the new views as to the sexual differences of the *Eclecti* to be correct, the following list of the species will show concisely their sexual differences and geographical distribution.

1. Eclectus polychlorus (Scop.).

Maximus: mas viridis colore obscuriore, lateribus rubro-puniceis, caudâ minus cœruleâ: femina rubra, fasciâ interscapulari, abdomine et annulo periophthalmico cyaneis.

Hab. in insulis Papuanis et Moluccanis Ternate, Gilolo, Batchian, Morotai, Guebè, Waigiou, Mysol, Gagè, Ké, Aru, Papua, Nova Hibernia, et Nova Britannia.

2. Eclectus grandis (Gm.).

Major: mas viridis, lateribus rubro-puniceis, caudâ vix cœruleâ: femina rubra, fasciâ interscap. et abdomine cyaneis, subcaudalibus purè flavis.

Hab. in insulis Ternate, Gilolo, Batchian, Morotai, et Gagè.

3. Eclectus cardinalis (Bodd.). Ibis. 1877, p. 283.

Minor: mas viridis, E. polychloro *similis, at colore lætiore caudâque magis cœruleâ distinguendus: femina rubra, fasciâ interscapulari et abdomine cyaneis; subcaudalibus auroreis vel rubro-flavis.*

Hab. in insulis Moluccanis Ceram, Bouru, et Amboyna.

4. Eclectus westermanni, Bp.

Minor: mas viridis, lateribus concoloribus. Femina adhuc ignota.

Hab. ——? (Viv. Nat. Art. Mag. et Zool. Soc. Lond.)

5. Eclectus corneliæ, Bp.

Mas ignotus: femina punicea, colore cyaneo neque dorsi neque lateris inferioris ullo.

Hab. ——? (Viv. Nat. Art. Mag. et Zool. Soc. Lond.)

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* *Vide* Darwin's 'Descent of Man,' vol. ii. p. 200 *et seq.* (1871).

Ibis, 1877, p. 412.

7. ON THE NESTING OF THE SPOONBILL IN HOLLAND. By P. L. Sclater and W. A. Forbes.*

That the Spoonbill (*Platalea* † *leucorodia*) breeds in Holland is a fact well known to every ornithologist; and most egg-collectors are aware that specimens of its eggs obtained in that country are to be purchased at a very cheap rate in the London egg-shops. But we are not sure that
Ibis, 1877, p. 413.
any ornithologist, at least of this country, has actually visited the nesting-places of this bird, or, at any rate, has published any account of them. In May 1867, as is recorded in Gould's 'Birds of Great Britain' (vol. iv. part 30), Sclater paid a visit to a nesting-place of he Spoonbill at Nieuwerkerk, near Rotterdam; but though he saw many Spoonbills, the nesting had not then begun; and the lake which he visited is said to have been drained since that time. We hope therefore that it may interest readers of 'The Ibis' to have an account of our recent experiences on this subject.

Being in Holland in the first week of May this year, Sclater made many inquiries as to where the Spoonbills could be seen performing the duties of reproduction, and finally ascertained from Hr. A. A. Van Bemmelen, Director of the Zoological Gardens at Rotterdam, that the most likely place to witness this interesting phenomenon was the Horster Meer, between Amsterdam and Utrecht. At Amsterdam it was ascertained that the first week in July would be a convenient period for the proposed excursion with this object, as about that time the birds would have commenced incubation.

On the 3rd of July, therefore, we found ourselves at the Amstel Hotel, at Amsterdam; and upon visiting Mr. Hegt, the Assistant-Director of the Zoological Society's Gardens there, found that he had kindly made every necessary arrangement for our proposed expedition next day. No railway-station being very convenient for the Horster Meer, he had ordered a carriage to take us from Amsterdam to the scene of action.

Next morning we started about 8 o'clock, and had about three hours' drive, passing the villages of Abgouda and Vreeland before arriving at Overmeer an de Vecht, the little village in which Hr. van Dyk, the lessee of the Horster Meer, resided. The Horster Meer consists of a large tract of water reed-beds and swamp, lying on the right bank of the Vecht, and immediately to the south of the Zuyder Zee. It is between the

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* Ibis, 1877, pp. 412–416.

† Mr. Dresser (B. Eur. pt. 23–24) uses *Platea* as the generic name of the Spoonbill instead of *Platalea*. It may be hoped, however, that this is a mere oversight, and that Mr. Dresser is not prepared to dissent from the canon that Linnean names are to remain inviolate.

railways going from Amsterdam to Utrecht on one side, and from Amsterdam to Amersfoort on the other. It belongs to a rich proprietor in Amsterdam, but is farmed out at a considerable rent for the sake of the fish, reeds, and bird's eggs which it produces. The last-mentioned objects are collected from the nests in which they are laid, twice a week during the months of May and June, and sold in Amsterdam to such persons as require a large supply of fresh eggs without being particular as to the source from which they are derived. Ibis, 1877, p. 414.

On arriving at Overmeer we were received by Hr. van Dyk and escorted to a boat, which conveyed us along a short canal into the Horster Meer. No sooner had we arrived on the lake than the air above us was filled with an enormous flight of Cormorants, who well knew what a visit to their domain portended. A few minutes afterwards about 500 Spoonbills were circling in the air over our heads, their long legs stretched behind them, and their white bodies glistening in the sun. The Meer, so far as visible, was not a very extensive piece of water, being closed in on all sides by enormous reed-beds, the homes of these and other aquatic birds. Having landed at the end of a ditch which penetrated into one of these beds of reeds, we pursued a track which led us first to a breeding-place of the Cormorants. Here was a circular space, perhaps fifty yards in diameter, cleared of reeds, in which the Cormorants' nests stood thick together on the swampy soil. They were formed of rather large sticks, piled somewhat loosely together to a height of about 18 inches above the surface. The top of the nest was only slightly hollowed out, and lined with a few broken reeds. The eggs were in no case more than two in number, the poor birds having been robbed continuously up to that time, and only within the last few days allowed to commence incubation.

Having inspected the Cormorants' breeding-place, we proceeded about fifty yards further through the reed-beds, over a still more treacherous swamp, to the breeding-place of the Spoonbills. The nests of these birds were not situated so near together as those of the Cormorants, but scattered about two or three yards from each other, with thin patches of reeds Ibis, 1877,
growing between then. There was, however, a clear open space in the p. 415.
neighbourhood, formed of broken-down reeds, in which the birds were said to congregate. The Spoonbill's nest, in the Horster Meer at least, is a mere flattened surface of broken reed, not elevated more than two or three inches above the general level of the swamp; and no other substance but reed appears to be used in its construction. What the proper complement of eggs would be if the birds were left undisturbed we cannot say; for, as in the case of the Cormorants, the nests are robbed systematically twice a week, until the period when it is known by experience that they cannot produce any more eggs. Then at last the birds are allowed to sit undisturbed. At the time of our visit the season for collecting eggs was just past; but we helped ourselves to eight fresh

eggs, from different nests, laid since the last collection had been made. During all the time that we were in the reed-beds the Cormorants and Spoonbills were floating about over our heads, fully aware that there was an enemy in the camp. We were told that there were several other nesting-places of the Spoonbill in different parts of the Horster Meer, containing altogether several thousand nests; so that we may hope that it will be some time before this fine bird becomes extinct in this locality.

The only other bird we found nesting in the Horster Meer was the Black Tern, of which we captured two young chicks.

After refreshing ourselves at the hostelry of Overmeer, we returned to Amsterdam in the evening by a different route, highly satisfied with our day with the Spoonbills.

We may observe, in conclusion, that on looking over Mr. Dresser's account of the Spoonbill in his 'Birds of Europe,' we find him quoting from Schlegel that this bird "is found in the neighbourhood of the large rivers, at Biesboch, Nieuwerkerk, on the Yssel at Rozenburg, and on the Maas; and breeds in Holland, arriving there in April and leaving in September." Again, a few pages further on, Mr. Dresser says, "It breeds in Holland; but I do not find any record of its having of late been found nesting elsewhere in Northern Europe, though in Hungary and South-eastern Europe it breeds numerously." In Mr. Gould's folio, too, no more detailed account is given, with the exception of the record of Sclater's unsuccessful expedition ten years ago. Now our experiences as to the position of the Spoonbill's nest certainly agree with the details given by Messrs. Dickson and Ross, who met with it breeding near Erzeroum (P. Z. S. 1839, p. 134); and this seems to have been the fullest account known to Mr. Dresser at the time of writing his article. So, although there seems to be no reasonable doubt that in some cases it nests in lofty trees, we may claim to have established the fact that in Holland it breeds on the ground among the reed-beds, and to be able to assure those naturalists who happen to be in Amsterdam at the right time that there is no better way of spending a spare day than an excursion to the Spoonbills' nesting-place on the Horster Meer.

Ibis, 1877, p. 416.

We cannot conclude this short account of a most delightful day without thanking Mr. Hegt most heartily for his kind arrangements for our trip, without which we should probably have encountered considerable difficulty in reaching our destination. It is to be feared that in England we could hardly promise to show our friends an equally interesting sight in such close proximity to our metropolis!

8. LEPIDOPTERA CAPTURED DURING AN EXCURSION TO SWITZERLAND AND THE ITALIAN LAKES.*

Ent. M. M. xiv. p. 243 (1877).

The following list of Lepidoptera, observed by myself and a friend (Mr. M. J. Michael, of St. John's College, Cambridge), during a short trip in Switzerland and the Italian Lakes last summer, may be of interest to entomologists who have collected on similar occasions, as showing how much (or, rather, how little) can be done in entomology on a tour where this is not the only object. When in company with non-entomological friends (we were in all a party of four) a great deal of collecting has to be done on the sly, as it were,—I mean by resorting to such expedients as walking up hills when travelling along the roads; and by these means a number of additional species were procured, though sometimes perhaps at the expense of the time of the less interested members of the party. Unfortunately, the time for departure from England (about the middle of August) coincided with the setting in all over Western Europe of the spell of bad weather which prevailed for about a month continuously; and this, combined with the lateness of the season, no doubt much contributed to the lack of species observed, and the entire absence of some usually common, *e. g. Daplidice*, *Palæno*, &c. It also entirely frustrated our intention of visiting Zermatt, where we had intended to have spent some days collecting the insects of the high Alps. The total number of species observed in the month was 107, of which 33 are not British species. For naming some of these I am indebted to Dr. Staudinger, whose nomenclature I have throughout followed.

List of Species observed.

Papilio podalirius—seen near Colico. *Papilio machaon*—Colico, Bellaggio, Menaggio. *Parnassius apollo*—one ♀ specimen at rest on thistles near Andeer. *Pieris brassicæ*, *rapæ*, *napi*—everywhere in cultivated grounds. *Leucophasia sinapis*—common in the gardens of the Villa Serbelloni and elsewhere at Bellaggio; also at Menaggio and Pallanza. *Colias hyale* occurred nearly everywhere, and usually commoner than the next. *C. edusa*—with the last. The var. *helice* occurred at Bellaggio and Menaggio, but not commonly. *Rhodocera rhamni*—Villa Serbelloni and Pallanza. *Polyommatus virgaureæ*—one ♂ specimen near the village of Splügen. *P. dorilis*—Baden; common at Bellaggio and Pallanza. In this species the ♂ is quite dark above, the ♀ having the primaries orange with dark spots, and an orange border to secondaries. *P. phlœas*—Baden, Bellaggio, Pallanza. The Italian specimens have the

* Ent. Month. Mag. xiv. p. 243.

markings less distinct, the copper colour redder, the spots smaller, the costal margin of the primaries darker, and the marginal band broader and narrower than any English examples I have. The underside, too, of the primaries, is redder, leaving the circumscriptions of the eyes and the veins of the wings paler. *Lycæna argiades*—This little "tailed" blue occurred, but not commonly, at Baden and Bellaggio. *L. argyrotoxus* (*ægon*)—Colico and Bellaggio, in the grounds of the Villa Serbelloni. *L. astrarche* (*agestis*)—Bellaggio *. *L. icarus*—Baden, Kandersteg, Colico, Menaggio, Bellaggio. *L. bellargus* (*adonis*)—Kanderthal, Chur, Bellaggio, Menaggio, Val Vedro. The var. *ceronus* (which also occurs in England) —at Bellaggio. *L. corydon*—Kanderthal, Chur, Menaggio, Val Vedro. Two ♂ Swiss specimens have all the blank points on the underside of the wings much smaller and less distinct than in English ones; in one
Ent.M.M. xiv. p. 244 (1877). also the row of orange spots on the post-margin of the underside of the secondaries has almost disappeared. *L. damon*—Kandersteg, Chur. *Apatura ilia.* The *ab. clytie*, which differs from the type in having the ground-colour of all the wings reddish ochreous instead of white, occurred commonly on the poplars lining the road between Chiavenna and Colico. This species flies strongly, but does not soar like *A. iris*, and sits on the leaves sunning itself till disturbed, but generally too high to be in reach of an ordinary net. The females have much less metallic gloss than the males. *Limenitis camilla*—in the gardens of the Hotel Grande Bretagne at Bellaggio, but not at all common: one specimen also in those of the Villa Serbelloni and Menaggio. *Vanessi io*—near Tiefenkasten. *V. atalanta*—Colico, Bellaggio, and Menaggio. *V. cardui*—Bellaggio. *V. antiopa*—We only saw one of this species throughout our trip, and that was at Sargans, on the railway from Zurich to Chur. *V. c-album*—Bellaggio and Villa Serbelloni. *Melitæa athalia*—Menaggio and Bellaggio, in meadows. *M. parthenie*—Baden. *M. didyma*—This species was not uncommon on the railway banks near Waldshut, and a timely delay of the train enabled us to get out of the carriage and procure some specimens before it started off again. *Argynnis dia*—Baden and the Via Mala. *A. paphia*—Baden, Colico, Bellaggio, Menaggio, and the Val Vedro. The var. *valezina* also occurred at the two last-named localities. *A. adippe*, var. *cleodoxa*—Bellaggio and Val Vedro. *A. niobe*, var. *eris*—near Splügen: also at Pallanza. *A. lathonia*—common at Baden; also at Bellaggio and near Tiefenkasten. *Melanargia galathea*—a worn specimen in the Val Vedro, and another on the hill behind Bellaggio. *Erebia stygne*—Kanderthal, near Frutigen, in meadows at about 2500 feet elevation; also on a rocky wooded hill behind Bellaggio. *E. nerine*—a single ♂ specimen of this rather rare species near Splügen. *Erebia*

* The Bellaggio specimens have both the red and black spots on the wings larger, and the ground-colour of the underside greyer than in English specimens.

pronoë, var. *pitho*—This handsome species was rather common in sloping dry meadows, between Frutigen and Kandersteg, at about 3000 feet elevation, but difficult to get in good condition *. *E. æthiops* (*blandina*)—Thun; common in the valley of the Kander, and on a hill behind Bellaggio. *E. ligea*—near Splügen. *Satyrus hermione*—Colico, Menaggio, and Bellaggio; frequented a rocky wooded hill behind the latter, and seemed to like resting in shady places. On the wing somewhat resembles a large *L. sibylla*. *S. circe*—A specimen of this handsome species was seen at Baden. *S. dryas* (*phædra*)—This fine species was abundant at Bellaggio, frequenting, like *S. hermione*, a rocky, bushy hill behind the town, wheeling in its flight over the bushes, the roughness of the ground making it a matter of some difficulty to catch specimens. The female is larger and lighter in colour than the male; has the blue eyes on the primaries larger, and with brighter blue pupils than in that sex, and is altogether a finer-looking insect. It also occurred at Menaggio, where it frequented the flowers of the millet (*Milium effusum*), which is grown in the vineyards in patches between the rows of vines, at Pallanza and near Colico. *S. actæa*, var. *cordula*—with the last, at Bellaggio and Menaggio, but much less common. *S. semele*—Menaggio and Bellaggio. *Pararge hiera*—Villa Serbelloni, at Bellaggio, Menaggio, and Val Vedro. *P. ægeria*—Bellaggio, Menaggio. I think those I saw belonged to the pale northern form *egerides*, but not having kept specimens cannot say for certain. *P. janira*—Baden, Colico, Menaggio, Bellaggio. *P. tithonus*— Ent. M. M. xiv. p. 245 (1877). Bellaggio, Menaggio, and Pallanza. *Cœnonympha pamphilus*—Baden, Bellaggio, Menaggio, and Val Vedro. *Spilothyrus alceæ*—Bellaggio. *Syricthus alveus*—Baden, Bellaggio, and Menaggio. *S. proto*—gardens of the Villa Serbelloni, at Bellaggio. *Hesperia comma*—everywhere: on the whole, the commonest butterfly, as far as regards our experiences. *Sphinx convolvuli*—gardens at Schaffhausen and Thun. *Macroglossa stellatarum*—common in gardens at all places visited, except in the Alpine valleys. *Zygæna filipendulæ*—Baden and near Chur. *Lithosia deplana*—one at Thun. *Callimorpha hera*—Via Mala; common at Bellaggio and Menaggio, fluttering about flowers in the sunshine like a butterfly. *Cossus ligniperda*—a full-grown larva picked up in the Via Mala, and an empty pupa-case near Liuno. *Bombyx rubi*—larvæ common, crawling in the roads, near Chur, Splügen, and in the Val Vedro. *B. trifolii*—a ♂ specimen picked up in the road near Menaggio. *Agrotis c-nigrum*—Thun. *Plusia triplasia*—Bellaggio. *P. gamma*—Schaffhausen, Bellaggio. *Catocala paranympha*—a single worn specimen in the inn "Belle Vue" at Frutigen. *Acidalia perochraria*—common in meadows near Baden, and in the Kanderthal, near Frutigen. *A. immorata*—Baden. *A. immutata*—Bellaggio. *A. strigilaria*—common at Pallanza, on grassy

* The var. *pitho* has the red bands nearly obliterated.

slopes near the lake. *A. ornata*—common at most places we visited, but not in the Alpine valleys. *Timandra ornata*—Schaffhausen, Liuno. *Numeria capreolaria*—one specimen near Chur. *Gnophos glaucinaria*—one specimen near Chur. *G. dilucidaria*—Baden, Bellaggio. *Ortholitha limitata* (*mensuraria*)—Chur. *O. bipunctaria*—Chur; larger and darker than English (chalk) specimens. *Minoa murinata* (*euphorbiata*)—Pallanza. *Anaitis plagiata*—Baden, Schaffhausen. *Lygris populata*—common in fir-woods, at about 4500 feet elevation, near Splügen. Some specimens marked with dark, but I saw none of the var. *musauaria*. *Cidaria variata*—two on the Merkur-Berg, near Baden. *C. ferrugata*—Schaffhausen. *C. cœsiata*—in company with *L. populata*, as in Scotland. *C. flavicinctata*—one specimen in the hotel at Splügen. *C. verberata*—common in all the Alpine valleys we passed through. *C. bilineata*—Baden, Schaffhausen, Chur, Liuno. *Eupithecia euphrasiata*—one specimen on a hill behind Bellaggio. *Rivula sericealis*—Bellaggio. *Hypena obesalis*—a specimen near Andeer. *H. obsitalis*—common in passages amongst vineyards, near Bellaggio. *Botys purpuralis*—meadows at Bellaggio. *B. cespitalis*—Baden. *B. nubilalis* (*lupulinalis*)—one specimen at Bellaggio. *B. lutealis*—near the waterfall on the Splügen. *Eurycreon verticalis*—Schaffhausen. *Pionea forficalis*—Baden. *Diasemia litterata*—This pretty little species was common at Bellaggio, flying gently in the sunshine just above the top of the grass, in grass and clover-covered meadows, in the neighbourhood of vineyards, &c. *Crambus tristellus*—Baden, Bellaggio. *C. culmellus*—Baden, Bellaggio. *C. perlellus*—Chur, Bellaggio. *C. geniculeus*—Bellaggio. *Pempelia semirubella* (*carnella*)—common at Bellaggio and Menaggio, in places like those frequented by *litterata*. The var. *sanguinella* (with pale costa) also occurred. *Myelois rosella*—one specimen of this pretty little species at Menaggio. *Sericoris conchana*—Baden. *Depressaria heydeni*—some pupæ picked up from moss under stones whilst searching for Coleoptera, on the Splügen, near the top of the pass (at about 6500 feet), produced this species, for naming which, as well as the last, I am indebted to Mr. E. Meyrick, of Trinity College, Cambridge.—W. A. Forbes, West Wickham, Kent: *January 17th*, 1877.

Ent. M. M. xiv. p. 16 (1877).

9. MELANISM IN LEPIDOPTERA.*

After Mr. Burchell's and Dr. Buchanan White's notes on this subject (vol. xiii. pp. 130 and 145), and the very feasible explanation the theory of natural selection gives of the prevalence (though not the cause)

* Ent. Month. Mag. xiv. p. 16.

of these dark varieties, I was somewhat surprised to see what may be called the "birthmark" theory revived to account for them by Mr. Fetherstonhaugh (p. 215), and subsequently supported by Mr. Tugwell (p. 256). It is almost impossible to one having any physiological knowledge to see how any impression on the sensorium of the parent can produce any permanent change (except, perhaps, a deficiency in some parts) in the structure of its offspring. As, however, one fact is worth a hundred theories, I may perhaps be allowed to quote here a passage from Darwin's 'Animals and Plants under Domestication' (1st edit. vol. ii. p. 263), which seems to me to be decidedly "ad rem" as regards the subject under discussion. He says, "it was formerly a common belief, still held by some persons, that the imagination of the mother affects the child in the womb. . . . . Dr. William Hunter, in the last century, told my father that during many years every woman in a large London lying-in hospital was asked before her confinement, whether anything had specially affected her mind, and the answer was written down; *and it so happened that in no one instance could a coincidence be detected between the woman's answer and any abnormal structure*; but when she knew the nature of the structure, she frequently suggested some fresh cause!" Natural selection perfectly explains the facts adduced by Mr. Tugwell about *Gnophus obscuraria*, for of course on a dark soil the darker individuals, on the light the lighter ones, will be best protected by their colours and will therefore have a better chance of escaping the notice of their enemies. That the dark colour of the soil can hardly be the true cause in *producing* these variations is, I think, pretty certain, from their occurrence in many places where the soil is not conspicuously dark, *e. g.* the Highlands of Scotland and the Alps *. I have just been looking through Dr. Staudinger's catalogue, and was much struck by the fact that in nearly every case where a local form (whether a "var." or "ab.") from the Alps is noticed, it is characterized as being "obscurior" or "multo obscurior," or with some of the markings "obsoleta." The great number of normally dark or black species of Lepidoptera in the Alps, as, for instance, the *Erebiæ*, *Psodos*, and some *Pyralides* (*cf.* Jordon, vol. xiii. p. 60), seems to me also to be worth notice in connection with this subject. In a few cases, Alpine insects are only sexually melanic, *e. g. Pieris napi* ♀, var. *bryoniæ*, *A. paphia* ♀, var. *valezina*, *Polyommatus virgaureæ* ♀, var. *zermattensis*. These cases are explicable on the theory that supposing sexual selection to have been such an efficient agent in modifying species as Mr. Darwin believes, it may have been more important for the males in the struggle for life to preserve their good looks than to have acquired sounder constitutions at the expense of the former. That the

* Conversely, too, one would expect, if this theory were true, to find more melanic vars. on the very dark soil of peat-mosses and fen-lands than is actually the case.

prime agent in this tendency to melanism is some unfavourable meteorological element, probably connected with an excess of moisture and reduced amount of sunshine, is strongly suggested by the fact that, as noticed by Messrs. Birchall and White, these dark forms are most frequent in the north of England, Scotland, Ireland, and, as I have stated, the Alps. Nor is this tendency confined to Lepidoptera. L. de Tschudi, in his 'Monde des Alpes' (2nd edit. 1870, p. 394), says, "Les différences d'altitude produisent encore sur les insectes des modifications d'une nature particulière. Une des choses qui frappent le plus celui qui visite nos Alpes, c'est l'obscurcissement des couleurs dans les coléoptères alpins comme en général dans une grand nombre d'insectes. Plus nous nous élevons plus nous voyons les scarabées qui vivent dans les trous, comme ceux qui habitent sur les plantes, dans les fumiers ou dans l'eau, devenir unicolores. Ceux qui sont les plus répandus dans les Alpes sont en général noirs ou d'un brun foncé; et ceux qui dans les zones inférieures sont ornés de couleurs à reflets métalliques deviennent dans les hauteurs d'un noir uniforme. Une foule des coléoptères verts et cuivrés sont sur les hautes Alpes d'un noir pur, un petit nombre seulement d'un bleu d'acier, et d'un bleu foncé: ceux qui sont bruns, olivâtres, et d'un vert doré, passent également au noir pur ou au noir bleuâtre: même la *Chrysomela alpina* jaune devient noir sur les Alpes." He then goes on to suggest as the probable cause of this, the fact that Alpine species live and undergo their metamorphoses for a great part of the year under a thick bed of snow, and consequently in profound darkness. A similar darkening in the coloration of some of our English Coleoptera may be seen as we go northwards, *e. g.* the Highland dark forms of *Carabus catenulatus* and the mountain *Calathus nubigena*. It would be interesting to hear if similar cases occur in other orders. The most probable conclusion seems that darkness of coloration is in some mysterious way correlated with a constitution better fitted to encounter unfavourable conditions of life, more especially meteorological.

Ent. M. M. xiv. p. 17 (1877).

P. Z. S. 1878, p. 120.

10. REPORTS ON THE COLLECTIONS OF BIRDS MADE DURING THE VOYAGE OF H.M.S. 'CHALLENGER.'—No. VII. ON THE BIRDS OF CAPE YORK AND THE NEIGHBOURING ISLANDS (RAINE, WEDNESDAY, AND BOOBY ISLANDS).*

THE collection of Birds made by H.M.S. 'Challenger' at Cape York and in its neighbourhood, of which the following is an account, comprises

* Proc. Zool. Soc. 1878, pp. 120–128. Read Feb. 5, 1878.

61 skins, referable to 37 species. As might have been expected, all, or nearly all, belong to well-known Australian forms, one or two only being left uncertain for want of more materials and on account of the immature condition of the specimens. Most of the skins are in excellent condition; and their value is much increased by the notes in Mr. Murray's journal as to the colour of the soft parts &c. Besides Cape York, Raine Island (at the end of the Barrier Reef), Wednesday Island (in Torres Straits), and Booby Island (also in Torres Straits) were visited, and collections made. I copy the following extracts from Mr. Murray's journal as regards the localities where birds were obtained:—

"Raine Island, Barrier Reef, Australia. Ship landed two boats for nearly three hours. The following birds were taken" (several sea-birds, *Rallus pectoralis*, and *Strepsilas interpres*).

"Cape York, Somerset. Ship arrived on evening of 1st Sept., 1874; left Cape York on Sept. 8th." (44 skins were obtained here.)

"Wednesday Island, Torres Straits. Parties landed the same day (Sept. 8). Most of the birds seen were the same as those shot about Cape York. The following two, however, have not been procured at Cape York; they were shot on shore (*Totanus incanus* and *Ægialites inornatus*). A great many flocks of Bee-eaters were noticed making passages between the islands. P. Z. S. 1878, p. 121.

"On 9th Sept., 1874, a party landed on Booby Island, a very small island, with only a few shrubs on it. The following land birds were shot or brought on board; and in addition a Rail was seen, a *Megapodius*, and one other land bird." (The species obtained were *Todirhamphus sanctus*, *Merops ornatus*, *Zosterops luteus*, *Pachycephala* sp., *Ptilopus superbus*, and *Synœcus cervinus*.)

In the following list I have, with a few exceptions, followed the arrangement and nomenclature of Mr. Gould's 'Handbook to the Birds of Australia.'

1. Ninox boobook (Lath.).

Ninox boobook, Sharpe, Cat. of B. ii. p. 168.

Spiloglaux marmoratus, Gld. Handb. B. Austr. i. p. 73.

One male skin of this species from Cape York. No. 167. "Stomach contained insects" (Murray, MS.).

The specimen sent agrees generally with two skins in Mr. Godman's collection from the same locality, and with Mr. Gould's description of *Spiloglaux marmoratus*, which Mr. Sharpe, in the second volume of his catalogue, treats as "the adult of the large form of *N. boobook*" (*l. c.* p. 170).

2. Podargus papuensis, Quoy & Gaim.

Podargus papuensis, Quoy & Gaim. Voy. de l'Astrol. Ois. t. 13; Gould, B. of Austr. Supp. pl.; id. Handb. B. Austr. i. p. 91.

"No. 186, ♀. Eyes red, feet and bill light yellow. Stomach contained insects." Cape York, one specimen.

3. Merops ornatus, Lath.

Merops ornatus, Gld. B. of Austr. ii. pl. 16; id. Handb. i. p. 117.

In all four specimens of this common Australian species. Two females from Booby Island (Nos. 199, 200), and a pair (♂ & ♀) from Cape York (nos. 147 and 178). Of all the eyes are stated to be "red," and the feet and legs black, except the female from Cape York, which is described as having the legs "with violet tint." The three females differ considerably from one another in the length of the produced middle tail-feathers; in the male the produced part is thinner and at least twice as long as in the other sex.

4. Todirhamphus sanctus (Vig. & Horsf.).

Todirhamphus sanctus, Gld. Handb. B. Austr. i. p. 128; Sharpe, Alced. pl. 91.

One specimen from Booby Island. "No. 192, ♂. Eyes black; mandibles black, except base of lower one, which is whitish. Stomach had remains of a crab."

P. Z. S. 1878, p. 122. 5. Halcyon macleayi, Jard. & Selby.

Halcyon macleayi, Jard. & Selby, Ill. Orn. vol. iii. pl. 101; Gld. B. of Austr. ii. pl. 24; Sharpe, Alc. pl. 78.

Cyanalcyon macleayi, Gld. Handb. B. Austral. i. p. 133.

One male specimen from Cape York. "No. 161. Eyes, bill, and legs black. Stomach contained insects."

6. Artamus leucopygialis, Gld.

Artamus leucopygialis, Gld. B. of Austr. ii. pl. 33; id. Handb. i. p. 154.

One specimen from Cape York. "No. 177, ♂. Bill blue tipped with black, feet black. Stomach contained insects."

7. Graucalus hypoleucus, Gld.

Graucalus hypoleucus, Gld. B. of Austr. ii. pl. 57; id. Handb. i. p. 196.

One skin of this species from Cape York. "No. 151, ♀. Legs, bill, and eyes black. Stomach contained insects."

8. Pachycephala, sp. inc.

"No. 196, ♂. Pachycephala. Eyes brown, bill and legs horn-colour. Stomach had insects."

A single skin of a *Pachycephala* from Booby Island, immature, still retaining some of the rufous feathers characteristic of immaturity in its wings. It is certainly one of the species which, when adult, are yellow beneath, the under tail-coverts being bright gamboge-yellow. The species of this group are so hard to determine, unless males and in adult plumage, that it seems better to leave this bird, although not exactly like any *Pachycephala* I have been able to examine in the British Museum or in Mr. Godman's collection, without a name for the present, more particularly as Mr. Sharpe is, I believe, now working at this group for the next volume of his catalogue.

9. Pinarolestes rufigaster (Gld.).

Colluricincla rufigaster, Gld. B. of Austr. i. p. xxxvii; id. Handb. B. Austr. i. p. 226.

Pinarolestes rufigaster, Sharpe, Cat. of B. iii. p. 296.

"No. 170, ♀. Shrike."

One specimen, from Cape York, of this difficult genus. Mr. Gould, to whom I showed the specimen, was inclined to identify it with his *Colluricincla parvissima* * (Ann. & Mag. N. H. ser. 4, x. p. 114), and has kindly lent me the type of that species (which Mr. Sharpe, *t. c.* p. 297, treats as the young of *P. rufigaster*) for comparison. I find, however, that the Cape-York bird has a distinctly shorter wing, a stronger and more arched bill, and is less rufous on the underside. Mr. Sharpe, who has recently worked up this group for his catalogue, has examined this specimen, and refers it to *P. rufigaster*.

10. Manucodia gouldi, Gray. P. Z. S. 1878, p. 123.

Manucodia gouldi, Gld. Handb. B. Austr. i. p. 236; Sharpe, Cat. of B. iii. p. 181.

Manucodia keraudreni, Gld. B. Austr. Suppl. pl. 9.

Two female specimens. "No. 152. Bower-bird. Eyes orange, bill and legs black. Stomach contained small seeds. For curious loop in the wind-pipe see body. This bird was shot on the island opposite Somerset by Moseley." The colours of the soft parts and contents of the stomach are the same in the other specimen.

The two skins sent agree well with Mr. Sharpe's description and differ from Mr. Elliot's figure of the New-Guinea species (*M. keraudreni*) in the points noticed in Gray's original description of the species. The curious conformation of the trachea in *M. keraudreni* has long been known, having been originally described by Lesson. Beccari (Ibis, 1876, p. 252) says he thinks it probable that this is a peculiarity of the male sex. Mr. Murray's notes, however, would seem to contradict this view, unless, as is hardly likely, two species otherwise so nearly allied should differ in this peculiarity.

* Count Salvadori suggests that this really = *P. megarhynchus* of New Guinea.

11. Ptilorhis alberti, Elliot.

Ptiloris alberti, Ell. P. Z. S. 1871, p. 583; id. Mon. Parad. pl. xxiv.; Sharpe, Cat. of B. iii. p. 156.

Ptiloris magnificus, Gould, B. Austr. Suppl. pl. 51.

Craspedophora magnifica, id. Handb. i. p. 595.

Six skins of this Rifle-bird from Cape York, four of which are adult males in full plumage, and one a female. Another, marked ♀, is either a young male coming into full plumage, or more probably an aged female assuming male plumage, as some of the feathers on the top of the head show traces of a metallic blue colour, as also does the shoulder, whilst more or fewer of the primaries on each side have acquired the black colour characteristic of the male. Of Nos. 164 and 165 it is noted in Mr. Murray's journal:—"Males: eyes, bill, and legs black, soles of the feet yellow. The stomach contained a red fruit, with a large stone about the size of a pea. Some parts of insects in 165." Of No. 184, "Female: eyes black; stomach contained ants and grubs." Besides the specimens sent, several others seem to have been procured. An interesting account of the shooting of these specimens will be found in Lord George Campbell's 'Log Letters from the 'Challenger,'' p. 185.

12. Mimeta viridis (Lath.).

Mimeta viridis, Gld. Handb. B. Austr. i. p. 462.

Oriolus viridis, Gld. B. Austr. iv. pl. 13; Sharpe, Cat. of B. iii. p. 212.

A young male from Cape York, agreeing generally with Mr. Sharpe's description (*l. c.*) of the young bird. "No. 169, ♂. Thrush."

13. Mimeta flavocinctus (King).

Mimeta flavocincta, Gld. Handb. B. Austr. i. p. 466.

P. Z. S. 1878, p. 124. *Oriolus flavocinctus*, Gld. B. of Austr. iv. pl. 14.

Oriolus flavicinctus, Sharpe, Cat. of B. iii. p. 206.

An adult male from Cape York, agreeing with skins in Mr. Godman's collection, collected by Cockerell. "No. 189, ♂. Shrike. Eyes red, bill red, feet bluish."

14. Sphecotheres flaviventris, Gld.

Sphecotheres flaviventris, Gld. B. of Austr. Suppl. pl. 37; id. Handb. B. Austr. i. p. 468; Sharpe, Cat. of B. iii. p. 225.

Three specimens from Cape York, of which two are males in full plumage, agreeing with specimens in Mr. Godman's collection. "Nos. 172, 173. Eyes black, feet flesh, bill black." The third specimen is marked female ("No. 174, ♀. Eyes black, bill horn, legs brownish. Stomach contained insects and seeds"), but, as there are traces of yellow on the breast, is more probably a young male assuming the adult plumage. The orbits in this bird (in the skin) are dark brownish black, not yellow, though this is probably accidental. In other points, too, particularly in the plainly striated under tail-coverts, and the colouring of the upper surface of the head, the specimen hardly agrees with Mr. Gould's description of the female *S. flaviventris*. Mr. Gould, to whom I have shown it, would give no decided opinion on it; but Mr. Sharpe has examined it, and pronounces it to be of this species.

15. Ptilotis chrysotis, Lewin.

Ptilotis chrysotis, Gld. B. of Austr. iv. pl. 32.

Ptilotis lewinii, Swains.; Gld. Handb. B. Austr. i. p. 503.

Three skins of this common Australian species, which is not recorded from N. Australia in the 'Handbook'—two from Cape York, one from Cape-York Island. "No. 150, ♀. Eyes brown, legs slate, bill black. Stomach contained insects." "No. 157, ♂. Eyes brown, bill black, legs blue, different from No. 156 (*P. filigera*). Stomach contained insects, same as 156."

16. Ptilotis filigera, Gld.

Ptilotis filigera, Gld. B. of Austr. Suppl. pl. 42; id. Handb. B. Austr. i. p. 522.

A single example, from Cape-York Island, of this distinct Honey-eater, originally described by Mr. Gould from this district. "No. 156, ♂. Eyes brown, bill black, legs bluish. Stomach contained insects and small brown bodies like seeds."

17. Philemon buceroides, Swainson.

Tropidorhynchus buceroides, Gld. B. of Austr. Suppl. pl. 44; id. Handb. B. Austr. i. p. 547.

One specimen from Cape York, agreeing with specimens in Mr. Godman's collection. "No. 160, ♀. Leatherhead. Eyes dark red, bill and skin about the head black. Stomach contained beetles and other insects."

18. Myzomela obscura, Gld. P. Z. S. 1878, p. 125.

Myzomela obscura, Gld. B. of Austr. iv. pl. 67; id. Handb. B. Austr. i. p. 559.

A single skin from Cape York. "No. 159, ♂. Eyes brown *."

19. Dicæum hirundinaceum (Shaw).

Dicæum hirundinaceum, Gld. B. of Austr. ii. pl. 34; id. Handb. B. Austr. i. p. 581.

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* Mr. Gould says "bright red."

A single specimen in full plumage, from Cape York. "No. 149, ♂. Eyes black, legs and bill black. Stomach contained green fruit."

20. NECTARINIA FRENATA, Müll.

Nectarinia australis, Gld. B. of Austr. Suppl. pl. 45; id. Handb. B. Austr. i. p. 584.

Three specimens from Cape-York Island (two males in full plumage, and a female) of this Sun-bird, which Mr. Sclater has recently shown to be the *Nectarinia frenata* of Müller (see P. Z. S. 1877, p. 104). "No. 153, ♂; 154, ♂; 155, ♀. Eyes brown, legs and bill black. Stomach contained small insects."

21. ZOSTEROPS LUTEUS, Gld.

Zosterops luteus, Gld. B. of Austr. iv. pl. 83; id. Handb. B. Austr. i. p. 590.

One specimen from Booby Island ("No. 197, ♀. Eyes brown, feet and bill with a bluish tinge. Stomach had small seeds"), which agrees with a specimen of this species collected by Macgillivray, kindly lent to me by Mr. Gould for comparison.

22. CACOMANTIS FLABELLIFORMIS (Lath.).

Cacomantis flabelliformis, Gld. Handb. B. Austr. i. p. 618.

Cuculus cineraceus, Gld. B. of Austr. iv. pl. 86.

A female, from Cape York, of this Cuckoo, agreeing with specimens in Mr. Godman's collection, except in having the breast and underparts much duller rufous, and faintly freckled and banded with dusty—indications, probably, of a young bird. "No. 146, ♀. Cuckoo. Eyes brown, legs yellow on hind aspect, brown on front, bill brown. Contained insects in stomach."

23. CENTROPUS PHASIANUS (Lath.).

Centropus phasianus, Gld. B. of Austr. iv. pl. 92; id. Handb. B. Austr. i. p. 634.

A female from Cape York. "No. 163. Legs bluish, bill horn. Stomach contained insects."

24. MICROGLOSSUM ATERRIMUM (Gmel.).

Microglossum aterrimum, Gld. B. of Austr. Suppl. pl. 61; id. Handb. B. Austr. ii. p. 27; Finsch, Pap. i. p. 370.

P. Z. S. 1878, p. 126. A pair of specimens from Cape York. "No. 185, ♂: eyes black; stomach contained seeds and fruit. No. 188, ♀: stomach contained fruit, same as 185." The male has the beak larger, and feathers of the crest more developed than the female.

25. Trichoglossus swainsonii, Gld.

Trichoglossus swainsonii, Gld. B. of Austr. v. pl. 28.

Trichoglossus multicolor, Gld. Handb. B. Austr. ii. p. 93.

A pair of this well-known species from Cape York. "No. 145, ♂. Legs and eyes grey. Bill orange, with a darker tinge. Green fruit." "No. 166, ♂. Same as 145."

This species of *Trichoglossus* is not recorded from the north part of Australia in Mr. Gould's Handbook, though, as noticed by Finsch (Papag. ii. pp. 822 and 824), it extends northwards as far as Cape York.

26. Ptilopus superbus (Temm.).

Ptilonopus superbus, Gld. B. of Austr. v. pl. 57.

Lamprotreron superbus, id. Handb. B. Austr. ii. p. 108.

Two males and a female, from Booby Island, of this Fruit-pigeon. "No. 193, ♀; 194, ♂. Eyes yellow, bills greenish, feet red. Stomachs had nothing in them." "No. 198, ♂. Dove; same as 194. Stomach contained nothing."

27. Carpophaga assimilis, Gld.

Carpophaga assimilis, Gld. B. Austr. Suppl. pl. 67.

Megaloprepia assimilis, Gld. Handb. B. Austr. ii. p. 111.

A male from Cape York, agreeing in coloration and size with specimens in Mr. Godman's collection. "No. 180. Feet green, eyes red, bill greenish yellow, red at base and about nostrils."

28. Geopelia humeralis (Temm.).

Geopelia humeralis, Gld. B. of Austr. v. pl. 72.

Erythrauchœna humeralis, id. Handb. B. Austr. ii. p. 142.

One from Cape York. "No. 171, ♂. Eyes red, feet purple, bill black. Stomach contained fruit."

29. Geopelia tranquilla, Gld.

Geopelia tranquilla, Gld. B. Austr. v. pl. 73; id. Handb. B. Austr. ii. p. 144.

A single specimen, apparently immature, of this little ground-dove from Cape York. "No. 148, ♀. Eyes white, cere blue, bill slate, legs pale flesh-colour. Stomach contained small seeds."

30. Megapodius tumulus, Gld.

Megapodius tumulus, Gld. B. of Austr. v. pl. 79; id. Handb. B. Austr. ii. p. 167.

A single specimen, unsexed, of a Megapode, from Cape York, agreeing with Mr. Gould's description of *M. tumulus*. "No. 168."

P. Z. S. 1878, p. 127.

31. Talegalla lathami (Gray).

Talegalla lathami, Gld. B. of Austr. v. pl. 77.

A male from Cape York, a district from which it is not recorded by Mr. Gould.

"No. 187. Eyes yellow*, head red. Stomach contained seeds."

32. Turnix melanota, Gld.

Turnix melanotus, Gld. Handb. B. Austr. ii. p. 182.

Hemipodius melanotus, Gld. B. of Austr. v. pl. 84.

Two females of this species, originally described by Mr. Gould from Moreton Bay, agreeing perfectly with the description in the 'Handbook.' "No. 176. Cape York, Albany Island. Eyes white, feet yellow, bill yellow and black. Stomach contained insects." "No. 195. Booby Island. Eyes white, legs yellow, base of bill yellow, tip black. Stomach contained small round seeds."

33. Synœcus cervinus, Gld.

Synœcus cervinus, Gld. Handb. B. Austr. ii. p. 195.

A Quail, from Cape-York Island, which agrees with specimens of this species in Mr. Gould's collection. "No. 175, ♂. Eyes brown, feet yellow, (bill ?) bluish black."

34. Ægialites inornatus (Gld.).

Hiaticula inornata, Gld. B. of Austr. vi. pl. 19.

Ochthodromus inornatus, Gld. Handb. B. Austr. ii. p. 237.

A female, from Wednesday Island, agreeing with specimens in Mr. Godman's collection, but with the markings on the face and the pectoral band somewhat darker. "No. 191. Wednesday Island. Eyes, legs, and bill black."

35. Totanus incanus (Gm.).

Totanus pulverulentus, Müll. Natuurk. Verhand. Land- en Volkenk. p. 152.

Totanus griseopygius, Gld. B. of Austr. vi. pl. 38.

Gambetta pulverulentus, Gld. Handb. B. Austr. ii. p. 268.

One from Wednesday Island. "No. 190, ♀ Sandpiper. Legs yellow, bill blackish, eyes black. Stomach contained remains of Crustacea."

36. Strepsilas interpres, L.

Three specimens from Raine Island. "No. 128, ♂. Eyes brown, feet light red with black claws, bill black. Stomach contained small

* "Brown,' according to Mr. Gould; his was probably a younger bird.

calcareous particles." "No. 129, ♀. Same as 128." "No. 142, ♀. Same as 128."

37. Rallus pectoralis, Gld.

Rallus pectoralis, Gld. B. Austr. vi. pl. 76.

Two males and a young female, from Raine Island, of this well-known species. The young bird, No. 130, resembles the old one generally in coloration, but has all the colours duller, the transverse barring of the lower surface much less conspicuous and altogether wanting on the breast, the white spots of the scapularies absent, those on the wing-coverts smaller, and those on the tertiaries also smaller, and tinged with rufous; the primaries also are less conspicuously banded with rufous. P. Z. S. 1878, p. 128.

"Nos. 126, 127, males. Eyes red, upper mandible dark, the lower with a slight red tinge, feet light brown. Stomach contained beetles, egg-shells, and small calcareous particles."

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11. ON A SMALL COLLECTION OF BIRDS FROM THE SAMOAN ISLANDS AND THE ISLAND OF ROTUMAH, CENTRAL PACIFIC.* P. Z. S. 1878, p. 351.

Mr. Sclater has lately put into my hands for determination a small collection of birds from the above localities, made by the Rev. G. Brown, C.M.Z.S., of the Wesleyan Mission. It consists of 47 skins referable to 19 species. Of these all but 4 skins, of two species, are from the Samoan Islands of Upolu and Savaii, and are well known already as inhabitants of these islands. They require no further notice here, except one.

Pachycephala icteroides, Peale; Finsch & Hartl. Faun. Centr.-Polyn. p. 76.

Three examples of this species, in different stages of plumage, though none are quite adult, traces of the rufous plumage of immaturity remaining to a greater or less extent. All are marked "from Upolu;" and the native name given is "Vasavasa." Mr. Layard (P. Z. S. 1876, p. 494) doubts the occurrence of this species in Samoa, and refers the bird from those islands to *P. flavifrons* (Peale), which, as Dr. Finsch has shown (J. f. O. 1872, p. 39), is the adult male of *P. icteroides*.

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* Proc. Zool. Soc. 1878, pp. 351–353. Read March 19, 1878.

The island of Rotumah is, as far as I am aware, entirely unknown ornithologically; and the three skins in this collection from that locality are, I believe, the first that have ever been received from the island. It is a small island, 4 or 5 miles in extent from north to south, and was discovered by Captain Edwards in his search for the 'Bounty' in 1791. It lies nearly midway between the Fijis and the Ellice group, in about
P. Z. S. 1878, p. 352. long. 177° E., lat. 12½° S. Some account of it will be found in the 'South-Pacific Directory,' 3rd edition, p. 627 (London, 1871). The two species of birds of this island represented are:—

APLONIS VITIENSIS, Layard, P. Z. S. 1876, p. 502.

Aplonis tavuensis, F. & H. Faun. Centr.-Polyn. p. 103, t. x. f. 2 (nec Gmelin).

One skin of this species, agreeing with skins from Fiji in the British Museum, and others from the same islands in the 'Challenger' collections, determined by Dr. Finsch as "*Aplonis vitiensis*, Lay." (conf. Finsch, P. Z. S. 1877, p. 735). The native name is given as "Husila."

MYZOMELA CHERMESINA, G. R. Gray, G. B. i. pl. 38; id. Cat. B. Trop. Islands, p. 11.

This species was figured by Mitchell in the 'Genera of Birds,' but not described; nor was any locality mentioned for it in the list of species of *Myzomela* in the same work. Bonaparte, however, in his 'Conspectus,' gave "New Guinea" as the habitat, though what reason for this he had, other than at that time "Nova Guinea" was a convenient "refuge for the destitute," is not known. The figure in the 'Genera' represents a bird with a uniform scarlet under surface; but fortunately the original specimen is still in existence, mounted in the Bird Gallery of the British Museum. Two specimens of a *Myzomela*, certainly distinct from any other known as inhabiting the Pacific Islands, were contained in Mr. Brown's collection from Rotumah; and a look at Gray's figure sufficed to indicate considerable differences between the two birds. On examining, however, Gray's type of his *M. chermesina*, it became evident at once that the two birds were really identical, and that the apparent difference, consisting in the belly and vent being of a uniform red in the plate, instead of a brownish-black, was due to a mistake on the artist's part. As *Myzomela chermesina* has not yet been described, and is irrecognizable from Gray's figure, I herewith proceed to give a diagnosis and description.

MYZOMELA CHERMESINA, G. R. Gray, Gen. B. i. pl. 38; id. B. Trop. Isl. Pacif. p. 11; Bp. Consp. Av. i. p. 394. sp. 3 ("ex Nova Guinea"!); Gray, Hand-l. B. i. p. 154. no. 1989 ("New Guinea ?").

♂ (*ad.*?). *Fusco-nigricans, alis caudaque nitore nonnullo metallico; mento, gula, pectore lateribusque abdominis, cum dorso uropygioque,* *nitide coccineis, plumis basi nigris; rostro nigro, pedibus brunneo-corneis. Long. tot. circa* $4\frac{1}{2}$, *rostr.* $\frac{5}{8}$, *al.* 3, *caud.* 2 (poll. Angl.).

Male. Fuscous-black; interscaplars and wing-coverts darker, and with a slight metallic gloss, which extends onto the tail; primaries browner, the internal web narrowly margined with whitish, except at tip; wings beneath pale greyish-brown; chin, throat, breast, sides of belly till near legs, back, rump, and upper tail-coverts shining crimson-scarlet, the feathers black at base; beak black; legs dark horn-colour.

A second specimen, marked female, resembles in general that described, but is rather smaller, and all the colours are duller, particularly the red of the throat and chest, so that the black-brown of the back forms a broad ring between the chin and breast. The under wing-coverts are whitish, and the pale internal margin of the primaries more conspicuous. It is probably a younger bird. P. Z. S. 1878, p. 353.

Habitat. Island of Rotumah, Central Pacific. Native name "Aramea." I ought to mention that Mr. Sharpe has lately received, in a collection from Erromango, one of the New Hebrides, a specimen of this bird almost identical with mine in every respect. This is very curious; for Erromango is far removed from Rotumah, and the neighbouring island of Tanna is inhabited by a *distinct* species (*Myzomela cardinalis* (Gm.), figured in Latham's Synopsis, vol. i. pl. xxxiii. fig. 2).

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12. LETTER CONCERNING THE LOCALITY OF *GARRULUS LIDTHI.**

Ibis, 1878, p. 491.

To the Editors of 'The Ibis.'

SIRS,—

In Messrs. Blakiston and Pryer's list of the birds of Japan, published in the July number of 'The Ibis' for the present year (pp. 209–250), but two species of *Garrulus*, *G. brandti* and *G. japonicus*, are recorded as being natives of Japan. To these *Garrulus lidthi* of Bonaparte (P. Z. S. 1850, p. 80, t. xvii.) should certainly be added; for though for a long time its exact *patria* was uncertain, yet now there can be little doubt (*conf.* Count Salvadori's observations in Atti Acc. Reale Tor. vii. pp. 473–476 [1872], duly noticed in 'The Ibis' [1873, p. 478] and 'Zoological Record' [1872, p. 53]) that Japan is the true habitat of this fine Jay. I believe, however, that the exact island or islands where it occurs have yet to be ascertained.

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* Ibis, 1878, p. 491.

Ent. M. M. xiv. p. 233 (1878).

13. *STAPHYLINUS FULVIPES* IN THE NEW FOREST.*

On two occasions last year, whilst staying at Lyndhurst for a few days, I had the good fortune to meet with a specimen of this rare and very pretty insect. Both captures were decidedly "flukes," as I shook the first out of moss in Beecham Lane on March 29th, whilst the second was taken running on the ground in a grassy ride at night, attracted thither by the light of a sugaring-lantern, at the end of July. This second capture was effected in the same wood where, in 1876, I took *Quedius dilatatus* at sugar. *Staphylinus fulvipes* has not, I think, been recorded from this district before; hitherto, Folkestone, Home Fen, and the Glasgow district seem to have been the localities most favoured by it.

P. Z. S. 1879, p. 420.

14. ON THE ANATOMY OF THE AFRICAN ELEPHANT (*ELEPHAS AFRICANUS*, Blum.).†

Although the African Elephant was well known, both in their wars and games, to the Romans, till within the last few years hardly any specimens of this species had been seen in Europe since the days of the Roman Empire. With but one exception, as far as I can find out, all our knowledge of the soft structures of the Proboscidea has been, till the present year, derived from examination of the Asiatic species. In his 'Mémoires pour servir à l'histoire naturelle des Animaux'‡, published in 1734 by the Académie Royale des Sciences of Paris, Claude Perrault describes an African Elephant "du Royaume de Congo," which
P. Z. S. 1879, p. 421. was presented to the King of France by the King of Portugal, and lived from 1668 to 1681 at Versailles, when it died and came into his hands for dissection§. In his memoir on this specimen (which extends over fifty pages) the anatomy of most of the soft parts is described, though, as a rule, somewhat briefly, that of the trunk, structure of the nasal organs, and female reproductive organs only being described at greater length. In the following account I shall make reference, where

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* Ent. Month. Mag. xiv. p. 233 (1878).

† Proc. Zool. Soc. 1879, pp. 420–435. Read May 6, 1879.

‡ Tome iii. partie 3, pp. 101–156, pls. 19–24.

§ This animal was a female, and was supposed to be, when it arrived in Paris, about four years old. (It was probably much older.) It was then 7½ feet high, but during the thirteen years it lived at Versailles only grew 1 foot in height. M. Perrault gives a figure of this specimen on pl. 19 of his memoir; this figure clearly shows the enormous ears characteristic of the African Elephant, but is very defective as regards the hind, and particularly the fore, feet.

necessary, to Perrault's figures and descriptions under the organs described*.

Within the last fifteen years African Elephants have been imported in considerable numbers from Nubia and other parts of the Upper-Nile basin, viâ Egypt and Trieste into Europe†. Altogether considerably more than a hundred must have reached Europe alive; but although some of these must surely, ere now, have fallen victims to the numerous diseases that attack animals in captivity, nothing, as far as I can learn, has been published on the anatomy of any of these animals till the current year. In the first part of the 'Archiv für Naturgeschichte' for the present year (1879), Dr. August von Mojsisovics, of Gratz, has published an article "Zur Kenntniss des afrikanischen Elephanten,"‡ in which he describes certain portions only of the visceral anatomy—namely, the structure of the pharynx, particularly as regards the existence of a "pharyngeal pouch" (hereafter to be alluded to), and of the bronchi, the pancreas and pancreatic duct, and the male genital organs; and of these figures are given on three plates.

During the past winter one of the African Elephants in the possession of the Alexandra Palace Company succumbed to the severity of the weather. By the courtesy of Mr. Jones, the Secretary of the Company, the body was made over to Mr. Bartlett, and was sent up to the Society's Gardens so as to be more easily examined§. As our anatomical knowledge of this species is still so rudimentary, I make no hesitation in laying before the Society the following notes on such parts of its anatomy as I examined, the more so as the very considerable differences which occur in the various accounts of those who have dissected the Indian species || make it advisable to put on record any observations, P. Z. S. 1879, p. 422.

* Besides this, there are a few short statements on various parts of the anatomy of *E. africanus* in Prof. Flower's lectures on the digestive organs of Mammalia (alluded to below) and in Prof. Macalister's recently published 'Morphology of Vertebrata.' Donitz has described the kidney (Reichert & Du Bois-Reymond's Archiv, 1872, p. 85).

† For an account of the introduction of African Elephants into Europe, see a letter by Carl Hagenbeck, the well-known animal-dealer of Hamburg, in 'Land and Water,' March 29, 1879.

‡ *L. c.* pp. 56–92, t. v.–vii.

§ Unfortunately this was not effected till about one week after the death of the animal. This fact, as well as the deaths of several other large animals requiring examination at the same period, made the preliminary dissections rather hurried, and must be an excuse for any errors or omissions in the following descriptions.

|| The amount of literature on the anatomy of the Indian Elephant is very considerable. A *résumé* of the principal papers on the subject will be found in Messrs. Miall and Greenwood's 'Anatomy of the Indian Elephant' (pp. 6, 7), recently published, a book which is itself a useful compendium of our present knowledge of Proboscidean anatomy. The myology, however, is described at greater length than any other parts.

however fragmentary, for the benefit of future dissectors of either of these huge animals.

The subject of these notes was a young female, which had been in the possession of the Alexandra Company only about eighteen months, but was probably four or five years old at the time of its death. I took the following measurements of the carcass :—

	inches.
From forehead to root of tail (along back)	78
Length of tail, from root	$26\frac{1}{2}$
Height at shoulder (measured to spines of vertebræ over body)	58
Circumference of right foot, fore	25
Circumference of right foot, hind	25
Length of ear, from front of meatus	19
Greatest depth	27

These measurements show that the ordinarily accepted rule that the height of an Elephant = twice the circumference of its feet very nearly expresses the truth.

As usual in this species, the fore limbs were provided with four, the hind with three nails.

There were eight molars in all in place. In all those of the upper jaw I counted five plates; in those of the lower, there were six in the first, and seven in the second, tooth, of each side.

The most remarkable point observed, when the ribs and other walls of the right side of the body had been removed, was the enormous extent of the thoracic cavity, which extended backwards above till near the sacrum, and the comparatively small part occupied by the abdominal viscera; this was, as far as I could judge, not more than about one third of the whole trunk. As is usually the case with Elephants, there was no fat visible, either in the subcutaneous tissue or in any part of the abdominal cavity.

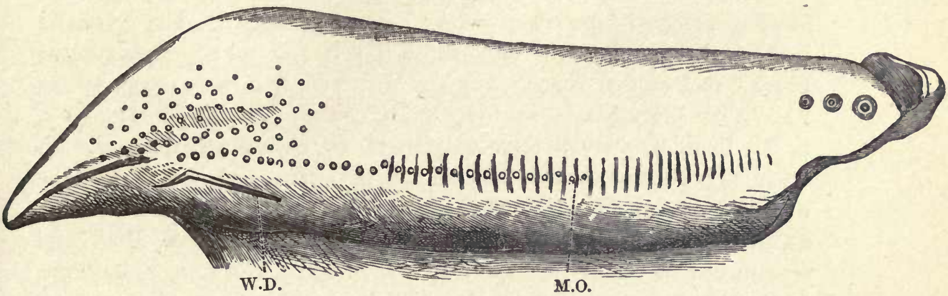
Mouth and Tongue.—The palate, gums, and cheeks were throughout smooth, with no ridges or papillæ, except a few small caruncular projections near the anterior ends of the lower gums.

The tongue (fig. 1, p. 49), as in the Indian species, is small for the size of the animal, much compressed, and rather deep*. Its anterior end alone is free for about $2\frac{1}{2}$ inches, and is bent down at an angle with the rest of the organ, and somewhat pointed. The length of the tongue in a straight line was $13\frac{1}{2}$ inches, along the curve 15 inches. The filiform papillæ are extremely fine and small, so that the tongue has an almost velvety touch. At the sides of the anterior part, extending

* Dr. Mojsisovics's figure (*l. c.* Taf. v. fig. 1) is evidently taken from a preserved and distorted specimen, and fails to show accurately the real shape of the tongue when fresh.

from near the papilla of Wharton's duct towards the tip, where it becomes obsolete, is a slightly raised longitudinal line. Below this are the openings of a considerable number of small glands, situated, apparently, in the substance of the tongue itself. Above and behind P. Z. S. 1879, p. 423.

Fig. 1.



Tongue of the African Elephant (reduced).
W.D. Wharton's duct. M.O. Mayer's organ.

this line are scattered about a few fungiform papillæ; but these get smaller, and ultimately disappear, towards the middle line, and extend but a small distance backwards over the sides of the tongue.

In a line with, and continued back from, this raised line, a single series of rather conspicuous, elevated papillæ, apparently of a glandular nature, is seen. These are continuous behind with "Mayer's organ"*, a series of vertical slit-like depressions, the larger of which are each provided with a pair of glandular papillæ, probably connected with mucous glands in the substance of the tongue. I counted about thirty-three slits in this organ, which extends backwards on the sides of the tongue for 5¼ inches, till within about an inch of the circumvallate papillæ. The slits are largest and deepest, and have their glands proportionately larger, a little before the end of the organ: the longest slit is ½ inch long. In the anterior part of the organ the papillæ of the sides of the tongue stand on the ridges between the slits; but more posteriorly this arrangement disappears. The circumvallate papillæ are situated near the back of the tongue, and nearer the middle line than the glands and papillæ just described. On the right side there are four, on the left three, with indications of a fourth. The posterior ones are considerably the larger (⅜ inch in diameter). The tongue is rounded off and considerably narrowed behind the circumvallate papillæ. In the walls of the pharynx in this region are a few irregular, raised, glandular patches, which attain a considerable size in the middle line.

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* So called in honour of its discoverer, Dr. C. Mayer (*cf.* Nov. Act. Acad. C. L. vol. xx. p. 746).

The tonsils are rather large and deep depressions. In the bottom are seen the openings of many conspicuous and rather large solitary glands. The length of each tonsil is about 2 inches. Between the tonsils the root of the tongue is narrowed to about an inch, so that the fauces become extremely small. Between the two posterior pillars a few thin wrinkled folds of mucous membrane run across in front of the epiglottis, forming the "*plica palato-epiglottica*" of Mojsisovics *. The epiglottis is short, thick, and evenly rounded. I failed to detect any "pharyngeal pouch," such as that described by Dr. Watson †, or even to recognize the "leicht zu übersehende, seichte Grube," which Dr. Mojsisovics (*l. c.* p. 60) found as its sole representative in the animal he examined. In other respects my observations on the pharynx closely agree with the descriptions and figure (*l. c.* Taf. v. fig. 1) of the last-named naturalist, as also with the description of the pharynx by Messrs. Miall and Greenwood in the Indian species (*l. c.* p. 52). The former, however, does not apparently recognize the subdivision of his "inner" pharyngeal sac (*l. c.* Taf. v. fig. 1, I) into two by a vertical fold of mucous membrane, which runs from the transverse fold in front backwards to a level with the hinder part of the larynx, and there, after getting deeper, terminates, sending off a fold to the laryngeal mass on one side and to the *palato-pharyngeus* on the other. Such an arrangement is clearly described by Messrs. Miall and Greenwood (*l. c.* p. 52) in their subject; but they mention only a single gland in each of the inner chambers, whereas I find that there are several glands on the *outer* walls only of each of the two innermost chambers of each side. The external chamber on each side is free from glands, as noticed by Dr. Mojsisovics (*l. c.* p. 62).

P. Z. S. 1879, p. 424.

The relations of the various parts of the hyoid arches to each other, and to the muscles in connexion with them, exactly agree with those that obtain in the Indian species, as first pointed out by Prof. Garrod ‡. Between the digastric and the stylo-pharyngeus pass the vessels supplying the thyroid glands.

Salivary Glands.—The parotid gland is large §; Stenson's duct opens in the cheek in the usual position.

The submaxillary gland is small and oval; it measured 2 inches long by $\frac{3}{4}$ inch deep and $\frac{5}{8}$ inch thick. Wharton's duct, 8 inches long, opens on each side on a single linear papilla beneath the tongue on the *frænum linguæ*, about 3 inches from the tip.

The sublingual is 5 inches long, 1 inch wide, and $\frac{5}{8}$ inch thick. It opens by many ducts beneath the tongue.

* *L. c.* p. 62, Taf. v. fig. 1, *pe.*

† Journ. Anat. Phys. viii. 1873, p. 91.

‡ P. Z. S. 1875, p. 365, and figure.

§ This was unfortunately damaged in removing the brain; consequently I can give no details.

Besides the above glands, which are usually present in Mammalia, there is a large, more superficially situated, gland that lies in front of the angle of the jaw on its inner side. This gland is much lobulated, is about 8 inches long, 1 inch wide at its greatest width, and $\frac{1}{2}$ inch thick. It opens by many ducts, some situated on raised papillæ, in the cheek*. It probably corresponds to the molar glands found in many animals, particularly Rodents. Dr. Watson and Messrs. Miall and Greenwood only found the parotid gland present in their examples†. P. Z. S. 1879, p. 425.

Alimentary Canal.—The œsophagus is of but small calibre; at its entrance into the stomach, when cut open and stretched out, it measures 4 inches.

The stomach in shape resembles that of the Indian Elephant as figured by Camper and others. Its long axis lies almost vertically in the animal, with the cardiac end directed upwards, the pyloric being downwards. In a straight line it measures 26 inches from the cardiac to pyloric ends; from the extremity of the cul-de-sac, along the greater curvature to the pylorus, $35\frac{1}{2}$ inches; along the lower curvature $18\frac{1}{2}$ inches. Its greatest depth is 9 inches, at the pylorus only $3\frac{1}{2}$. The rounded cul-de-sac, to the left of the entrance of the œsophagus, is $9\frac{1}{4}$ inches long by $7\frac{3}{4}$ deep. Perrault gives $3\frac{1}{2}$ feet by 14 inches as the dimensions of the stomach in his adult animal. In his figure of this viscus (*l. c.* pl. 20) the cardiac cul-de-sac is represented as nearly conical; and in other respects his representation is not good.

The mucous membrane of the cardiac cul-de-sac is raised up into about fifteen thick zonary folds, which are arranged with considerable regularity in that part of the stomach, but decrease both in size and regularity as they approach the pyloric part; so that the posterior third of the inner part of the stomach is almost smooth, with only slight and irregularly disposed rugæ‡. The folds are very expansible; but in the ordinary state none exceeds about 1 inch in depth. The greater part are continuous all round the stomach; but others blend with adjacent folds; so that it is not possible to count the exact number with any great accuracy. The mucous membrane of the œsophagus is sharply marked off from that of the stomach: here it is covered by numerous short slit-like depressions

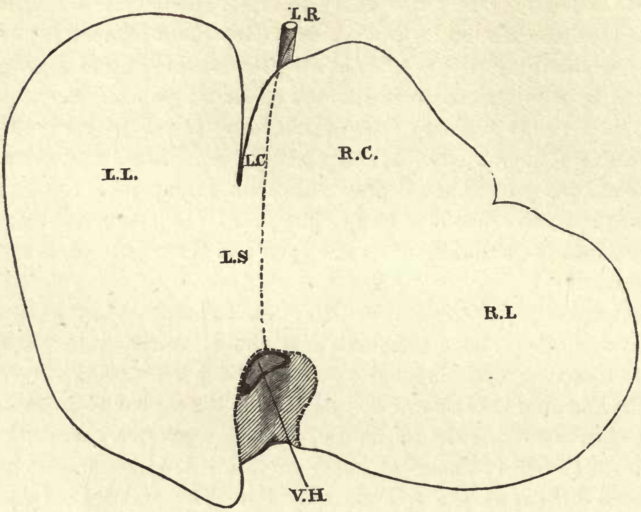
* My friend Mr. W. Ottley, of University College, was kind enough to help me by dissecting out and measuring these glands.

† Mr. Bartlett tells me that in both sexes of the African Elephant the peculiar temporal gland, which is found in the Indian species, and opens externally between the eye and ear, is certainly present. I omitted, unfortunately, to look for it.

‡ Mayer's figure (Nov. Act. Acad. C. L. vol. xxii. pt. 1, pl. iv. fig. 3, 1847) of the stomach of the Indian species does not sufficiently indicate the regularly zonary nature of these folds; in that of Sir James Emerson Tennent ('The Wild Elephant,' p. 59 [1867]), on the other hand, these folds are represented as much too regular and sharply defined.

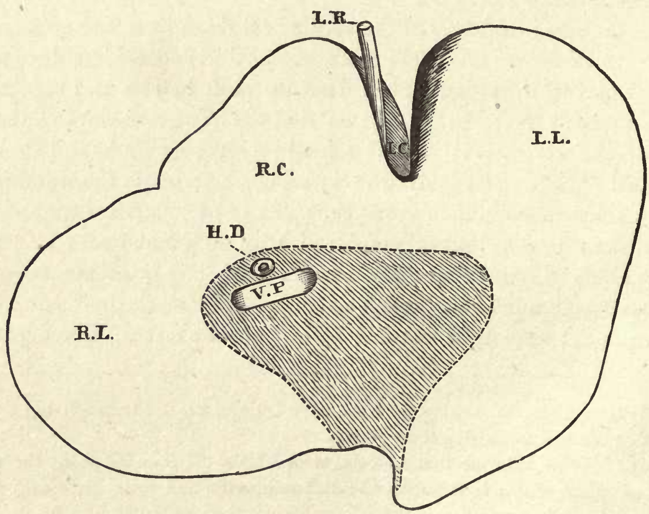
P. Z. S. 1879, p. 426.

Fig. 2.



View of liver of *E. indicus*, from above.

Fig. 4.



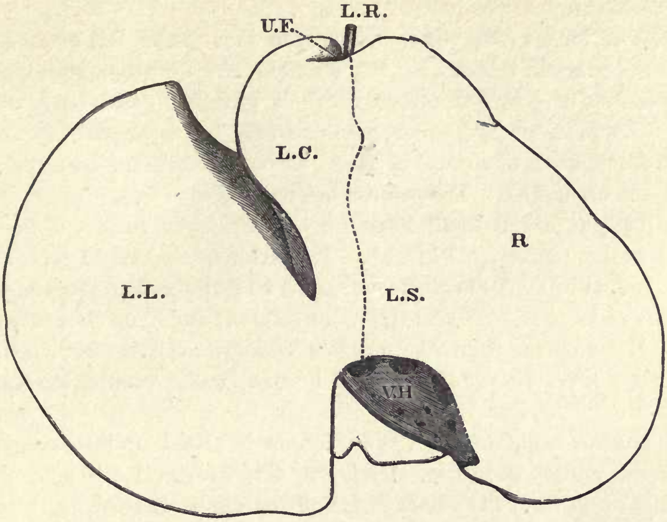
View of liver of *E. indicus*, from below.

All the figures much reduced. Figs. 2 and 4 from drawings by Prof. Garrod.

L.L. Left lateral. L.C. Left central. R.C. Right central. R.L. Right lateral. R.

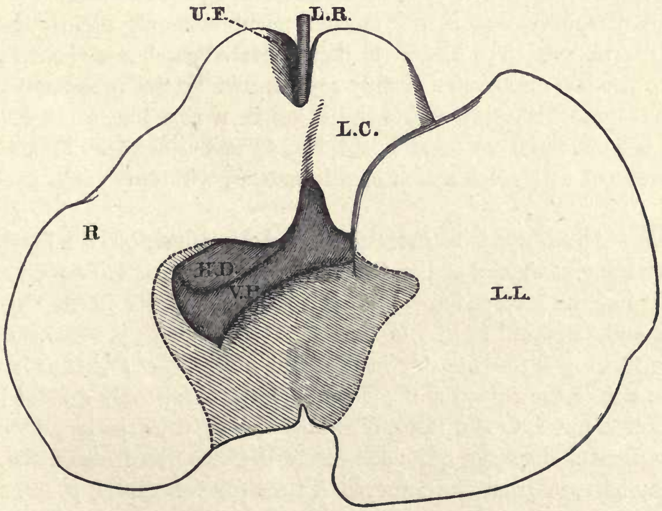
Fig. 3.

P. Z. S. 1879, p. 427.



View of liver of *E. africanus*, from above.

Fig. 5.



View of liver of *E. africanus*, from below.

Right lobe of liver. V.H. Hepatic vein. V.P. Vena Portæ. H.D. Hepatic duct. L.R. Round ligament. L.S. Suspensory ligament. U.F. Umbilical fissure.

(probably mucous canals) in the anterior two thirds; but in the posterior third these disappear or become obsolete.

About $4\frac{1}{2}$ inches from the œsophagus, in the middle line of the lesser curvature, is a small, blunt, slightly elevated, circular prominence, pitted in the centre, of $\frac{1}{6}$ inch diameter, which is probably glandular in nature Prof. Garrod, in his MS. notes, records small glands, apparently formed by the aggregation of several of these, as occurring in a similar position in the Indian species. The pylorus has no distinct valve.

The length of the small intestine was 27 feet 4 inches, of the very capacious large intestine 16 feet *. The latter was arranged on a mesocolon, just as in Prof Flower's description † of the Indian species. The cæcum was large and sacculated, forming a broad and blunt cone 22 inches long. It lay on the right side, near the middle line of the belly, pointing forwards. Prof. Flower (*l. c.*) found it in a similar position on the left side in a fœtal African Elephant.

P. Z. S. 1879, p. 428.

The mucous membrane of the duodenum is raised up into irregularly transverse, almost dendritic, closely set, slightly elevated rugæ. These continue throughout the whole length of the small intestine, but towards the ileum become arranged more longitudinally. For about 6 inches before its opening into the large intestine the ileum is surrounded internally by large, elevated, pitted glandular patches, caused by a breaking-up and intersection of the rugæ, and somewhat resembling an immensely broadened Peyer's patch. For about the last $1\frac{1}{2}$ inch of the ileum these patches disappear, leaving the mucous membrane only slightly longitudinally wrinkled. The longest of these elevated patches is about $1\frac{1}{2}$ inch long. The ileo-cæcal valve is only represented by the prominent edges of the ileum, which project into the colon in a ring-like manner. The ileum is here, when cut up and laid flat, $4\frac{1}{2}$ inches across. The mucous membrane of both colon and cæcum is smooth, with only slight irregular folds.

Liver.—All authors from Perrault onwards have described the Elephant's liver as being composed of two lobes. In his lectures on the organs of digestion of the Mammalia, published some years since in the 'Medical Times and Gazette,' Prof. Flower (*l. c.* Oct. 5, 1872, p. 372) thus describes this organ (presumably in the Indian form):—"The liver is small for the size of the animal and of simple form, being only divided by an umbilical fissure into two lobes, of which the right is the larger." But this statement does not quite accurately describe the facts of the case. As may be seen from the annexed figures (figs. 2 and 4, p. 52) taken

* Perrault gives 38 feet and 22 feet as the lengths of the small and large intestines respectively in his specimen; so that the ratios of the two measurements are nearly the same. The cæcum measured $1\frac{1}{2}$ foot.

† Med. Times and Gazette, Oct. 5, 1872, p. 372.

from drawings by Prof. Garrod (who was the first to point this out to me), of the liver of *Elephas indicus*, the suspensory ligament runs not in, but a little to the right of, the large notch which has been taken for the umbilical fissure by most authors, and is there connected, as usual, by a thin membranous expansion with the round ligament. In this species there is no umbilical notch visible*.

In *Elephas africanus* (figs. 3 and 5, p. 53), the suspensory ligament lies still further to the right of the large notch, and there is a conspicuous umbilical notch (about 2½ inches deep), visible on both surfaces of the liver.

From a comparison of the two livers it becomes clear that in both species the liver consists of *three* lobes, a right lobe (slightly divided in both species), a left central lobe (extremely small in *E. indicus*, but P. Z. S. 1879, clearly marked off in *E. africanus*), and a left lateral lobe, of large size in p. 429. both species. In *E. indicus*, as may be seen from the figures, the right margin of the liver is slightly notched, apparently marking out the distinction of right central and lateral lobes: in *E. africanus*, however, there are two such notches, both very shallow and superficial. In both species there is a large area behind the transverse fissure on the under surface of the liver bare of peritoneal covering (indicated by the portion within the dotted lines in figs. 4 and 5). The angulated line of attachment of the suspensory ligament in this species will also be noticed (fig. 3).

The liver in my specimen weighed 13 lb. 5 oz.: its greatest length transversely was 20¼ inches, the greatest breadth (from behind forwards) 16 inches. In Perrault's example it measured 3½ ft. × 2½ ft. His figure (pl. 20) is not at all like my specimen; nor is Mayer's drawing (*l. c.* pl. v. fig. 1—which, by the way, clearly shows the above-described relations of the suspensory ligament to the large median notch) of that of *E. indicus* very satisfactory.

As in the Indian species, there is no gall-bladder; but the hepatic duct has its epithelium reticulated at the lower end, and is very spacious, measuring 9 inches long by 1⅞ broad.

The pancreas is a lobulated, elongated gland, 17 inches long. It opens by a single, wide and short duct (one inch long) into the hepatic duct at the junction of the latter with the wall of the duodenum, through which the common duct is continued for 3½ inches. The common duct is provided with distinct circular valve-like folds, exactly as shown by Camper (*conf.* also Dr. Mojsisovics's figure, *l. c.* Taf. vi.), and opens on a slightly raised nipple-like projection on the sides of the duodenum; its

* In a liver of *E. indicus* in the Royal College of Surgeons (810 F) there is visible, at the place where the round ligament is lost in the substance of the liver, a narrow fissure, which runs obliquely for some way towards the margin, but does not reach it; so that there is no notch formed.

aperture is about $\frac{1}{8}$ inch broad. Like Perrault and Dr. Mojsisovics, I saw nothing of any secondary pancreatic duct opening into the intestine separately from the hepato-pancreatic one, such as has been described by many naturalists (*conf.* Mojsisovics, *l. c.* pp. 72, 75) in *E indicus.*

Spleen.—This viscus was of a very long irregular oval, with the attached margin nearly straight, the other somewhat irregular. It measured $23\frac{1}{2}$ inches by $5\frac{1}{4}$ across *: it was flattened and thin, and of a slaty-grey colour.

Thyroid Gland.—This consists of two circular cake-like lobes of considerable consistency, united by a short isthmus. Each lobe measures about $4\frac{1}{2}$ inches in diameter.

Heart.—The ventricles were not separated at the apex by any deep groove, such as is noticed by Mayer (*l. c.* p. 44) and Messrs. Miall and Greenwood (*l. c.* p. 68) in *E. indicus.* This separation of the ventricles is probably an individual feature, as neither Hunter (' Observations,' ii. p. 172) nor Vulpian and Philipeaux (as quoted by Miall and Greenwood, *l. s. c.*) observed it. The fossa ovalis was very deep, admitting the first two joints of the index finger. Hunter also (*l. c.*) found the remains of the foramen ovale distinct. The ductus arteriosus was of the size of a
P. Z. S. 1879, p. 430. quill pen, and about one inch long, but quite impermeable. The aorta gives off an innominate artery, which is only an inch long and then divides into right brachial and right and left carotids. The left brachial is given off immediately after the innominate. This agrees with the descriptions of *E. indicus* as given by Hunter, Owen, Vulpian and Philipeaux, Watson, and Miall and Greenwood. On the other hand, Cuvier and Mayer found three trunks, namely two brachials and a common carotid. I found no " *arteria thyroidea inferior simplex* " coming off from the point of division of the two carotids, such as is figured by Mayer (*l. c.* pl. 11. fig. 3) and Watson (Journ. Anat. & Phys. vi. pl. vi. fig. 1). The weight of the heart and great vessels, cut short and cleaned of blood, was 7 lb. There was no *os cordis*; and the same was the case in Perrault's specimen; nor is any such bone recorded in *E. indicus* by recent anatomists.

Respiratory System.—The lungs were very simple in form, each lung being undivided and bluntly triangular in general outline, the left being shorter and broader. In the undistended state they measured as follows:—Right lung 23 inches long by 12 broad, left 21 inches by 14. I found no accessory lobe on the right side, such as has been observed by some anatomists in *E. indicus.* There is no extra bronchus.

The trachea is short, measuring about a foot in length, and not quite two inches in external diameter. It is composed of 28 rings, which are nearly complete, leaving hardly any space behind between their ends.

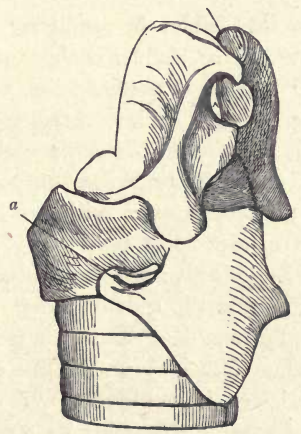
* Perrault gives 3 feet by 7 inches.

They vary considerably in size in different parts of their circumference. The first three rings, as in *E. indicus*, are truncated obliquely behind, the space so formed being covered in by the body of the cricoid cartilage.

The larynx (fig. 6) is of considerable size. The epiglottis, when covered by its soft parts, is short, thick, and rounded. The thyroid consists of two rhomboidal wings, 4 inches long, and 3¼ deep, which are united in front superiorly for about one inch, the deep and narrow notch left between the remaining part of the wings being filled up by connective tissue. The superior cornua are short and scarcely project. The posterior are about one inch long, and are directed downwards and forwards in close proximity with the body of the thyroid cartilage, to which they are attached by connective tissue. The postero-inferior angle of the thyroid cartilage also develops an articular facet; and this is enclosed with that of the posterior cornu, in the common capsule of the crico-thyroid articulation. The cricoid (see fig. 6) is of the usual type. Its anterior part is 1 inch deep, the posterior (somewhat pentagonal) part 2 inches. The processes for articulation with the thyroid stand out in a step-like way, and are more or less clearly divided into two facets, corresponding to the double articulating surfaces of the thyroid.

The arytænoids (see fig. 6) are vertically elongated. Each measures

Fig. 6. P. Z. S. 1879, p. 431.



Larynx of African Elephant (about half nat. size) viewed somewhat obliquely from behind. The thyroid cartilage has been removed. *a*, points to the double facet of the crico-thyroid ariculation.

about 2½ inches long by 1½ broad. They have a conspicuous, vertically directed, raised spine-like process, and a large notch behind the supero-posterior angle. The cartilage of each side articulates with its fellow both above and below this notch. The *processus vocalis* is short and P. Z. S. 1879, p. 430.

P. Z. S. 1879, p. 431. blunt. The true vocal cords are well-marked and thick elastic folds, $2\frac{3}{4}$ inches long. The false vocal cords hardly exist. Between the two is a slight laryngeal pouch, which extends backwards a little way, as in the Indian Elephant (Miall and Greenwood, *l. c.* p. 76). The muscles of the larynx closely agree with those described by the last-named anatomists. The superior fibres of the *crico-arytænoideus posticus* run transversely across in the interval left above by the more inferior, diverging fibres of that muscle.

Urino-genital System.—The kidneys lie in the usual position. Their shape is an irregular oval. The following details refer to the single kidney (right) which I preserved for further examination. The length is 10 inches, the breadth about 6. The hilus is not marginal, but lies about 1 inch from the side; its length is $4\frac{1}{2}$ inches. The weight of the kidney is 3 lb. The kidney is indistinctly divided into eight lobes, which are of varying size and shape; one lobe is scarcely visible on the hilar surface. These lobes are essentially distinct, each consisting of a cortical and medullary part, not, however, very clearly marked off from each other. The Malpighian corpuscles are clearly visible. Perrault's figure of the kidney (*l. c.* pl. 20) is too elongated and shows no lobes. The number of lobes in the kidney of *E. indicus* has been variously stated at from two to eight or nine. The suprarenal bodies resemble those of the Indian species.

The ureters open into the bladder by semilunar slits about 2 inches from its orifice. The neck of the bladder is short and thick.

The female organs are formed on precisely the same type as those of the Indian species*, consisting of a long urino-genital passage ("the common vagina, which is common to the urine and penis" of Hunter), P. Z. S. 1879, p. 432. a secondary vagina ("the proper, or rather uncommon, vagina, which the penis cannot enter"), a corpus uteri, with two horns, and Fallopian tubes and ovaries. The ovaries lie in pouches of peritoneum, attached by peritoneal folds to the kidneys: the one I examined resembled in form those figured by Mayer in the Indian species. It was a little over an inch long, and generally smooth, with only a few small lobular processes and erupted Graafian follicles near the line of attachment to the peritoneal pouch. The latter is continuous with the opening of the Fallopian tube, and is of considerable size: its walls are thickened by muscular fibres, prolonged into it apparently from the Fallopian tubes. The tubes are of small calibre, of the size of a crow-quill, about 3 or 4 inches long, and, after a tortuous course, open into the cornua uteri at the side of that tube, as well shown in Mayer's figure (*l. c.* pl. vi. fig. 2).

The two cornua are about $\frac{1}{2}$ inch across at their commencement, and

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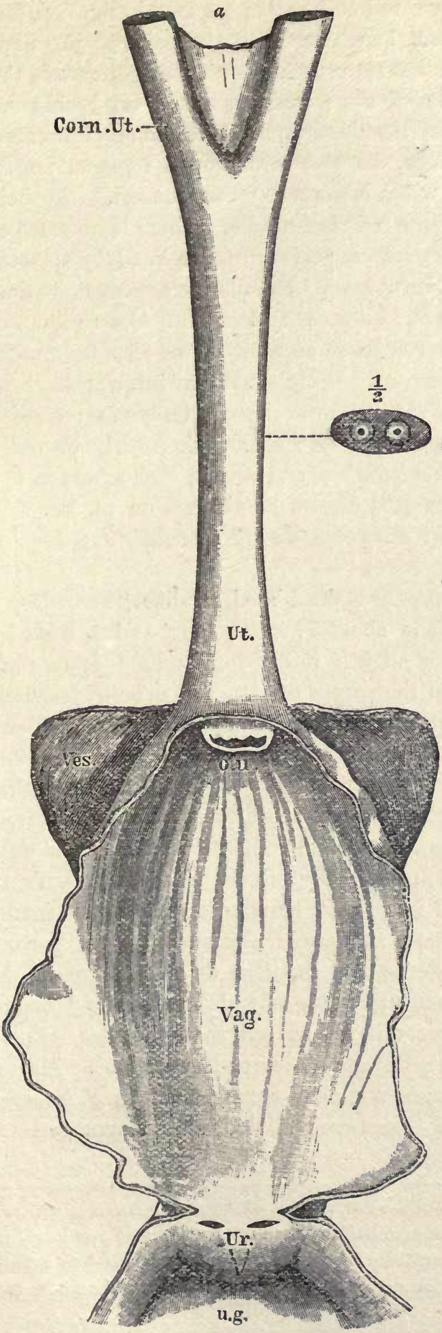
* *Cf.* Hunter, 'Observations,' &c. ii. p. 175; Mayer, *l. c.* p. 37, t. vi.; Owen, Anat. Vert. iii. p. 692; Miall and Greenwood, *l. c.* p. 62, pl. iv.

Fig. 7.

P. Z. S. 1879, p. 433.



a. Uterus and vagina of African Elephant (about half natural size), viewed from behind. The vagina (*Vag.*) and urinogenital canal (*u.g.*) have been laid open from behind. *Corn. ut.* Cornua uteri cut short above. *Ut.* True uterus, formed by the coalescence of the two cornua, but not marked off externally from the conjoined cornua by any constriction. *o.u.* Above this is the valve-like structure corresponding to the *Os uteri.* *Ur.* Prominence on which the urethra opens ; above it are seen the Malpighian canals ; below the letters is the papilla-like free point (*vide* fig. 8). *Ves.* Bladder.

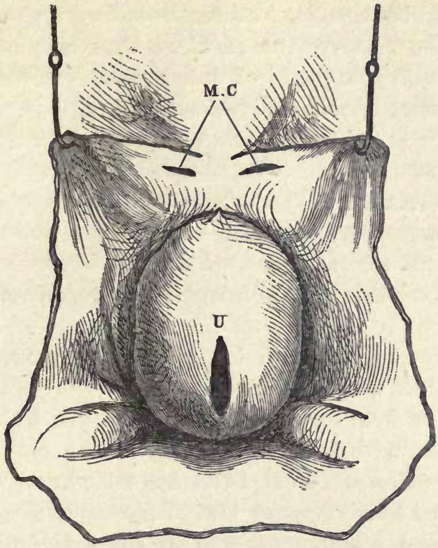
b. Section of the conjoined uterine cornua, half the natural size, to show the distinctness of the two tubes internally at this point.

have very thick muscular and elastic walls. For the last $4\frac{1}{2}$ inches of the course of the cornua they are united together (as seen in fig. 7, p. 59) into a single tube, which is about 1 inch across at the point of junction. This tube is externally single; but nevertheless, on cutting it across, the two comparatively small cavities of the cornua are seen lying beside one another, but separated by a considerable septum. Without any difference in the external calibre of the tube, the two cornua open together into a common cavity $2\frac{1}{2}$ inches long, which is the true "corpus uteri." At their opening each cornu admits a large knitting-needle. There is no valve of any kind at the opening. Both cornua and corpus are lined by smooth, longitudinally plaited, mucous membrane. A similar arrangement to that here described would seem to be indicated by Perrault's description:—"Ces cornes, au lieu de s'écarter et de se séparer comme elles font ordinairement, etoient jointes l'une contre l'autre, montant jusqu'au hauteur d'un pied, et n'étant séparés que par une cloison mitoyenne; ensuite elles se séparent en deux branches." In his example (nearly or quite adult) each horn measured 2 feet 8 inches, and was $1\frac{1}{2}$ inch across at the commencement. The female genital organs he pictures on pl. 21: this shows the conjoined cornua, which are separate till near their end, as seen in section.

The next part of the genital organs is the dilated, sac-like, "secondary" or "uncommon," vagina. This is about $5\frac{3}{4}$ inches long, and is lined by smooth mucous membrane, with slightly raised longitudinal folds, running from the opening into it of the corpus uteri. This opening is small, only admitting the tip of the little finger, and is provided behind with an irregularly bilobed thick valve of mucous membrane. This constriction and valve undoubtedly represent the "os uteri." Perrault describes this "secondary vagina" as the "corps ovale;" in his specimen it measured 18 inches by 6 inches, and was smooth and polished within. It is well shown in his figure (*l. c.* pl. 21); but the "valvule frangée aux embouchures des cornes de la matrice" is not quite like the valve in my specimen. In the text he says, "Deux trous au dedans...étoient entourés par un appendice de la membrane interne...en manière de la frange ou de pavillon." It would appear, then, that in his animal there was no "corpus
P. Z. S. 1879, uteri," such as that which exists in mine, but that the two cornua
p. 434. opened separately into the "corps ovale" (=secondary vagina). Mayer apparently (*l. c.* pl. 6, p. 38) found a similar arrangement in *E. indicus*. Hunter, Owen, and Miall and Greenwood all indicate an arrangement like that which obtained in mine*.

* In a specimen (2776 A) in the College of Surgeons of the uterus &c. of *E. indicus*, the "corpus uteri" is very much more capacious than in my (young) specimen, is about 7 inches long, and is only separated off from the "secondary vagina" by a prominent zonary fold of mucous membrane. The calibres of these two chambers are about the same.

Fig. 8.



Opening of urethra (U) into the urino-genital canal, about natural size (somewhat diagrammatic). The walls of the urino-genital canal are cut close round the urethral eminence. M.C. Malpighian canals; below (anterior to) the letters is seen the constriction separating the vagina from the urino-genital canal; on the top of the urethral eminence is seen the small free point; below it is the cul-de-sac of the urino-genital canal.

N.B. In the natural position the lower parts of the figure are anterior, the upper parts posterior.

The secondary vagina, which lies behind the neck of the bladder, is separated by a constriction, leaving only a very small opening, from the urino-genital chamber, which is marked off by the livid blue colour of its mucous membrane from the parts already described. On each side of this median constriction lies a small obliquely-placed slit, about $\frac{1}{4}$ inch long, and admitting a probe for about the same distance into the small sacs (canals of Malpighi), of which they are the openings. Exactly the same arrangement occurs in the Indian Elephant. There is no trace of any hymen-like organ dividing this median constriction into two, such as noticed by Miall and Greenwood (*l. c.* pl. iv. fig. 3, *h*). This point about corresponds with the entrance of the genital organs into the pelvis. P. Z. S. 1879, p. 435.

Perrault describes and figures (pl. 22) in his example two "valves sigmoïdes," which guarded the "orifice interne de la matrice," and also a "rebord qui s'avançoit au-devant du col de la matrice de la longueur d'environ deux pouces." What the two sigmoid valves are I do not see, as in his figure he indicates the two Malpighian canals as well. The "rebord" probably corresponds to the tumid rounded eminence (fig. 8, *suprà*) about one inch long, terminating above and behind in a little point, on which the urethra opens by a somewhat narrow aperture, just below and in front of the opening into the secondary vagina*. In front of this eminence the urino-genital canal, as the remaining part of these organs may be called, is produced into a small cul-de-sac. The total length of this canal is about 20 inches†; the clitoris, which resembles the same organ in *E. indicus*, and which has similar relations to the urino-genital canal, is about 15 inches from the attachment of its crura to the pelvis to its extremity. The glans clitoridis is about two inches long, rounded anteriorly, flattened and grooved posteriorly, where it is in contact with the urino-genital canal. There is a well-marked preputial-like reversion of the integuments round the glans, as in *E. indicus*.

The brain was removed with but little injury; but its description must be deferred till some future occasion.

As will be seen from the foregoing account, but little difference, on the whole, exists in the visceral anatomy of the only two remaining species of Proboscideans. What differences there are chiefly relate to the stomach, liver, and female organs; but, till more specimens of *E. africanus* have been dissected, it is impossible to say how many of the points above noticed are due to individual peculiarities or those of age and the like. There appears, therefore, little ground, from an anatomical point of view, to separate *Loxodon* as a genus from *Euelephas*.

P. Z. S. 1879, p. 166.

15. ON THE SYSTEMATIC POSITION OF THE GENUS *LATHAMUS* OF LESSON‡.

(Plate I.)

In their paper on Australian birds in the Linnean Society's Transactions for 1828 (vol. xv. p. 74), Messrs. Vigors and Horsfield established a genus *Nanodes*, of which the *Psittacus discolor* of Shaw§ was made the type, and full generic characters were given. Besides *Nanodes discolor*, three other species (those now generally known as *Melopsittacus undulatus*, *Euphema pulchella*, and *Platycercus venustus*) were included in the genus, which was considered by its authors to be allied to *Pezoporus*

* This raised part, on which is the opening of the urethra, is probably identical with the "Klappe" figured by Mayer (*l. c.* pl. vi. fig. 1) as existing between the two orifices of the bladder and vagina.

† In Perrault's adult example the length was 3 feet 6 inches.

‡ Proc. Zool. Soc. 1879, pp. 166–174, Pl. XVI. Read Feb. 18, 1879.

§ White's Voyage, pl. 263 (1790). For the synonymy of the species, see Finsch, Papag. ii. p. 863.

and *Platycercus*, and as connecting these Australian forms with the South-American *Psittacaræ* (= *Conurus* auct.). *Nanodes* having been already used by Schönherr for a genus of Rhynchophorous Coleoptera*, Lesson† substituted for this name that of *Lathamus*, including under that head four other species (one a *Euphema*, one a *Cyanorhamphus*, and two *Trichoglossi*, as now understood), remarking that Swainson "a parfaitement établi ses caractères" in his 'Zoological Illustrations'‡, where, however, *E. pulchella* is considered the type of the genus§. As will be seen from the species associated with it, all these authors were evidently puzzled by the characters of this peculiar little Parrakeet; and the same seems to have been the case with all subsequent naturalists who have treated of it. The majority, however, seem to have considered that it had Trichoglossine affinities. P. Z. S. 1879, p. 167.

Thus Bonaparte|| included *Lathamus* as "dernier des Trichoglossiens;" and Gould, likewise acknowledging the validity of the genus, places it amongst the Trichoglossidæ. He says:—"Having had ample opportunities of observing the bird in a state of nature, I concur in the propriety of separating it into a distinct genus; in its whole economy it is most closely allied to the *Trichoglossi*, and in no degree related to the *Euphemæ*" (Handb. B. Austr. ii. p. 89). Dr. Finsch, in his great work on Parrots¶, after a careful examination of its peculiarities, came to the conclusion that these were not sufficient to justify its separation as a distinct genus, and included it as a *Trichoglossus*. More lately, the same position (*i. e.* that of a member of the family Trichoglossidæ) has been assigned to it by Gray**, Sclater††, Wallace‡‡, and others. On the other hand, Sundevall in his 'Tentamen'§§ placed it in his fourth family "*Platycercini*," remarking, "Hæc species, plerumque cum sp. Trichoglossinis (*Ps. concinno* &c.) consociata, vera tamen est species Platycercina, maxillâ inferiori tumidâ, &c., *Euphemæ* maxime affinis." In his paper on the anatomy of the Parrots, Prof. Garrod|||| shows that *Lathamus* differs from *Lorius* and its allies in having a superficial left carotid, a feature common to it and *Platycercus*, *Psephotus*, &c., from which, however,

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* Schönh. Curcul. Disp. Meth. p. 322 (1826).

† Traité d'Orn. p. 205 (1831).

‡ 2nd series, vol. i. part 5, no. 21 (1829).

§ Swainson, however, in his 'Classification of Birds' (vol. ii. p. 304, 1837), makes *Lathamus* a member of his "subfamily Platycercinæ," in which he also includes *Coracopsis*, *Pezoporus*, *Platycercus*, and *Calopsitta*, with the remark that it is a "subtypical" form.

|| Comptes Rend. xliv. p. 536 (1857).

¶ Pap. ii. p. 863 (1868).

** *Trichoglossus*, c. *Nanodes*, gen. no. 2047, Hand-l. B. ii. p. 156 (1870).

†† List Vert. 6th ed. p. 269 (1877).

‡‡ Geogr. Distrib. Animals, ii. p. 327.

§§ Methodi Naturalis Avium disponendarum Tentamen, p. 71 (1872).

|||| P. Z. S. 1874, p. 586.

it differs in the possession of a furcula *. He further says:—"It may at first seem very heretical to remove *Lathamus* from the Loriinæ, the brush-tongue being considered characteristic of that subfamily. To the unbiased student, however, the brush-tongue is a character not more important than several of those that have been above considered. . . . . The character of the papillæ is somewhat different in *Lathamus* from what it is in *Lorius*, they being blunter and shorter in the former genus than in the latter."

Having undertaken at Prof. Garrod's suggestion an investigation of the pterylosis of the Parrots, the results of which I hope to communicate to this Society at no distant date, *Lathamus* was one of the first forms I examined; and I at once saw that its pterylosis confirmed the relationship of this form to the Platycercinæ already insisted on by Sundevall and Garrod. From this I was led to an examination of some other parts of
P. Z. S. 1879, p. 168. its structure; and I propose to lay the results of my inquiries before the Society to-night, in order to establish the view that *Lathamus* must be removed from the brush-tongued Trichoglossinæ, with which it has been so generally associated, and must be considered a (no doubt aberrant) member of the Platycercine group.

The pterylosis of this form having first struck my attention, I will describe this in the first instance, the more so as, as far as I know, no description of this part of the structure of the bird in question has yet been published. I may perhaps anticipate part of my paper on the pterylosis of the Psittaci in general, and point out briefly the general characters of the distribution of the feathering in these birds, so as to enable the reader without any further trouble to appreciate the points of distinction in this respect between *Lathamus* and the other species with which I have compared it.

As will be evident from the figures (Plate I. figs. 1–6), the tracts of contour-feathers in a Parrot may be arranged as follows:—On the upper surface of the body, continuous in front with the feathering of the top and sides of the head, is a long narrow tract, the "superior tract," which divides behind in the interscapular region in a fork-like manner, forming the "scapular fork." Behind this, occupying the hinder part of the back and pelvis, is another, more or less Y-shaped tract, with the "handle" (which is usually short) of the fork placed close to the posterior extremity of the trunk, whilst the more lengthy "arms" of the Y are more anterior and run in, in front, between the corresponding ones of the "scapular fork," usually becoming very feebly feathered in so doing. This tract may be called the "dorso-lumbar" fork. Scattered more irregularly and

* M. Blanchard, indeed, says (Compt. Rend. 1857, xliv. p. 521) that *Lathamus* has no furcula; but this bone is present, though small and weak, in the specimens I have seen: *cf.* also Owen, Cat. Ost. Ser. R. C. S. i. p. 279 (1853).

diffusely over the sides of the pelvis, and external to the last-named tract, is the "lumbar feathering," which passes posteriorly on each side into the narrower but more distinct "femoral tracts." These are continued onto the legs as far as the tarsi as the "crural tracts," clothing the legs in a trouser-like way. On the inferior surface, on each side, is a continuous tract, running from the upper part of the neck (where it may or may not unite with its fellow of the opposite side), over the breast and abdomen, to the anus. This "inferior tract," besides one or two small branches running towards the humerus and patagium (the first and second "humeral tracts"), gives off, at about the commencement of the sternum, a more or less separate and well-marked external branch, the "outer pectoral" tract, which runs down more or less parallel to the main part of the inferior tract for a little way, but ceases before the thighs.

Amongst the various species of *Psittaci* I have examined, well marked differences in some of these tracts occur, more particularly in the arrangement of the "dorso-lumbar fork," and the greater or lesser development of a distinct "outer pectoral" branch to the inferior tract.

In *Lathamus discolor* (Pl. I. figs. 1, 2) the inferior tract of each side starts from about the angle of the jaw, and does not unite with its fellow. On the sternum it is about eight or nine feathers broad at the widest part, the feathering being rather strong and not close. As in most Parrots, there are two humeral tracts. The space on the carina sterni between the inferior tracts of the two sides is not wide. There is a well-marked outer pectoral tract, about 1 inch long, distinguished by its rather stronger and closer feathering. It is quite separate from the main part of the inferior tract, the space between the two tracts being about as broad as the latter tract itself. The outer pectoral has the appearance of being somewhat dilated at its free end, owing to the presence of a few irregularly placed and small feathers lying to the outside of its termination. The main part of the inferior tract is rather narrow, with its rows of four and five feathers each separated by rather considerable spaces.

P. Z. S. 1879, p. 169.

The scapular fork is rather long, the tracts being narrow and moderately strongly feathered.

The dorso-lumbar fork is elongated; each arm is of nearly the same length and breadth throughout, beginning a little outside the scapular fork, with the part inside the arms of the latter represented only (as usual in the Psittaci) by one or two rows of small feathers, placed singly or in pairs. Each arm is composed of about fourteen rows of feathers (counting to the junction with its fellow), the rows being four feathers wide, rather close together, and of about the same width as the space between the tracts. There is some tendency in some of the anterior rows towards a dilatation of the tract, one or two of the rows being five feathers wide. In the more anterior parts of each arm the most internal feather of each row is often placed in front of and at an angle with the other feathers composing it, and so comes to stand between two rows of three feathers each; so that at first each tract looks as if made up of rows of three (or four) feathers alternating with single feathers. This tendency to a 3.1.3 arrangement, however, disappears in the more posterior parts of the tracts, the four feathers of each row there standing in a direct line with one another. The two arms unite to form the "handle" at about three quarters their entire length; after the junction the tract narrows rather rapidly towards the tail. The dorso-lumbar fork is throughout quite distinct from the lumbar feathering, which is very weak and diffuse.

In all the truly Platycercine* forms that I have examined—namely *Platycercus eximius* and *pennantii*, *Psephotus hæmatogaster* (four specimens) and *P. hæmatonotus*, *Pyrrhulopsis splendens* and *P. personata*, *Cyanorhamphus auriceps* and *C. novæ-zealandiæ*—the disposition of the outer pectoral tract and dorso-lumbar fork resembles essentially that of *Lathamus*. In all the outer pectoral is a distinct, more closely feathered, and rather narrowish tract, clearly separated throughout from the main part. In *Cyanorhamphus* this tract is distinctly hook-like, dilated at the end. In all the same length†, and uniformity in strength and width, of P. Z. S. 1879, p. 170. the arms of the dorso-lumbar tract is observable, the inclosed space being of about the same width as either of the tracts inclosing it, no tendency to a dilatation of the arms *at their junction* (though there is some in front) being present, and the rows of feathers in front having a more or less clear 3.1.3 arrangement. The lumbar feathering is always very weak; so that the boundaries of the dorso-lumbar fork are very clearly defined. *Lathamus*, however, differs from the above-mentioned forms a little by its longer and not so widely divaricated scapular fork, and by the greater breadth of its inferior tract on the sternum, thereby causing a corresponding diminution in the breadth of the carinal space. The general agreement, however, of the pterylosis in the two types will, I think, at once be evident from the figure of *Lathamus* (Pl. I. figs. 1, 2), and that of *Platycercus pennantii* (Pl. I. figs. 3, 4), which I have represented next to it for the sake of comparison.

If now we turn to the Trichoglossinæ‡ (see Pl. I. figs. 5, 6), in which so many naturalists have included *Lathamus*, we shall find important and well-marked differences in the two tracts mentioned above,

* *I. e.* excluding *Aprosmictus*, *Polyteles*, *Euphema*, *Pezoporus*, &c.

† In *Pe. pennanti* and in the two species of *Pyrrhulopsis* I counted fourteen, in *C. auriceps* thirteen, in *Ps. hæmatonotus* thirteen, and in *Ps. hæmatogaster* eleven rows of feathers in the arms of this tract to their junction.

‡ Of these I have examined the pterylosis in *Eos rubra*, *Trichoglossi ornatus*, *hæmatodes*, *swainsoni*, *concinnus* (two specimens), and *pusillus*, and *Coriphilus fringillaceus*.

though the general character of the pterylosis remains the same in all*. The outer pectoral tract is never so narrow and distinct here as it is in *Lathamus* and its allies; it is usually almost triangular in shape, and so tolerably broad, shorter, and not so divergent, the interspace between it and the main tract being much narrower, and frequently with a few scattered feathers in it uniting the two tracts together. The inferior tract on the breast is always much broader, and the carinal space narrower.

Still better-marked characters between the two groups are to be seen in the disposition of the dorso-lumbar fork. This in all the Trichoglossinæ is extremely weak in front, the tracts not getting at all strongly feathered till some way (in *T. cincinnus* ½ inch) from the ends of the scapular fork. Each arm is much shorter (in all the forms I count about eight rows of feathers to the junction), wider and more diffusely feathered than in the Platycercinæ, and becomes dilated and more strongly feathered towards its junction with its fellow, which takes place further from the tail than in the other group. The united tract is strongly feathered and rather broad at first, but narrows rapidly again towards the tail. Figs. 5 and 6, Pl. I. represent the pterylosis of *Trichoglossus concinnus* (a bird a little larger than the "*Swift Parrakeet*"), and show the differences between the two groups, which, if somewhat slight, are nevertheless easily appreciable after a little study, and are as well marked as any others I have as yet observed in the pterylosis of this order.

Several points in the external characters of *Lathamus* show that it has in fact no particular relationship to the Trichoglossinæ. The shape of the upper mandible, with a small but distinct tooth, is obviously (see fig. 1, p. 68) much nearer to that of *Psephotus* (fig. 3) than it is to that of a Lory (fig. 5). The same story is told still more plainly by its maxilla, which has none of the laterally compressed, elongate, and pointed form characteristic of the Lories, and which induced Sundevall to divide all Parrots into two groups "Psittaci proprii" and "Psittaci orthognathi," the latter including only the Lories and *Nestor*, and characterized by having the "maxilla inferior recta, angusta, altitudine longior." In *Lathamus* the maxilla is short and deep, with a broad and rounded anterior margin. These differences will be seen by a glance at figures 5 and 1, representing the heads of a *Trichoglossus* (*concinnus*) and of *Lathamus*. P. Z. S. 1879, p. 172.

In all the Trichoglossinæ I have examined, the cere is rather narrow from before backwards, the anterior margin only sinuate, and the nostrils elongated and ovate, with their long axis directed forwards and *inwards*, and so somewhat *transversely* to the direction of the beak (fig. 5, p. 68). This is very evident in the living birds, and is also to be made out in

* I have as yet been unable to confirm Nitzsch's observation (Pterylogr., Eng. edit. p. 100) that in *Lorius garrulus* and *L. domicella* the inferior tracts are continuous over the lower surface of the neck.

P. Z. S. 1879, p. 171.

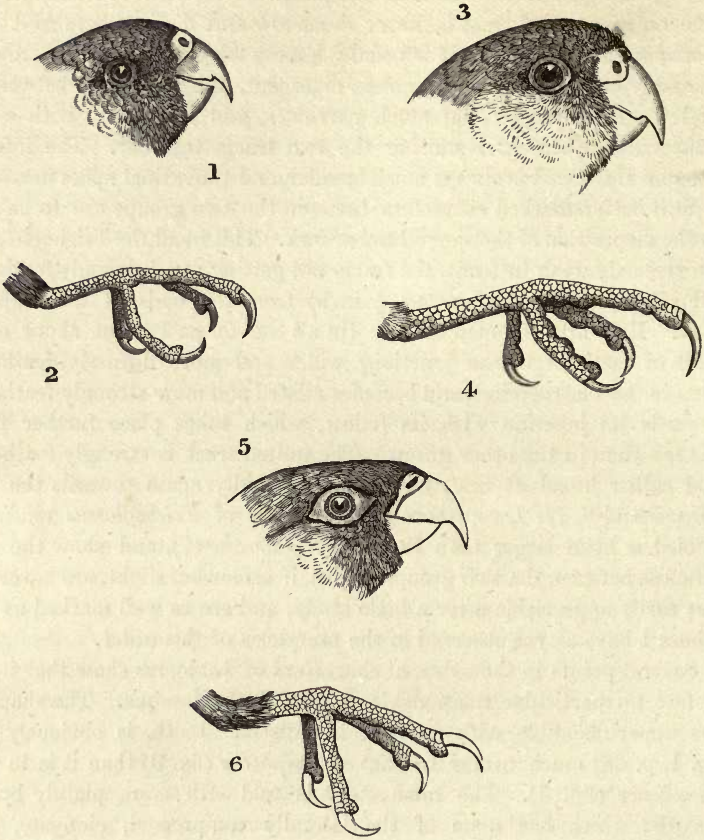

Fig. 1. Head of *Lathamus discolor*.
Fig. 2. Foot of ditto.
Fig. 3. Head of *Psephotus hæmatogaster*.
Fig. 4. Foot of ditto.
Fig. 5. Head of *Trichoglossus concinnus*.
Fig. 6. Foot of ditto.

P. Z. S. 1879, p. 172.

skins. In *Lathamus*, however, and the Platycercinæ generally, the cere is much larger, with the anterior border on each side mearly semicircular; and the nostrils are oval and directed *upwards*, more nearly parallel with the culmen (see figs. 1 and 3).

In the small size of the nude orbital ring *Lathamus* agrees with the Platycercinæ rather than with the Lories, in which it is of fair size and rather conspicuous in the living birds.

In the shape of the wings, no doubt, *Lathamus* is somewhat aberrant, and nearer the Lories than the *Platycerci*. This is, however, so obviously an adaptive modification, due to the swift flight and arboreal habits of both these birds as compared with the more ground-loving mode of life of the *Platycerci*, that no stress can be laid on it as a taxonomic character. The *rounded* end of the wing-feathers, however, of *Lathamus* still point to its Platycercine affinities. Its feet, too, though not typically Platycercine, differ from those of the Trichoglossinæ (cf. figs. 2 and 6, p. 68) by their more elongated and slender tarsi and toes, with the latter not so much flattened and fitted for grasping branches, &c., as are those of the Lories, and with the claws not so strong and longer, particularly that on the third digit. In both these points more resemblance to the *Platycerci* is shown (cf. fig. 4, p. 68, foot of *Psephotus hæmatogaster*), though the different modes of life * have here again induced a certain amount of change from the form observed in the truly terrestrial *Platycerci*.

A thorough study of the osteology of the Parrots has yet to be made; and till that is done it is perhaps somewhat premature to generalize. P. Z. S. 1879, p. 173. Nevertheless, having examined somewhat carefully a considerable number of the skeletons of the two groups with which *Lathamus* has been generally associated, I have, I believe, been able to detect certain differences which will help us in referring the bird at present under discussion to its proper place.

First, as regards the skull. This, in all the Trichoglossinæ, is remarkable for its somewhat depressed form and the lateral compression and elongation of the upper and lower jaws, the mandible when deprived of its horny sheath showing even more clearly the peculiar shape of the lower jaw in these birds, first pointed out by Sundevall and already alluded to above (Pl. I. fig. 7). In the *Platycerci* the skull is less depressed above and much shorter in proportion, and the mandible is not pointed, but has its symphysial portion wide, deep from above downwards, and somewhat truncated. The same is the case in *Lathamus* (Pl. I. fig. 8).

In the Lories the lengthening of the beak has led to a similar elongation in the anterior limb of the palatine bones, so that this part is as long as, or longer than, the posterior one; and the latter is considerably shorter than the pterygoids. In the *Platycerci* the anterior part of the palatines is not so elongated; but, on the contrary, the posterior limb is somewhat lengthened, and, in fact, nearly as long as the pterygoids. Here, again, *Lathamus* agrees more with the *Platycerci*.

In the Lories (Pl. I. fig. 9, *Eos rubra*) the anteorbital processes are much larger and better-developed than in the *Platycerci*, where the

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* Mr. Gould says ('Handb. B. Austr.' ii. p. 89):—"In its actions and manners it is closely allied to the *Trichoglossi*, but differs from them in some few particulars, which are more perceptible in captivity than in a state of nature. It has neither the musky smell nor the jumping motions of the *Trichoglossi*. I have never observed it alight on the ground, or elsewhere than among the branches."

hinder margin of these parts, as seen from above, is not very far from being on a level with the cranio-rostral suture, and so causes the orbits to take up a larger part of the surface of the skull (in a view from above) than in the other group. The same is the case in *Lathamus* * (Pl. I. fig. 10).

The retention of the furcula is no doubt associated with the rapidity of flight of this bird, whilst in the more slowly moving *Platycerci* it has disappeared almost entirely. As we already know from M. Blanchard's researches (Ann. Sci. Nat. Zool. xi. pp. 84–85, 1859), but little assistance as regards classification can be gained in this group from a study of the sternum.

The pelvis, however, has been of more use to me.

In the Lories this is always elongated and narrow in proportion, the preacetabular part being particularly elongated, and the iliac fossæ on each side for the attachment of the gluteal muscles being deeper and more extensive. In the *Platycerci* and *Lathamus* the pelvis is wider, the preacetabular part much shorter, and the iliac fossæ shallower and smaller. These differences will be visible from the figures which I exhibit (Pl. I. figs. 11, 12), in which are shown respectively the pelvis of *Lathamus* and of *Lorius tricolor*.

P. Z. S. 1879, p. 174.

As regards internal anatomy, little can be said of any important characters, except the difference in the disposition of the carotid arteries in the two groups, first pointed out by Prof. Garrod, and already mentioned above. The nature of the tongue in *Lathamus* requires reexamination, as also does the coloration of the eyes, this presenting very marked characteristics in all those Trichoglossinæ I have been able to examine alive (of the genera *Lorius*, *Eos*, *Chalcopsitta*, and *Trichoglossus*), and being quite unlike that prevalent in the *Platycerci* and most other Parrots.

In coloration *Lathamus* is no doubt aberrant, but is no more clearly related, as far as I can see, to one group rather than the other. The external rectrices being blue is perhaps a hint of its Platycercine relations.

To conclude, the more important characters of *Lathamus*, *i. e.* pterylosis and superficial left carotid, beaks, nostrils, cere, feet, skull, and pelvis, all point to a near relationship to *Psephotus*, *Platycercus*, and allied genera.

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* Bonaparte (Compt. Rend. xliv. p. 536, 1857), following Owen (Cat. Osteol. Series R. C. S. 1853, p. 279, no. 1451), says that in *Lathamus* the orbit is completed below by the junction of the lacrymal with the "mastoid." This is certainly not the case in a skull lent to me by Professor Garrod, and, if true, would be an anomaly for any member of either of the above-mentioned groups. In the specimen referred to in the Museum of the College of Surgeons (no. 1451) it appeared to me on examination that there was in reality no bony union between the two bones, which were connected simply by ligament.

P.Z.S. 1879. Pl. XVI.

Fig. 7.

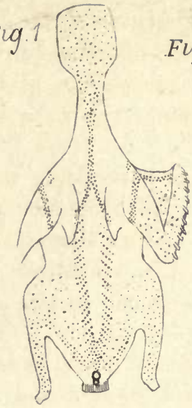

Fig. 1.

Fig. 2.

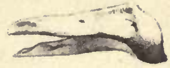

Fig. 8.

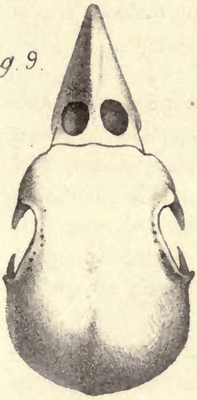

Fig. 9.

Fig. 3.

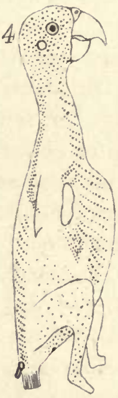

Fig. 4.

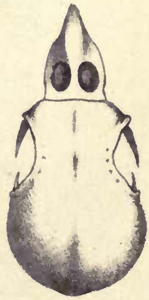

Fig. 10.

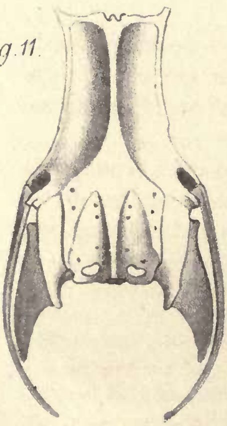

Fig. 11.

Fig. 5.

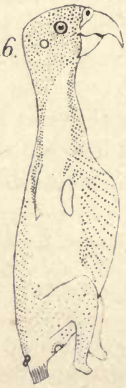

Fig. 6.

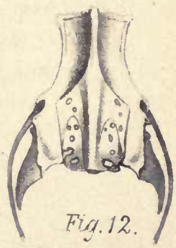

Fig. 12.

J. Smit lith.

Hanhart imp.

STRUCTURE OF LATHAMUS.

The abnormal tufted tongue, the retention of the furcula, and the sharp pointed wings may be regarded as adaptations to its tree- and flower-loving modes of life, and not as due to any consanguinity with the Trichoglossinæ. *Lathamus* may be a more or less modified remnant of a group that branched off from the common stock with the progenitors of the more typical *Platycerci*, and of which all the others have become extinct (perhaps due to the competition with the more specialized Trichoglossinæ); or it may be a member of the Platycercine group that has become specialized to modes of life like those of the true Lories and Lorikeets, and so has come to resemble them in some few superficial particulars.

EXPLANATION OF PLATE I.

Figs. 1, 2. Back and side views of *Lathamus discolor*, showing pterylosis.
3, 4. The same of *Platycercus pennantii*.
5, 6. The same of *Trichoglossus concinnus*.
7. Mandible, deprived of horny sheath, of *Eos rubra*.
8. The same of *Lathamus discolor*.
9. Skull, seen from above, of *Eos rubra*.
10. The same of *Lathamus discolor*.
11. Pelvis of *Lorius tricolor*.
12. The same of *Lathamus discolor*.

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16. A SYNOPSIS OF THE MELIPHAGINE GENUS *MYZOMELA*, WITH DESCRIPTIONS OF TWO NEW SPECIES.*

P. Z. S. 1879, p. 256.

(Plates II. & III.)

The genus *Myzomela* † was instituted by Messrs. Vigors and Horsfield in their paper on Australian birds in the Linnean Society's 'Transactions' for 1826 (vol. xv. p. 316, note), *Myzomela sanguinolenta*, Lath. (for *M. cardinalis*, Gm. apud Vig. & Horsf. *l. c.*, is clearly not that species, but the smaller Australian one), being the type.

Lesson (Traité d'Orn. p. 298) in 1831 established a "sous-genre" *Phylidonyris*, in which were included *Certhia sanguinolenta*, *Cinnyris rubrater*, and *Cinnyris eques*; but this name must be, as he himself observes, regarded as merely a synonym of *Myzomela*.

Reichenbach in 1851 (Handb. d. spec. Orn. p. 283) made *Cinnyris eques* the type of a new genus *Cosmeteira*, which he included amongst the Nectariniidæ, its dull colours, with no metallic gloss, being apparently the chief reason for the separation. This species, however, in tongue, bill, feet, and, in fact, in all points is a true *Myzomela*, though it has

* Proc. Zool. Soc. 1879, pp. 256–279, Pls. XXIV. & XXV. Read Mar. 4, 1879.

† μύζω, I suck in, μέλι, honey; hence *Myzomela*.

been included amongst the Nectariniidæ till within the last few years by most writers.

On similar grounds of divergent coloration, Bonaparte separated *M. pectoralis* * under the name *Cissomela* (C. R. xxxviii. p. 264, 1854); but as no generic characters whatever are given, this name falls to the ground, even if any structural differences in the bird exist, which as yet I have been unable to discover.

Myzomela is characterized by its Meliphagine tongue, rather short, narrow, and slender curved bill, which is depressed and broadened at the base, rounded and compressed anteriorly, and there finely serrulated on its cutting-margins. The nostrils are linear and curved, extending for almost one third of the length of the bill, and covered in by a conspicuous opercular membrane. The wings are moderately long, the

P. Z. S. 1879, p. 257. "first" † primary short, the 3rd to 5th longest and subequal, the 6th longer than the 7th, which about equals the 2nd. The tarsi are about as long as the bill, rather slender, and covered with 6–7 scales in front, the lower ones being the smallest and transverse. The 2nd and 4th toes are very slender, about equal in length, and shorter than the 3rd. The hallux is unusually stout for the size of the bird. The tail has 12 feathers, is short, and nearly square.

Most of the species have more or less red in their plumage; but this colour is altogether absent in some, and becomes only a slight tint, confined to the margins of the feathers, particularly of the head, wings, and tail, in others. As yet our knowledge of the phases and changes of plumage is by no means perfect. In one group (e. g. in *M. sanguinolenta* and its allies, including *M. nigrita*) the females seem to retain throughout life the brown plumage of immaturity; whilst in others (e. g. *M. nigriventris*, *obscura*, &c.) the adults of each sex are similar. In most cases the first plumage seems to be nearly uniform brown, lighter beneath, with the wing-coverts lighter at the edges, and the quills margined externally with olive-yellow. Throughout the group there is seen a great

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* Although Bonaparte expressly states "*Myzomela nigra*, Gould, est pour moi le type du nouveau genre *Cissomela*," yet it is evident from his description, "*Subtus cum uropygio alba, torque pectorali nigro*," that *M. pectoralis* was intended!

† I have here adopted the system of notation for the remiges generally in use amongst ornithologists. But would it not be better, as is usually done in other cases of serially-repeated homologous organs, to begin counting from the *proximal* rather than from the *distal* end of the series? At present, if a bird, for instance a Passerine, be said to have a "long first primary," two things may be meant:—either that the bird has only *nine* primaries, the true "first" (or tenth) being absent, and the (morphologically) "second" (or ninth) being of the ordinary length (as, *e. g.*, a Finch, or *Drepanis*); or that there are *ten* primaries, with the "first" (tenth) fully developed, as is the case in the "Formicarioid" Passeres of Wallace. This ambiguity would be avoided by counting the feathers from the end nearest the humerus; for any Passerine with a long "*tenth*" primary could then only be a "Formicarioid."

tendency to retain these markings on the wings, as likewise a white margin on the inner web of the primaries.

The eggs seem to be generally whitish or buff, spotted with darker, red or yellow. According to Gilbert (Gould, Handb. B. A. i. p. 558) *M. nigra*, like many other species of Meliphagidæ, lays only two eggs. The nests are small and cup-shaped, rather flimsily constructed of grass-stems, hair, spiders' webs, &c., and often placed in the fork of a tree or bush.

In their habits the *Myzomelæ* seem to resemble the other smaller Honeysuckers, frequenting flowering shrubs and trees, not apparently so much for the sake of the nectar of the flowers, as for the insects attracted thereby.

But one or two species of this genus, which is perhaps most nearly allied to *Acanthorhynchus*, but distinguishable by its longer beak and different coloration, were known to the older authors. Bonaparte, in his 'Conspectus' (p. 394, 1850), enumerates 9, one of which, however (*Certhia sanguinea*, Gmel.), is a *Drepanis*, whilst *M. eques* is omitted. Gray (Hand-l. B. i. p. 153, 1869) gives 17, though here again *M. eques* is omitted, being included as "*Cosmeteira eques*" amongst the Nectariniidæ (no. 1337). In the present paper 26 species, including two new ones, are recognized as distinct, besides one other which remains doubtful. Of these 26 species, 24 are known to me autoptically. Of the two which I have not seen, one (*M. lafargii*) is unique in the Paris Museum, the other (*M. rubro-tincta*) has lately been described from specimens at Leyden by Count Salvadori.

The collection in the British Museum, that made by the 'Challenger,' and the specimens in the collections of Mr. Sclater and Messrs. Salvin and Godman have formed the basis of my present paper. In addition to these I have to thank Canon Tristram, F.R.S., Dr. A. B. Meyer, and Count Salvadori for the very liberal way in which they have lent me valuable series of specimens. To the two latter, in particular, I am P. Z. S. 1879,
indebted for sending over to me the types of the species described by p. 258.
them from New Guinea and its islands, and several others which I should not otherwise have been able to examine, and for their kind permission to figure any of them. Count Salvadori, too, has sent me some very valuable notes as to the range &c. of the Papuan species; whilst to M. Oustalet I am much obliged for information on the type specimen of *M. lafargii* and on some other points.

The following table will assist in the determination of the 26 valid species. It, however, only holds good for adult birds, and in many cases only for the males, our present imperfect knowledge of many of the species making a table that would have included all stages alike an impossibility.

A. Corpore rubro ornato, aut unicolori.
  α. Corpore subtùs plus minusve olivaceo-griseo aut albicante.
    a. Fronte coccineâ.
      b. Torque pectorali nullo.
        c. Capite et dorso concoloribus.
          Alis fusco-nigris; abdomine flavido-griseo .... 1. *sanguinolenta.* / 2. *caledonica.*
          Alis olivaceo-fuscis; abdomine griseo-flavido........ 3. *chloroptera.*
        c'. Capite rubro; dorso fusco .... 4. *adolphinæ.*
      b'. Torque pectorali fusco.
        Abdomine albicante .... 5. *boiæi.*
        Abdomine fusco-griseo .... 6. *erythrocephala.*
    a'. Fronte nigrâ.
      d. Capite suprà maculâ rubrâ ornato.
        e. Gulâ rubrâ.
          Gutture summo nigricante .... 7. *vulnerata.*
          Gutture croceo-flavo .... 8. *jugularis.*
        e'. Gulâ nigrâ.. 9. *lafargii.*
      d'. Capite suprà omnino nigricante........................ 10. *sclateri.*
  β. Corpore subtùs dorso concolori.
    a. Corpore nigro.
      Subalaribus albis .... 11. *nigrita.*
      Subalaribus nigris .... 12. *pammelæna.*
    a'. Corpore griseo-brunneo.
      b. Striâ gulari coccineâ.. 13. *eques.*
      b'. Striâ gulari nullâ.
        Capite solùm rubro tincto.................................... 14. *obscura.*
        Alis et caudâ rubro tinctis .... 15. *simplex.*
        Corpore, alis et caudâ rubro tinctis.................. 16. *rubrotincta.* / 17. *rubro-brunnea.*
    a''. Corpore rubro .... 18. *cruentata.*
  γ. Corpore subtùs nigro et rubro vario.
    a. Gulâ coccineâ.
      b. Capite toto coccineo.
        c. Abdomine rubro; crisso nigro.............................. 19. *rubratra.*
        c'. Abdomine et crisso nigris.
          d. Pectore coccineo .... 20. *nigriventris.* / 21. *cardinalis.*
          d'. Pectore nigro .... 22. *lifuensis.*
      b'. Capite suprà nigro .... 23. *chermesina.*
    a'. Capite toto nigro.. 24. *rosenbergi.*
B. Corpore nigro alboque vario.
  Gulâ uropygioque nigris .... 25. *nigra.*
  Gulâ uropygioque albis.. 26. *pectoralis.*

P. Z. S. 1879, p. 259.

1. MYZOMELA SANGUINOLENTA.

? *Scarlet Creeper*, Lath. Gen. Syn. i. pt. 2, p. 740 (1782).
? *Certhia rubra*, Gmel. S. N. i. p. 479 (1788).
Sanguineous Creeper, Lath Gen. Syn. Suppl. ii. p. 167, t. 130 (1801).
Certhia sanguinolenta, Lath. Ind. Orn. Suppl. p. xxxvii (1801).
Cochineal Creeper, Lath. Gen. Syn. Suppl. ii. p. 167 (1801).
Certhia dibapha, Lath. Ind. Orn. Suppl. p. xxxvii (1801).

Red-rumped Creeper, Lath. Gen. Syn. Suppl. ii. p. 169 (1801).

Certhia erythropygia, Lath. Ind. Orn. Suppl. p. xxxviii (1801).

Certhia australasiæ, Leach, Zool. Misc. i. p. 30, t. 11 (1814).

Myzomela cardinalis, V. & H. (nec Gm.) Linn. Trans. xv. p. 316 (1826).

Myzomela sanguinolenta, Gld. B. A. iv. pl. 63; id. Handb. B. A. i. p. 555.

♂ ad. *capite, dorso cum uropygio, pectore et lateribus abdominis coccineis; macula anteoculari, alis caudaque nigris; alarum tectricibus conspicue albido, remigibus olivaceo-griseo limbatis; abdomine sordide flavido; subcaudalibus griseo alboque variis; rostro nigro, pedibus corneis. Long. al.* 2·4, *caud.* 1·6, *rostr.* 0·45, *tars.* 0·5 (*poll. Angl.*).

♀ *sordide griseo-brunnea, subtus dilutior; dorso et uropygio rufescenti tinctis; alis caudaque fuscis, remigibus olivaceo, tectricibus alarum pallide brunneo marginatis.*

Hab. in Australiâ.

The phases of plumage in this species, the type of the genus (for *M. cardinalis*, apud Vig. & Horsf. *l. s. c.*, is this bird), seem to have caused some confusion amongst the older authors. It seems to me that in all probability Latham's "Scarlet Creeper," on which Gmelin founded *Certhia rubra* in his edition of the 'Systema Naturæ,' really applies to this species, the description "lower part of belly and vent white," together with the size ("of a Wren") and the locality ("from some part of the South Seas") quite coinciding with this bird, and not at all with *M. cardinalis*, of which, in his Ind. Orn. (i. p. 290, 1790), Latham treated it as being the female. Besides this, Latham bestowed at least three other Latin names (each with its equivalent vernacular) on this little bird.

Myzomela sanguinolenta is perhaps most nearly allied to *M. chloroptera*, which differs, however, as below pointed out. Only the males possess the beautiful red plumage; and in these, if not quite adult, the variegation of each breast-feather, which is grey at the base, then paler, and red only at the tip, produces the somewhat mottled appearance of the red underparts.

According to Mr. Gould, the irides are "dark brown."

Myzomela sanguinolenta is the commonest species of *Myzomela* in Australia, and is familiarly known to the colonists as the "Little Soldier." Mr. Ramsay, in his list of Australian Birds (Proc. Linn. Soc. N. S. W. ii. 1877), records it from Rockingham Bay, Port Denison, the Wide-Bay District, the Richmond- and Clarence-River Districts, New S. Wales, the interior, Victoria, and S. Australia; so that it ranges over the greater part of Eastern Australia. P. Z. S. 1879, p. 260.

Mr. Ramsay has given us a good account of the habits and nesting of this species near Sydney, where it is a summer visitor, arriving in October and November, in 'The Ibis' for 1865 (p. 304).

2. Myzomela caledonica, n. sp.

Myzomela sanguinolenta (ex Novâ Caledoniâ) auct.

♂ *præcedenti simillima, sed tectricibus alarum marginibus albidis carens.*

Hab. in Novâ Caledoniâ.

Mus. H. B. Tristram.

The *Myzomela* from New Caledonia, although no doubt very closely allied to the preceding Australian species, is, I think, fairly entitled to rank as a distinct species; and I have therefore separated it under the above name. My attention was first directed to this form by a specimen kindly lent me by Canon Tristram, and shot by Mr. Layard near Noumea. This bird, a fully-plumaged male, differs from a considerable number of Australian specimens with which I have compared it, in the almost entire absence of the conspicuous greyish-white margins to the feathers of the wing-coverts, so that they are nearly entirely black, with only a trace of *olive-colour* at the margins. Besides this, the red colour of the body is hardly so bright, and extends a little further down on the abdomen, and the margins to the quills are more of an olive-yellow. The size is about the same (wing 2·25), Australian specimens varying a little in this respect. Canon Tristram writes me that he has six specimens of the New-Caledonian bird, and that the differences which I pointed out to him are constant in the series. Mr. Layard gives the following notes as to the soft parts on the label of his specimen:—"Beak black, legs brown-black, iris brown."

Mr. Layard also met with a *Myzomela*, which he referred to *M. sanguinolenta* (Ibis, 1878, p. 280), in the New Hebrides, on the islands of Vatè, Api, and Mallikollo, and remarks that a specimen procured is identical with the New-Caledonian bird; so that it seems probable that *M. caledonica* may extend its range as far as these islands; but specimens to show this are as yet wanting.

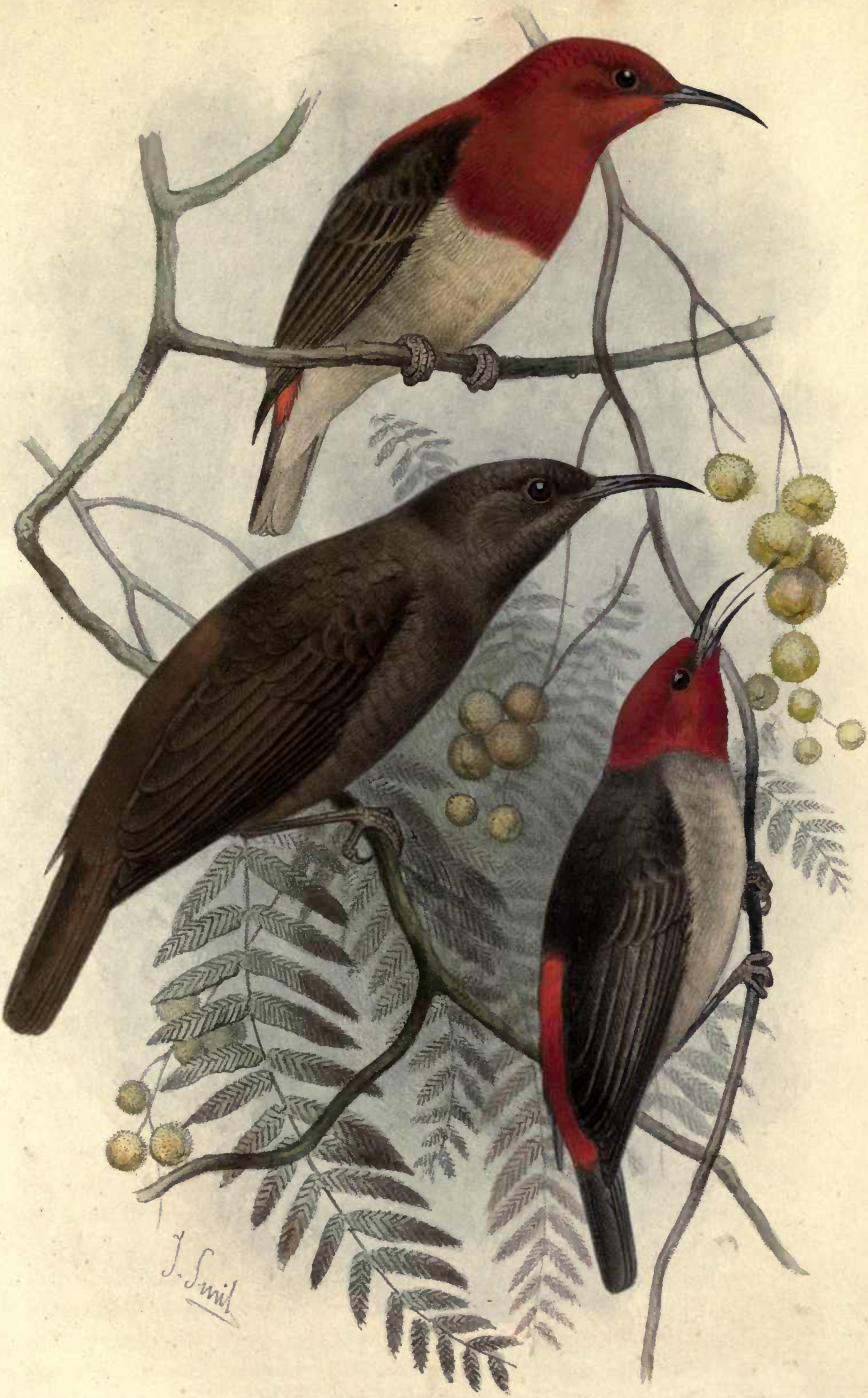
3. Myzomela chloroptera. (Plate II. fig. 1.)

Myzomela chloroptera, Wald. Ann. N. H. 4th ser. ix. p. 399 (1872); Salvad. Ann. Mus. Civ. Gen. vii. p. 662 (1875).

♂ ad. *capite, dorso uropygioque, cum pectore, coccineis; corpore subtus griseo-flavido; alis caudaque fuscis, remigibus et tectricibus alarum olivaceo limbatis, subalaribus et margine interna remigum albis, alæ flexura flavo-albida; macula anteoculari nigra; rostro nigricante pedibus obscure corneis. Long. al.* 2·2, *caud.* 1·5, *rostr.* ·55, *tars.* ·50 (*poll. Angl.*).

Hab. in insulâ Celebes.

This *Myzomela*, the westernmost of the whole genus, was described by the late Lord Tweeddale from imperfect specimens collected by Dr. Meyer at Menado, where it has also been obtained by Bruijn's col- P. Z. S. 1879, p. 261.
lectors; and from one of these specimens, kindly lent me by Count



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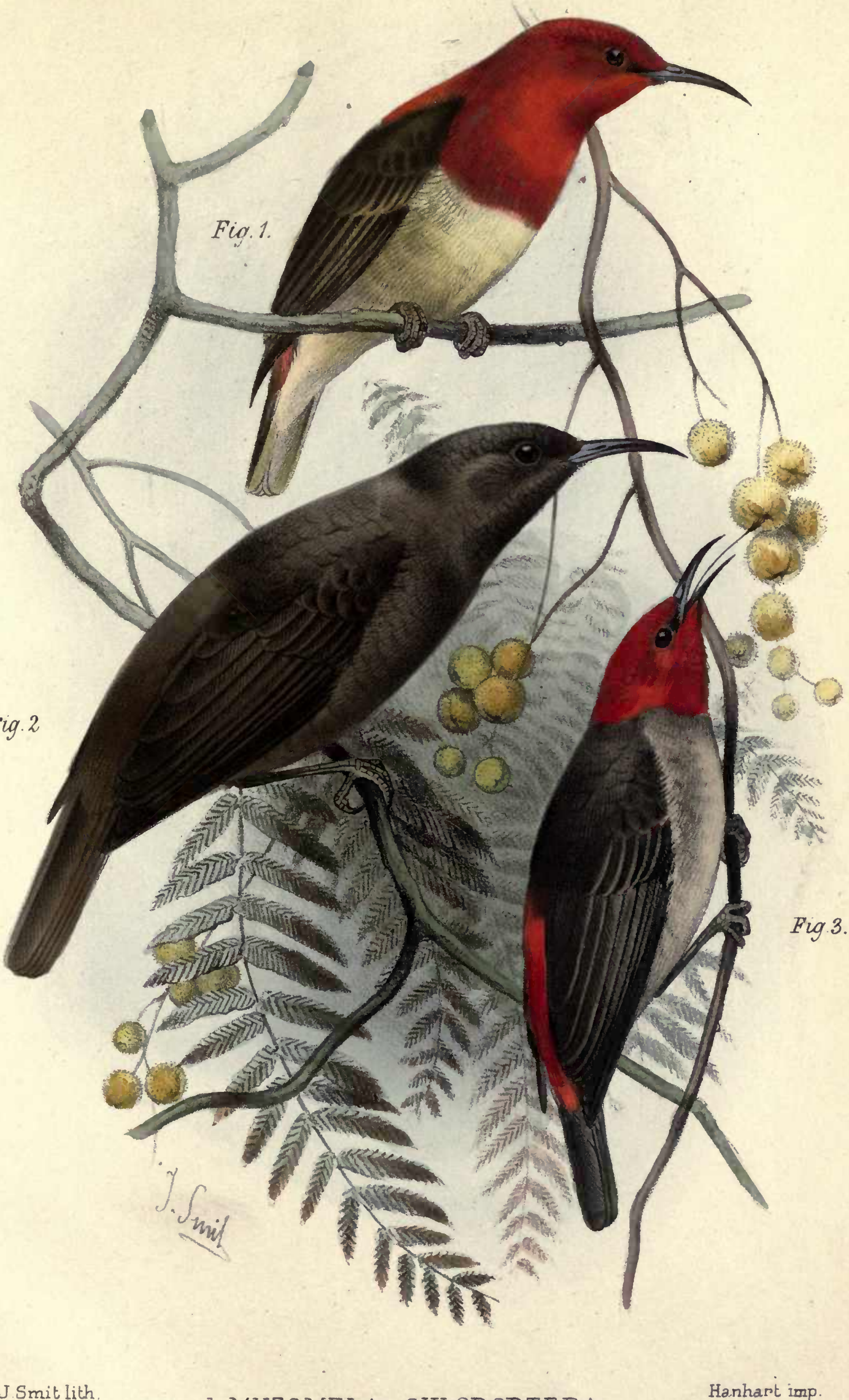

J. Smit lith. Hanhart imp.

1. MYZOMELA CHLOROPTERA.
2. " RUBROBRUNNEA.
3. " ADOPHINÆ.

Salvadori, the figure is taken. As yet, I believe, it has only occurred near Menado; and the young and female remain unknown, or at least undescribed.

Myzomela chloroptera resembles the Australian *M. sanguinolenta*, but is a smaller bird, and also differs in the smaller extent of the red on the chest, and in that colour being more intense, the abdomen yellower, and the wings and tail not so black. The black anteocular spot is less conspicuous.

In his original description Lord Tweeddale remarks that this bird nearly resembles plate 54 of the 'Oiseaux Dorés,' vol. ii., representing "L'Heorotaire écarlate" from the "South Seas," taken from a drawing of a bird in the Leverian Museum. The figure certainly corresponds very fairly with this species, but, from the locality given, is probably intended for the Australian one (*M. sanguinolenta*).

4. Myzomela adolphinæ. (Plate II. fig. 3.)

Myzomela adolphinæ, Salvad. Ann. Mus. Civ. Gen. vii. p. 946 (1875).

♂ *pallio, dorso superiore, alis caudaque olivaceo-fuscis, tectricibus alarum, remigibus et rectricibus externe subtiliter olivaceo limbatis; capite uropygioque coccineis; macula anteoculari nigra; corpore subtus flavido-albido, pectore grisescenti lavato; subalaribus et remigum margine interna albis; rostro nigricante, pedibus corneis. Long. tot. circa* 3·5, *al.* 2·2, *caud.* 1·5, *rostr.* ·45, *tars.* ·5 (*poll. Angl.*).

♀ *minor, feminæ* Myzomelæ boiæi *similis.*

Hab. in montibus Arfak.

This is one of the numerous discoveries of Beccari and Bruijn in the Arfak Mountains, and only a few specimens have as yet been obtained. Count Salvadori writes (*l. s. c.*):—"This species resembles *M. erythrocephala* of Gould, but differs from it in its much smaller dimensions, by the very slight olive tint of the back, and by the lower parts being not grey-brown, but whitish, very slightly tinged with yellowish on the breast and abdomen." The female resembles that of the Banda species (*M. boiæi*), but differs as pointed out under that species (*vide infrà*).

The figure (Pl. II. fig. 3) represents an adult male, one of the types of this species, most obligingly lent me by Count Salvadori.

5. Myzomela boiæi.

Myzomela boiei, Sal. Müll. Verh., Land- en Volkenk. p. 172 (1839–44); id. Verh., Zool. Aves, p. 66, t. 10. fig. 1, 2.

♂ *capite, dorso uropygioque coccineis, plumis ad basin nigris; macula anteoculari, alis caudaque, cum torque pectorali nigris; corpore subtus griseo-albo; subalaribus et remigum margine interna albis; rostro nigro; pedibus corneis, plantis flavis. Long. al.* 2·2, *caud.* 1·8, *rostr.* ·5, *tarsi* ·6 (*poll. Angl.*).

P. Z. S. 1879, p. 262. ♀ *minor, capite pectoreque sordide griseis olivaceo lavatis; dorso, tectricibus alarum et uropygio brunneis; fronte anguste gulaque rubris; alis caudaque fuscis, pennis anguste flavido limbatis; abdomine et subcaudalibus flavo-albidis; rostro pedibusque corneis.*

Hab. in insulâ Banda.

This species is confined to the island of Banda, where it is not uncommon, according to Müller, in the nutmeg-plantations. The male resembles *M. erythrocephala* (ex insulis Aru), but differs from it in the black and white colours being purer and more contrasted. The female is extremely like that of *M. adolphinæ*, but is smaller, has the breast greyer, the forehead redder, and the yellowish-olive margins to the quills more conspicuous.

The iris is "brown" (*S. Müller*; *Murray*).

6. Myzomela erythrocephala.

Myzomela erythrocephala, Gould, P. Z. S. 1839, p. 144; id. B. A. iv. pl. 64; id. Handb. B. A. i. p. 556 (nec Meyer, Sitzungsber. Wien. Akad. lxx. pp. 204–206).

♂ *capite, dorso inferiore et uropygio intense coccineis; pallio, dorso superiore, alis caudaque cum torque pectorali fuliginosis, remigibus subtilissime olivaceo limbatis; abdomine et subcaudalibus sordide olivaceo-griseis; subalaribus et margine interna remigum albis; macula anteoculari nigra; rostro nigricante; pedibus nigro-corneis. Long. tota circa* 4·0, *al.* 2·4, *caud.* 1·75, *rostr.* ·55, *tars.* ·55 (*poll. Angl.*).

Hab. in Australiâ septentrionali, insulis Aru, et Novâ Guineâ meridionali.

There is some doubt as to the exact range of this species, and as to whether one or more species have not been included by various writers under the same name. Unfortunately I have not been able to see a sufficient number of specimens to clear up the question, the solution of which must wait till a larger series from different parts becomes available for comparison.

Myzomela erythrocephala was first described by Mr. Gould from specimens from Port Essington, and was characterized as "*intense fusca, capite et uropygio coccineis.*" This description agrees well enough with the figures in his folio work, and with the skins in the British Museum from Aru collected by Wallace. In the text, however, as also in the 'Handbook,' the general colour of the plumage is described as "deep chocolate-brown," a term which can hardly be said to agree either with "*intense fusca*" or with the figures.

In one of his expeditions to Southern New Guinea, Signor D'Albertis obtained a single male (nearly or quite adult) of a *Myzomela* at Mon, Hall Bay, of which Count Salvadori, in the account of the collection

(Ann. Mus. Civ. Gen. vii. p. 825, 1875), says that it in no way differs from one from Australia with which he has compared it, and further remarks that Gould's plate is inaccurate in representing the back &c. as almost black, instead of only slightly darker than the under surface. In a letter to me, however, he says that now he is "not quite satisfied as to this bird being the same as the Australian species; this and the Aru bird seem to me much darker," and further proposes to separate it P. Z. S. 1879, and the Aru form as a new species, *Myzomela infuscata.* But the bird p. 263. from Mon, which Count Salvadori has most kindly lent me, differs from the Aru birds in its much lighter colours above, which are moderately dark greyish brown, not brownish black, and in the dark colour on the breast shading off more gradually into that of the flanks and abdomen, so that there is less appearance of a dark pectoral band. The anteocular spot is brown. The size is about the same as that of the bird described above (from a specimen in Mr. Godman's collection, collected by Cockerell, and agreeing with Wallace's Aru skin in the British Museum). Not having seen an authenticated adult Australian specimen, I cannot say whether the New-Guinea bird is or is not identical with that from Australia; but it certainly differs considerably from the Aru birds in colour. If on further investigation the Aru bird proves really distinct, it will have to stand as *Myzomela infuscata*, Salvad. in litt. On the other hand, if Mr. Gould's figure and description are correct, it would seem that the bird from Southern New Guinea is distinct. I have not seen the female of this species. Mr. Gould describes it as "uniform brown above, lighter beneath."* Count Salvadori describes the female of *M. infuscata* thus:—"*Brunneo-grisea, subtus pallidior, fronte et gula late rubris; remigibus exterius subtiliter olivaceo-marginatis;*" and this description closely agrees with a young male from the Aru Islands in the British Museum, in which, however, there are also some red feathers on the back.

Gould gives the irides as "reddish brown," D'Albertis as "black." In Australia, *Myzomela erythrocephala* is confined to the northern districts, having occurred at Port Essington (*Gould*), Port Darwin (*Masters*), and Cape York (Ramsay's list of Australian birds). It was included in Marie's list of New-Caledonian birds (Ibis, 1877, p. 362), but is omitted by Verreaux and Desmurs, and Mr. Layard has as yet not found it. M. Oustalet, too, tells me that he has not seen it from the mainland of New Caledonia.

7. Myzomela vulnerata.

Nectarinia (*Myzomela*) *vulnerata*, Müll. Verh., Land- en Volk. p. 172 (1839–44); id. Verh., Zool. pl. 10. figs. 3, 4.

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* In the plate the forehead is shown as tinged with red.

Fusco-nigricans, capite supra macula magna, gula et uropygio sanguineis; abdomine, subcaudalibus, subalaribus, et margine remigum interna albis; rostro nigro; pedibus plumbeis. Long. al. 2·2, *caud.* 2, *rostr.* ·5, *tars.* ·53 (*poll. Angl.*).

Hab. in insulâ Timor.

This very distinct species is confined to the island of Timor. It is somewhat allied to *M. boiœi* and *erythrocephala*, but is at once distinguished from both by the red on the head being confined to the vertex and throat, and by the much darker tint of that colour. The female is similar to the male, but smaller, with the colours less distinct. The irides are reddish brown (*Sal. Müller*).

P. Z. S. 1879, p. 264. 8. MYZOMELA JUGULARIS.

Myzomela jugularis, Peale, U.S. Expl. Exped. p. 151, t. 41. f. 2 (1848); Cassin, U.S. Expl. Exped. p. 176, t. 12. f. 2 (jr.) (1858); H. & F. Orn. Centr.-Pol. p. 54, t. 7. figs. 1, 2 (ad. et jr.).

Myzomela solitaria, Hombr. & Jacq. Voy. Pôle Sud, Zool. iii. p. 99, Atlas, t. 22. f. 6 (1853).

Ad. *fusco-nigricans, subtus flavescenti-albida, mento, gula, maculaque magna occipitali cum uropygio coccineis; gutture croceo-flavo; remigibus, primis duobus exceptis, et tectricibus alarum majoribus flavido marginatis; rectricibus, duabus mediis exceptis, tectricibusque alœ minoribus nonnullis ad apicem albis; rostro nigro; pedibus corneis. Long. al.* 2·45, *caud.* 1·6, *rostr.* ·6, *tarsi* ·55 (*poll. Angl.*).

Jr. *macula occipitali nulla, gutture sordide flavo, et uropygio brunneo-olivaceo distinguenda.*

Hab. in insulis Vitiensibus.

This *Myzomela* hardly admits of being mistaken for any other species. It is perhaps most nearly related to *M. lafargii* of the Solomon Islands, but is at once distinguishable from that species by the red throat and orange-yellow chest, besides other differences. The red of the throat is separated from the yellow of the chest by a distinct though narrow black line. The red on the back appears last, that on the chin first. In not fully plumaged birds the rump and lower back are olivaceous. The sexes when adult are nearly alike, the female being only distinguishable by the colours being less bright. Very often, too, though not always, the red occipital spot is absent in the female.

Mr. Murray records the iris as "black," Mr. Layard as "brown," the legs being "verditer" and "dark livid" in the living bird, with the soles of the feet yellow.

This bird is entirely confined to the Fijis, where, according to Mr. Layard's list (Ibis, 1876, p. 391), it is found in all the larger islands of that group *; and in addition to the islands enumerated by him, speci-

* See also P. Z. S. 1875, p. 431, for an interesting account of its habits.

mens from Matuku are in the British Museum (*Rayner*). Its occurrence in the Samoan group has not yet been confirmed (cf. Whitmee, Ibis, 1875, p. 447). Hombron and Jacquinot indicated their "*Myzomèle solitaire*" as being from the "Iles Salomon" with some doubt; and, relying on them, Mr. Sclater included "*M. solitaria*" in his list of Solomon-Island Birds (P. Z. S. 1869, p. 124), where, however, only *M. lafargii*, so far as is yet known, occurs.

9. Myzomela lafargii.

Myzomela lafargii, Hombr. & Jacq. Voy. Pôle Sud, Zool. iii. p. 98, t. 22. f. 5 (1853).

Corpore supra cum capite, gutture et pectore superiore nigris; occipite coccineo; abdomine flavido-olivaceo; alis caudaque nigris, remigibus olivaceo-limbatis, subalaribus albis; rostro nigro, pedibus plumbeis. P. Z. S. 1879, p. 265.

Hab. in insulis Salomonis.

This species was obtained by the French Expedition to the South Pole; and the type specimen in the Paris Museum remains, I believe, unique in Europe. M. Oustalet, to whom I wrote for information about it, kindly replies to me, on comparing it with the figure in the Atlas to the 'Voyage:'—"Je trouve dans celle-ci quelques inexactitudes. Les proportions de l'oiseau ont été un peu exagérées : le noir de la gorge a été trop etendu et trop marqué. L'oiseau type est plus petit, et il a le haut de la gorge seulement noir, le bas, vers la poitrine, étant un peu mêlé de jaune verdâtre."

M. lafargii is somewhat allied to *M. jugularis* of the Fijis, but differs from the latter in having the red confined to the top of the head, and in the throat and chest being black.

10. Myzomela sclateri, sp. n. (Plate III. fig. 2.)

♂ *corpore supra, alis caudaque fusco-nigricantibus, capite saturatiore, plumis dorsi inferioris apice flavidis; remigibus, alarum tectricibus et rectricibus externe olivaceo-flavo limbatis; gula splendide coccinea; corpore subtus griseo-flavido, gutture sordidiore; subalaribus et margine interna remigum albis; rostro nigro, pedibus obscuris. Long. tot. circa* 4·5, *al.* 3·65, *caud.* 1·7, *rostr.* ·6, *tars.* ·55 (*poll. Angl.*).

Hab. in Novâ Britanniâ.

A few weeks ago Mr. Sclater, after whom I propose to name this new species, lent me for examination a single specimen of it, marked "male," which he had recently received in a letter together with two *Pachycephalæ*, from the Rev. G. Brown, C.M.Z.S., of the Wesleyan Mission at present established on the Duke-of-York Islands. The exact locality given on the label is "Palaküru Island, New-Britain coast." I have not been able to find Palaküru Island on any map; but it is probably only an islet lying close to the shores of the larger island.

At first I had some doubts as to this individual being adult; but now from the absence of red feathers on any other part, and from the singularly bright and shining colour of those on the throat, I have little doubt that it has very nearly or quite attained its full plumage. *Myzomela sclateri* hardly admits of being compared with any other species of the group, the entirely dark upperside and the red being confined to the throat, rendering it quite unlike any species yet known to us.

11. Myzomela nigrita.

Myzomela nigrita, G. R. Gray, P. Z. S. 1858, p. 173; Salvadori, P. Z. S. 1878, p. 97.

Myzomela erythrocephala, Meyer (nec Gould), Sitzungsber. Wien. Akad. lxx. p. 204 (1874).

P. Z. S. 1879, p. 266. *Myzomela meyeri*, Salvadori, Ann. Mus. Civ. Gen. vii. p. 947 (1875).

♂ *nitenti-niger, subalaribus et remigum margine interna albis; rostro nigro, pedibus corneis.*

♀ *griseo-brunnea, subtus dilutior; fronte gulaque rubro lavatis; remigibus externe olivaceis.*

Hab. in Novâ Guineâ occidentali et insulis vicinis.

This *Myzomela*, conspicuous for the almost entirely black plumage of the adult male, was first described by the late Mr. Gray from specimens collected in the Aru Islands by Wallace, where it was obtained again during the recent voyage of the 'Challenger.' It also occurs on the mainland of the north-western peninsula of New Guinea, at Dorey (*Wallace*) and Rubi (*Meyer*), and in the islands of Jobi and Miosnom (*Meyer* and *Beccari*), the birds from the mainland and these islands being considerably bigger than those from Aru. This is particularly the case with those from Jobi and Miosnom, so that Count Salvadori is inclined to separate them as a new species. But, as the following table will show, considerable differences in the measurements of this species occur in various localities; so that at present I consider it better to retain all forms under one name.

	Wing.	Tail.	Beak (from forehead).	Tarsi.	
1. ♂. Aru?	2·2	1·65	·55	·5	
2. ♂. Wokan	2·4	1·65	·55	·5	
3. ♂. Aru	2·35	1·7	—	·5	
4. ♂. Rubi	2·5	2·0	·65	·5	
5. ♂. Dorey	2·4	1·8	·65	—	
6. ♂. Miosnom	2·7	2·0	·65	·5	"*M. pluto*," Salvadori, in litt.
7. ♂. Jobi	2·5	2·0	·67	·5	
8. ♂ jr. Miosnom	2·6	1·7	·67	·53	
9. ♂ jr. Rubi	2·3	1·8	·6	·53	
10. ♂ jr. Rubi	2·3	1·8	·58	·5	
11. ♀. Rubi	2·1	1·65	·55	·45	
12. ♀. Aru?	2·1	1·4	·55	·45	

The male of this species resembles that of *Myzomela pammelæna* from the Admiralty Islands, but differs as below specified. The female retains more of the normal colouring of the group, and approaches those of *M. boiœi* and *M. adolphinæ*. The young birds resemble the female, the red on the head in the young males being obtained before any indication of the black plumage. Dr. Meyer obtained only females and young of this bird, and referred these with considerable hesitation to *M. erythrocephala* of Gould, a very different species. Count Salvadori saw that this was a mistake, and proposed the name *meyeri* for the specimens collected by Dr. Meyer. But on subsequently examining the birds at Dresden, he found that in reality they were the young and females of the present species, the female having been only briefly indicated in Gray's original description.

Mr. Murray notes of a male from Wokan, Aru Islands, that the eyes are "hazel," the "bill and feet black." P. Z. S. 1879, p. 267.

12. Myzomela pammelæna.

Myzomela pammelæna, Sclat. P. Z. S. 1877, p. 553.

♂ ad. *nigerrimus, remigum marginibus internis cineraceo-albidis, rostro pedibusque nigris. Long. tot. circa* 5, *al.* 2·7, *caud.* 2, *rostr.* ·65, *tars.* ·65 (*poll. Angl.*).

Jun. *præcedenti similis, sed omnino sordidior, abdomine et subcaudalibus rufo-tinctis, et subalaribus albis distincta.*

Hab. in insulis Admiralitatis.

Two specimens, an adult male and a young bird, of this *Myzomela* were obtained during the stay of the 'Challenger' at Nares Harbour, Admiralty Islands. It is closely allied to *Myzomela nigrita* of the Aru Islands and New Guinea; but the adult male of the new species differs from the more western one by its *black* under wing-coverts (although these are *white* in the young bird), dirty white margins to the remiges, and longer and stouter feet and tarsi. In size it exceeds any specimens I have seen of *M. nigrita* from the Aru Islands, but is equalled in length of wing and tail by the larger birds from the islands and shores of Geelvink Bay.

Mr. Murray marks the irides of the adult bird as "hazel-brown."

13. Myzomela eques.

Cinnyris eques, Less. Voy. Coq. p. 679, t. 31. fig. 1 (1826).

Nectarinia eques, Müll. & Schleg. Verhand. p. 62 (1839–1844).

Cosmeteira eques, Meyer, Sitzungsber. Wien. Akad. lxx. pp. 215–217 (1874).

Cosmeteira minima, Wald. Ibis, 1870, p. 50 (♀).

Omnino cinerascenti-brunnea, subtus dilutior ; stria gulari nitide coccinea ;

rostro pedibusque nigro-corneis. Long. al. 3, *caud.* 2·5, *tarsi* ·6 (*poll. Angl.*). (♂ ex Novâ Guineâ.)

Hab. in Novâ Guineâ et insulis vicinis.

Although generally placed amongst the Nectariniidæ, this species in structure and coloration is a true *Myzomela*, allied to the Australian *M. obscura*, from which it is at once distinguished by its bright red gular streak. The sexes are similar; but the females are considerably smaller than the males; and on one of these from Mysol the late Lord Tweeddale founded his species *C. minima*.

Dr. Meyer describes (*l. s. c.*) the young as having the forehead and top of the head tinged with reddish—an interesting fact, as showing in the young bird a style of coloration not retained in the adult, but occurring in other members of the genus, and therefore probably a more primitive character.

This species is widely distributed over New Guinea, occurring at Dorey (*Wallace* and *Meyer*), Rubi, Passim (*Meyer*), Sorong (*Mus. Lugd.*, fide *Salvadori*), and Wa Samson (*Beccari*); and D'Albertis found it on the Fly River. It also occurs in Waigiou (*Lesson*, *Wallace*, and *Bernstein*) and Mysol (*Wallace* and *Hoedt*). Count Salvadori has lent me specimens from Salwatti, and says that in the Leyden Museum there is one said to be from Ceram (*Moens*), but that this locality, as well as Gilolo (*Forsten*), are in all probability errors.

P. Z. S. 1879, p. 268.

14. Myzomela obscura.

Myzomela obscura, Gould, P. Z. S. 1842, p. 136; id. B. A. iv. pl. 67; id. Handb. i. p. 559.

Ptilotis fumata, "Müll. Mus. Lugd., ex Nova Guinea," Bp. Consp. i. p. 392 (1853).

Omnino griseo-brunnea, subtus pallidior, capite vinaceo tincto; remigibus externe subtilissime griseo limbatis; alis caudaque subtus griseis, remigum margine interna albida; rostro pedibusque nigro-corneis. Long. al. 2·7, *caud.* 2·2, *rostr.* ·6, *tars.* ·6 (*poll. Angl.*).

Hab. in Australiâ septentrionali et Novâ Guineâ.

This plainly-coloured Honey-eater was first described by Mr. Gould from specimens obtained at Port Essington by Gilbert. It seems to have rather a wide range over the northern parts of Australia, occurring at Port Darwin (*Masters*), Cape York ('*Challenger*'), and in the north of Queensland "as far south as the Mary river" (*Ramsay*). D'Albertis found it at Naiabui and on the Fly River; and there are specimens from the river Utanata in the Leyden Museum—the originals of Bonaparte's "*Ptilotis fumata*" (cf. Salvadori, Ann. Mus. Civ. Gen. xii. p. 334, 1878).

The sexes are similar. I have not seen young birds.

The iris has been variously recorded as "red" (Gould), "brown" (*Murray*), and "black" (*D'Albertis*).

15. Myzomela simplex.

Myzomela simplex, G. R. Gray, P. Z. S. 1860, p. 349.

Sordide griseo-brunnea, subtus dilutior; remigibus et rectricibus rubido limbatis; margine interna remigum albida; rostro pedibusque corneis, his pallidioribus. Long. tot. 5·2, *al.* 2·3, *caud.* 2, *rostr.* ·5, *tarsi* ·6 (*poll. Angl.*).

Hab. in Halmaherâ et insulis adjacentibus.

This plainly-coloured *Myzomela* was first discovered by Wallace in the island of Batchian, and it also occurs in most of the other islands of the Halmahera group of the Moluccas, but is replaced on Obi by the nearly allied *Myzomela rubrotincta.* Count Salvadori informs me that he has seen "many specimens in the Leyden Museum from Gilolo (*Bernstein*), Tidore (*Bernstein, Von Rosenberg*), and Dammar (*Bernstein*). A specimen from Ternate (*Bruijn*) is in Turati's collection. A single specimen from Morty in the Museum of Leyden is much darker than the others."

This species is allied to *M. rubrobrunnea* and *M. rubrotincta*, but differs from them in the less extent of the red colour, which is confined to the margins of the quills and tail-feathers. The sexes are probably similar in colour; I have not seen the young bird.

16. Myzomela rubrotincta. P.Z S 1879, p. 269.

Myzomela rubrotincta, Salvad. Ann. Mus. Civ. Genov. xii. p. 344 (1878).

"*Brunnea, dorso, alis et cauda pulcherrime rubro tinctis; pectore, abdomine et subcaudalibus obsoletius rubro tinctis. Long. tot.* ·120 *m.*, *alæ* ·067, *caud.* ·048, *rostri* ·020, *tars.* ·020."

Hab. "in ins. Obi (*Bernstein*)," Salvad. *l. c.*

This species has recently been described by Count Salvadori from five specimens—two males and three females—the two sexes are similar—in the Leyden Museum. He says it "resembles *M. simplex* of Gray from Halmahera, in which only the remiges and rectrices (and not all the parts between the head and neck) are margined with red, and in which the red colour is very indistinct."

17. Myzomela rubrobrunnea. (Plate II. fig. 2.)

Myzomela rubrobrunnea, Meyer, Sitzungsber. Ak. in Wien, lxx. p. 203 (1874).

♂ *grisescenti-brunneus, subtus dilutior, capite saturatiore, plumis plus minusve vinaceo limbatis; dorso inferiore et uropygio, cum marginibus externis remigum et rectricum vinaceo-rubris; alis caudâque subtus griseis; margine interna remigum albida; rostro pedibusque nigro-corneis. Long. tota circa* 4, *alæ* 2·4, *caud.* 1·8, *rostr.* ·6, *tars.* ·55 (*poll. Angl.*).

♀ *mari similis, sed coloribus minus intensis et paullo minor.*

Hab. in insulâ Mysore.

Dr. Meyer first discovered this beautiful species of *Myzomela*, during his travels in and about New Guinea in 1873. He obtained only two specimens, both males, at Kordo, the chief settlement in the island of Mysore in Geelvink Bay. Beccari obtained others in the same island, to which it is apparently confined; and from one of his specimens, a fine male, kindly lent me by Count Salvadori, the figure is taken.

This species resembles *M. simplex* and *M. rubrotincta* of the Moluccas, but differs from both in the red margins to the feathers being continued over a larger part of the bird.

18. Myzomela cruentata.

Myzomela cruentata, Meyer, Sitzungsber. Ak. Wien, lxx. i. p. 202 (1874); Gould, B. New Guin. pl. pt. v.

Myzomela coccinea, Ramsay, Proc. L. S. N. S. W. ii. p. 106 (1877)? (Ex insulis Ducis Eboraci.)

Myzomela erythrina, Ramsay, Proc. L. S. N. S. W. ii. p. 107 (1877)? (Ex Novâ Hiberniâ.)

P. Z. S. 1879, p. 270.

♂ *corpore omnino chermesino, uropygio splendidiore, plumis ad basin nigris; alis rubricantibus, plumis externe rubris; remigibus fuscis, primis duobus exceptis, rubro limbatis; rectricibus rubido-griseis, externe rubro marginatis; alis caudaque subtus griseis; rostro pedibusque nigris. Long. tot. circa* 4, *al.* 2·2, *caud.* 1·5, *rostr.* ·55, *tars.* ·5 (*poll. Angl.*).

Hab. in montibus Arfak Novæ Guineæ.

This very beautiful *Myzomela*, at once distinguished from all others of this group yet described by its uniformly red colour, was first obtained by Dr. Meyer, in the Arfak Mountains, in 1873. Only one specimen, an adult male, was procured; and this and another specimen, likewise a male and nearly or quite adult, procured by Bruijn's collectors in the same locality, and now in the Genoa Museum, are, I believe, the only examples yet brought to Europe of this splendid little bird.

A short time ago Mr. E. P. Ramsay, of the Sydney Museum, described two new species of *Myzomela*, both remarkable for their nearly uniform red coloration. One is indicated as a female and from the Duke-of-York Islands (*M. coccinea*); the other, a young male (*M. erythrina*), is from New Ireland. Of it Mr. Ramsay says:—"This species is smaller than the preceding, and the bill is comparatively stronger and stouter; otherwise I should be inclined to consider it the young of the former." From his description it is evidently a young bird; and after having carefully compared both it and that of the other species with Dr. Meyer's and Count Salvadori's specimens, I have come to the conclusion that both *M. coccinea* and *erythrina* are probably referable to *M. cruentata*. If this is so, it would seem, provided Ramsay's specimens are correctly sexed, that the adults of this species are nearly or quite similar in coloration. The species probably has a wide range through New Guinea eastward of the Arfak Mountains.

19. Myzomela rubratra.

Cinnyris rubrater, Less. Voy. Coquille, Zool. p. 678 (1826); id. Man. ii. p. 55 (1828); Kittlitz, Kupf. Vög. t. 8. fig. 1 (1832).

Myzomela rubratra, Bp. C. R. xxxviii. p. 263 (1854); Hartl. P. Z. S. 1868, p. 5; Hartl. & Finsch, P. Z. S. 1872, p. 94; Finsch, Journ. God. Mus. xii. p. 26 (1876).

Myzomela major, Bp. C. R. xxxviii. p. 263 (1854). (Ins. Carol.)

Myzomela sanguinolenta, pt., Gray (nec Lath.), Gen. B. i. p. 118; Bp. Consp. i. p. 394 (1850).

Ad. *coccinea, alis, cauda, crisso et subcaudalibus nigricantibus; alis caudaque subtus griseis, remigum margine interna albida; rostro nigricante, pedibus corneis. Long. al.* 2·95, *caud.* 2·3, *rostr.* ·65, *tars.* ·75 (*poll. Angl.*).

Jr. *olivaceo-brunnea, remigibus externe olivaceis; subalaribus obscuris.*

Hab. in insulis Pelewensibus, Marianis, et Carolinis.

This species belongs to the group of *M. cardinalis, nigriventris*, and *chermesina*, but is at once distinguished from all of these by the greater extent of the red colour in the adult, only the vent and under tail-coverts being black.

Myzomela major was founded by Bonaparte on specimens of this bird from the Caroline Islands, and characterized as "*Similis* M. rubratræ, *sed major et percoccinea.*" But any such difference in size is not constant, and Dr. Hartlaub says (*l. c.*) that Pelew birds are as large as Caroline ones. P. Z. S. 1879, p. 271.

The young bird is nearly uniformly dark olive-brown, and gradually attains its full plumage by the gradual appearance of the red on various parts of its body.

M. rubratra is remarkable for its wide range over the archipelagos of the North-eastern Pacific. Lesson found it on the island of Ualan in the east of the Caroline group (his assertion that it was also found in the Philippines by M. Dussumier being of course erroneous), as did Kittlitz, who gives an interesting account of the habits of this species as observed by him on this island and the Marianne Island of Guam (Denkwürd. ein. Reise, i. pp. 364 and 381, 1858). Kubary found it on Ponapè in the east, and on Yap and the Mackenzie Islands in the west, of the Carolines; so that it is probably found all over that archipelago. Specimens from these islands are in the Godeffroy Museum; likewise examples from the Pelews (or Palaos). Gray, in his Catalogue of Pacific birds, gives "Island of Vanicoro" with a query; but in all probability this is a mistake, for as yet no *Myzomela* has been found there.

20. Myzomela nigriventris.

Myzomela nigriventris, Peale, U.S. Expl. Exped. p. 150, pl. 41. f. 2

(1848); Cassin, U.S. Expl. Exped. p. 175, pl. 12. f. i. (1858); H. & F. Orn. Centralpolyn. p. 56, t. 7. f. 3 and 4 (ad. and jr.).

Myzomela rubratra, Hartl. (nec Lesson), Wiegm. Arch. 1852, p. 130 (ex Samoa).

Myzomela cardinalis, Hartl. (nec. Gmel.), Wiegm. Arch. 1852, p. 109.

" *Myzomela arnouxi*, Verr.," Bonaparte, C. R. xxxviii. p. 263 (1854).

Ad. *capite, dorso uropygioque cum pectore fulgido-coccineis, plumis ad basin nigris; corpore subtus, macula anteoculari, alis caudaque nigris; remigibus interne albidis; rostro pedibusque nigris. Long. al.* 2·75, *caud.* 1·8, *rostr.* ·65, *tars.* ·7 (*poll. Angl.*).

Jr. *olivaceo-fusca, subtus dilutior et flavido lavata; uropygio rubro tincto; remigibus olivaceo-limbatis; subalaribus et margine interna remigum albis.*

Hab. in insulis Samoensibus.

This species is very closely allied to *M. cardinalis*, which it replaces in the Samoa group. The differences between the two I have pointed out under the last-named species.

From *M. rubratra*, with which it was at first confounded, both these species differ in the black flanks and belly, these in *M. rubratra* being red, only the vent and under tail-coverts being black, whilst the red on the chest in all three of these species easily separates them from *M. lifuensis*.

M nigriventris is confined to the Samoan Islands, its reported occurrence in the Fijis being erroneous (cf. Layard, Ibis, 1876, p. 391) and founded on a mistake of Dr. Gräffe. It is apparently rather a common bird in the Samoan group, occurring both on Savaii and Upolu.

P. Z. S. 1879, p. 272.

21. Myzomela cardinalis.

Cardinal Creeper, Lath. Gen. Syn. i. pt. 2, p. 733, pl. 33. f. 2 (1782).

Certhia cardinalis, Gm. S. N. i. p. 472 (1788); Lath. Ind. Orn. i. p. 290 (1790).

Cardinal Honey-eater, Lath. Nat. Hist. iv. p. 199, pl. 71. f. 2 (1822).

Myzomela cardinalis, Gray, B. Trop. Isl. p. 10 (1859); Tristram, Ibis, 1876, p. 261.

Myzomela melanogastra, Bp. C. R. xxxviii. p. 263 (1854).

Ad. *capite, dorso uropygioque cum pectore superiore coccineis, plumis ad basin nigris; macula anteoculari, alis caudaque nigris, his nitore nonnullo metallico; corpore subtus fuliginoso-nigro; remigum margine interna albida; rostro pedibusque nigris. Long. al.* 2·9, *caud.* 2·1, *rostr.* ·7, *tars.* ·75 (*poll. Angl.*).

Jr. Myz. nigriventri *similis, sed supra magis brunnea, et subtus dilutior; dorso uropygioque castaneo-brunneis, nec rubris.*

Hab. in Novis Hebridibus.

This Honey-eater, one of the few of this genus known to the older authors, is very nearly allied to *M. nigriventris* of the Samoan group, which it replaces in the New Hebrides.

The adult bird (I agree with Messrs. Hartlaub and Finsch in considering that in this section of the group the sexes are nearly similar) is distinguished from *M. nigriventris* by the scarlet of the upper parts and chest being duller, and extending not quite so far down on the chest. The black of the lower parts is less intense, being tinged with brownish; the white margin to the remiges internally is more distinct; and the bill is stouter. It is also a slightly larger bird.

The young bird is paler and browner above (not so much dark brown as greyish brown), and paler and yellower below; the rump and back are washed with chestnut-brown. Judging from the series of specimens I have seen, the red colour in this species seems to appear first on the *head*, and not on the *back* as in *M. nigriventris*. The remiges, as usual in the young of this genus, are externally lined with olive-yellow. From *M. lifuensis* this species may be distinguished by its larger size and by the red extending on to the breast. Latham's description and figure clearly apply to this bird, not to *M. lifuensis*.

The irides are marked "black" or "dark brown."

Latham describes this bird from the island of Tanna, where, he says, it is called "Kuyameta" and is common, sucking the juices of flowers; and I have seen specimens collected on that island by Mr. Layard. There are specimens in the British Museum from Erromango and Aneiteum (*Cuming*); and Canon Tristram has received it from the latter island, as well as from Tanna and Aniwa. It thus seems to be confined rather to the southern portion of the New-Hebridean archipelago, being replaced in the north by *M. caledonica*? and *M. chermesina*.

22. MYZOMELA LIFUENSIS. P. Z. S. 1879, p. 273.

Myzomela lifuensis, E. L. and L. C. Layard, Ibis, 1878, p. 258.

♂ *capite, dorso uropygioque coccineis; alis, cauda et corpore subtus toto cum macula anteoculari fuliginoso-nigris; alis caudaque nitore nonnullo metallico; remigum margine interna albida; rostro nigro, pedibus nigro-corneis. Long. tota circa* 4·2, *al.* 2·5, *caud.* 1·75, *rostr.* ·55, *tars.* ·68 (*poll. Angl.*).

Hab. in Lifu, ex insulis "Loyalty" dictis.

Canon Tristram having kindly submitted to me two skins (now in his collection, both marked "males" and adult) collected by the Messrs. Layard, who first indicated this species, I can give a more complete account of it, and say that it is certainly a very good species. It is nearly allied to *M. nigriventris* and *M. cardinalis* of the Samoas and New Hebrides respectively, more particularly to the last, but is at once distinguished from both by the red below not extending beyond the head, the breast being sooty-black like all the rest of the lower parts. It is also a considerably smaller bird; the bill is shorter and more slender; the tarsi are not so stout, and the claws smaller. From *Myzomela erythrocephala* it is easily distinguishable by the uniform black of the lower parts.

Mr. Layard notes the "beak black, legs very dark brown, iris dark brown," and food "insects." Both specimens were obtained at Hepenehe, the chief town in the island of Lifu, the largest of the Loyalty Islands.

Whether *M. erythrocephala* of Marie's list (Ibis, 1877, p. 362) is this bird, remains uncertain; as yet, *M. caledonica* is the only *Myzomela* certainly known to be found on New Caledonia itself.

23. Myzomela chermesina. (Plate III. fig. 1.)

Myzomela chermesina, Gray & Mitch. G. B. i. pl. 38 (1840) (fig. mala); Gray, Cat. B. Trop. Isl. p. 11 (1859); Forbes, P. Z. S. 1878, p. 352.

♂ ad. *fusco-nigricans, alis caudaque nitore nonnullo metallico; mento, gula, pectore lateribusque abdominis, cum dorso uropygioque nitide coccineis, plumis ad basin nigris; subalaribus nigris, remigum pogonio interno griseo; rostro nigro, pedibus brunneo-corneis. Long. tota circa* $4\frac{1}{2}$, *al.* 3, *caud.* 2, *rostri* $\frac{5}{8}$, *tarsi* $\frac{5}{8}$ (*poll. Angl.*).

Hab. in insulis Pacificis Rotumah et Mallikollo.

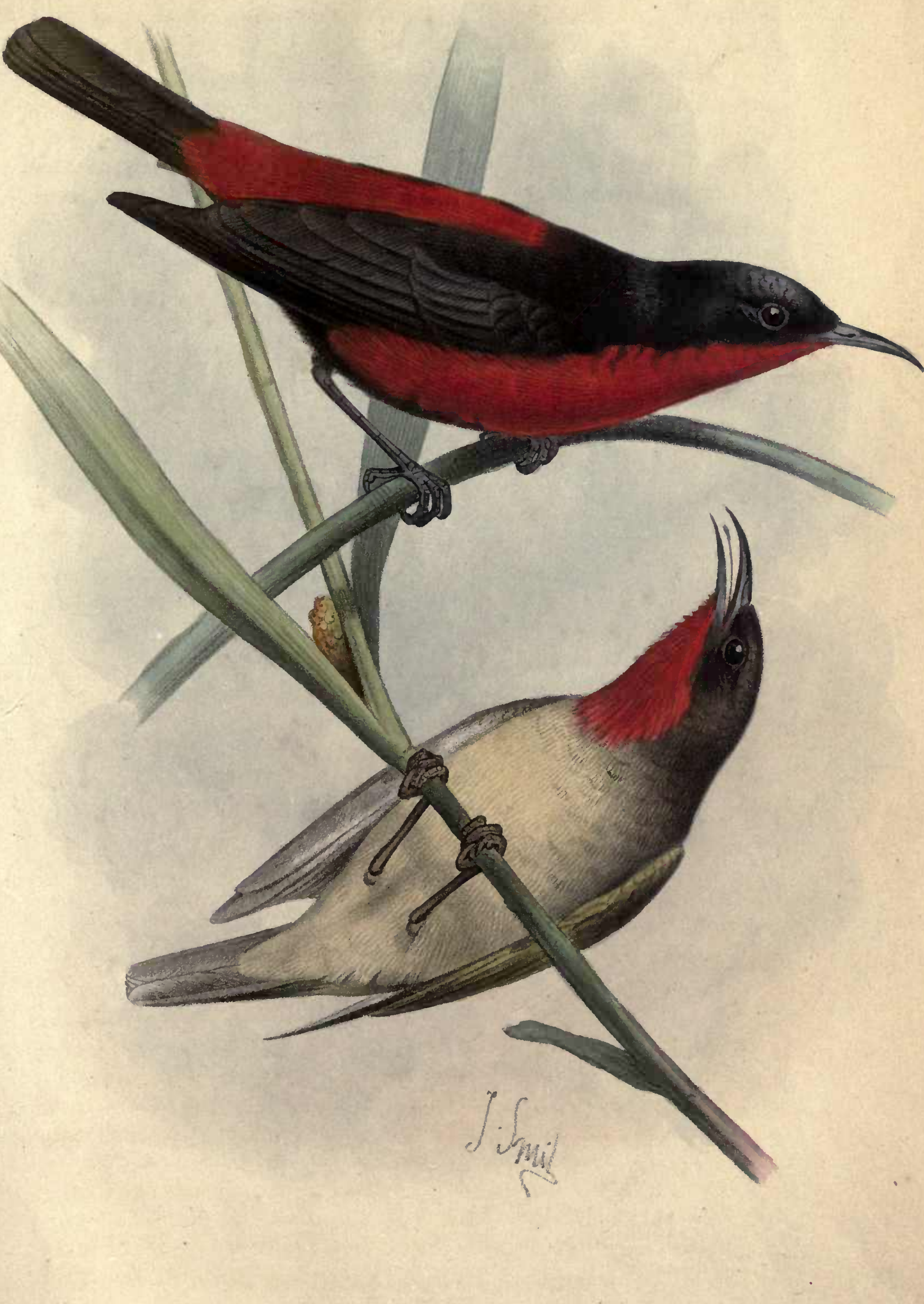
This species was first figured by Messrs. Gray and Mitchell in their 'Genera of Birds;' but no description was given, the species being only mentioned in the list of the species of *Myzomela*; nor was any habitat indicated. Bonaparte, and Gray later on, in his 'Hand-list' (vol. i. no. 1989), gave "New Guinea?" as the locality, without any apparent reason for so doing. The bird was never recognized again till last year, when Mr. Sclater received two specimens, an adult male and a nearly adult female*, from the Rev. G. Brown, C.M.Z.S., of the Wesleyan Mission, together with some other birds, from the small island of Rotumah, north of the Fijis. Fortunately Gray's type is still in existence in the gallery of the British Museum; and on comparing the birds from Rotumah with it, it was at once evident that they were of the same species, though Gray's figure represents a bird with a uniformly scarlet underside. About the same time Mr. Sharpe got a specimen (from which the figure is taken) of the same bird, apparently identical in every respect, from the island of *Mallikollo* (in my paper, *l. c.*, by a mistake I wrote *Erromango*) in the New Hebrides, where it was obtained by Mr. Wykeham Perry, H.M.S. 'Pearl.' The species thus has a wide range, though I believe the above-mentioned four specimens (which are all nearly or quite adult) are as yet the only ones of this bird ever brought to Europe. The female is similar to the male in colour, but a little duller (*cf. loc. cit.* p. 353).

P. Z. S. 1879, p. 274.

24. Myzomela rosenbergi.

Myzomela rosenbergi, Schleg. Ned. Tijd. Dierk. iv. p. 38 (1871);

* These birds are now in the Paris Museum.



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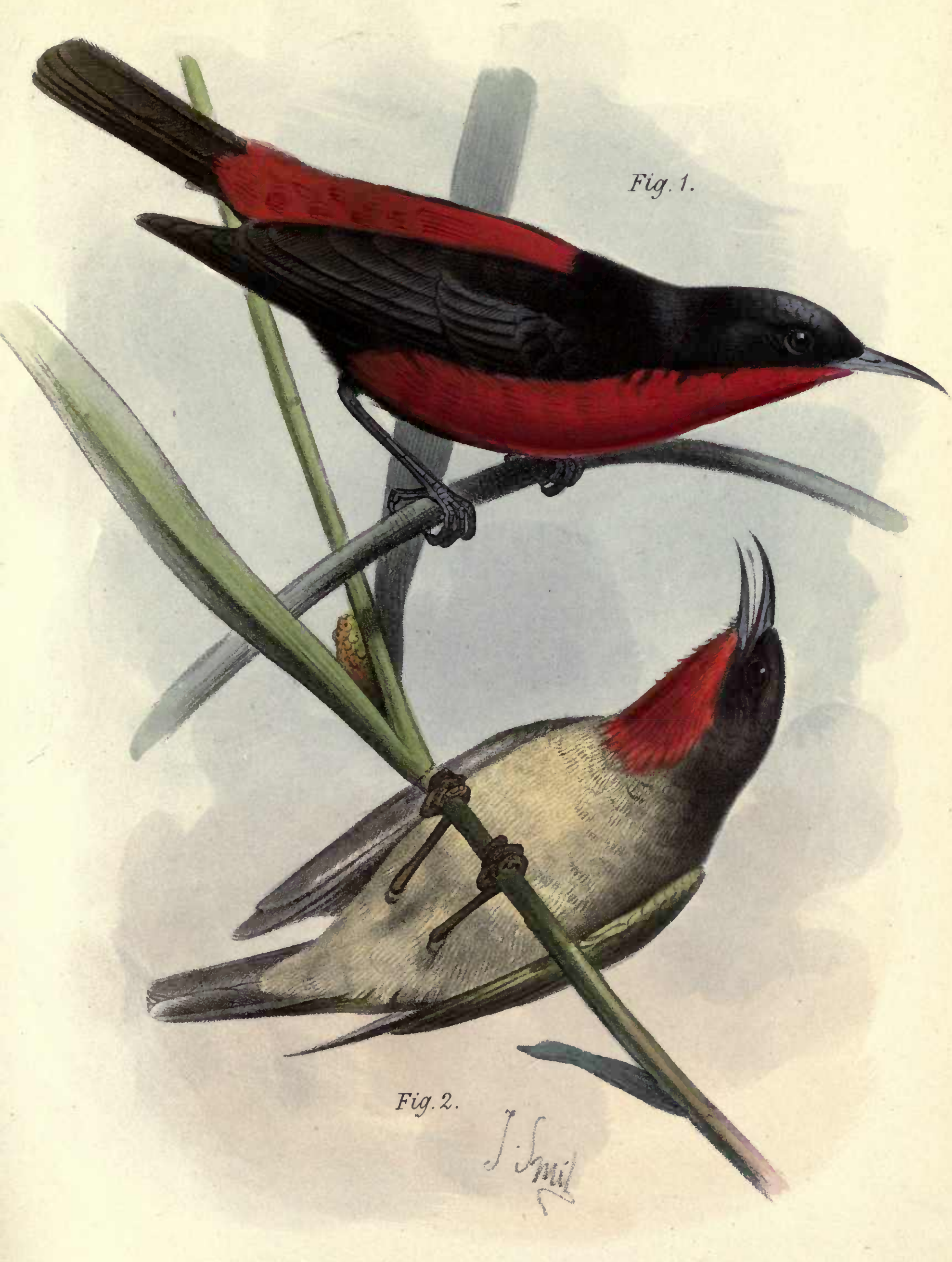


J. Smit lith.

Hanhart imp.

1. MYZOMELA CHERMESINA.
2. " SCLATERI.

Rosenberg, Reist. Geelv. Baai, p. 138, t. xvi. fig. 2 (1875); Meyer, Sitzungsber. Wien. Akad. lxix. i. pp. 211, 212 (1874).

♂ ad. *niger nitore nonnullo metallico; collo, dorso, uropygioque, cum pectore splendide coccineis; rostro nigro, pedibus corneis. Long. al.* 2·5, *caud.* 1·7, *rostr. a culm.* ·65, *tars.* ·55 (*poll. Angl.*).

♀ *rufescenti-brunnea, plumis ad basin nigris, ad rhachin pallidioribus; fronte, pectore uropygioque coccineis, mento gulaque nigricantibus; alis caudaque fuscis, remigibus externe olivaceo-limbatis, tectricum alarum apicibus brunneis; pogoniis internis remigum albis.*

♂ jr. *feminæ similis, sed fronte, pectore, uropygio, mento gulaque corpore concoloribus.*

Hab. in Novâ Guineâ.

This beautiful and very distinct *Myzomela* was first described by Prof. Schlegel from two specimens, both males, collected by Von Rosenberg in the north-western peninsula of New Guinea. Dr. A. B. Meyer obtained five specimens from the Arfak Mountains near Hattam, at an elevation of about 3500 feet above the sea, during his expedition to New Guinea in 1873. Since then numerous specimens have been obtained by various travellers in the same district. That the species is not confined, however, to the Arfak Mountains is shown by the fact* that Signor D'Albertis obtained two skins of this same bird, identical with Arfak specimens, from the natives of the neighbourhood of Epa, near Hall Bay, S.E. New Guinea.

According to Dr. Meyer the adults of both sexes are similar, and the bird above described as the female (from two nearly identical specimens so sexed by Beccari) is really the young assuming adult plumage. Count Salvadori, however, writes me that he has about 40 specimens of this species, and maintains the view he has already expressed (Ann. Mus. Civ. Gen. vii. p. 947, 1875), that Meyer's "young" are in reality females. A very young bird (♂) in the Genoa Museum, described above, has only a trace of red on the throat, and is probably a bird of the year. The varied colouring of each feather gives a somewhat flammulated appearance to the head, back, and chest of the young and females. P. Z. S. 1879, p. 275.

25. Myzomela nigra.

Myzomela nigra, Gould, B. A. iv. pl. 66; id. Handb. B. A. i. p. 558 [nec *Cissomela nigra*, Bon. C. R. xxxviii. p. 261 (1854)].

♂ *capite, dorso, uropygioque cum pectore superiore et linea media abdominali nigris; lateribus abdominis, ventre et subcaudalibus albis; alis, subalaribus caudaque brunneis; rostro pedibusque nigris. Long. alæ* 2·7, *caudæ* 1·7, *rostri* ·65, *tarsi* ·5 (*poll. Angl.*).

* *Cf.* Ann. Mus. Civ. Genova, vii. p. 799 (1875).

♀ *supra brunnea, subtus albida, mento, gula et pectore fusco variegatis; stria superciliari et remigum margine interna albidis.*

Hab. in Australiâ.

This species, which differs somewhat in coloration from the other members of the group, has a wide range over Australia. Gould found it on the plains of the Namoi; and Gilbert met with it in Western Australia on the Swan River. Mr. Ramsay, in addition, marks it in his list from the Port-Darwin district, from the interior, Victoria, and S. Australia.

26. Myzomela pectoralis.

Myzomela pectoralis, Gould, P. Z. S. 1840, p. 170; id. B. A. iv. pl. 65; id. Handb. B. A. i. p. 557.

Cissomela nigra, Bon. (nec Gould), C. R. xxxviii. p. 265 (1854).

♂ ad. *niger, uropygio, mento, gutture et corpore subtus albis, pectore fascia angusta nigra transversim notato; rostro pedibusque nigris.*

♀ (*aut* jr.) *dorso medio castaneo-brunneo diversa.*

Long. tota 4·5, *al.* $2\frac{5}{8}$, *caud.* $1\frac{3}{4}$, *rostr.* $\frac{5}{8}$, *tars.* $\frac{5}{8}$ (*poll. Angl.*).

Hab. in Australiâ septentrionali.

This *Myzomela*, which in its black-and-white coloration departs considerably from the general coloration of the group, is confined to the more northern parts of Australia. Gould's original specimens were from the N.W. coast. Mr. Ramsay in his list records it from Ports Darwin and Essington, the Gulf of Carpentaria, Cape York, and Rockingham Bay.

It is not as yet ascertained with certainty whether the chestnut-backed birds are the adult females, or merely the young, of this species.

Besides the above 26 species, which are all founded on actual specimens, and which are here recognized as valid, there remains the following, based on a figure of one of the older authors, but never yet again met with, which may or may not be a real bird. This is

P. Z. S. 1879, p. 276. Myzomela pusilla.

Le Kuyameta, Vieill. Ois. Dor. ii. p. 92, t. 58 (1802). (*Certhia cardinalis*, Gm. in text.)

Myzomela pusilla, G. R. Gray, B. Trop. Isl. p. 10 (1859).

M. cardinalis, pt., F. & H. Orn. Centralpolyn. p. 57 (nota).

This extremely doubtful species was founded by Gray on a drawing (from a bird once in the Leverian Museum) in Vieillot's "Oiseaux Dorés." This plate, as well as the description, indicates a black-and-red *Myzomela*, like *M. cardinalis* or *M. rubratra*, but smaller ($3\frac{1}{2}$ inches in length), and with the abdomen, vent, &c. entirely red, only the wings, tail, and an anteocular spot being black. In the letterpress the bird is named *Certhia cardinalis* of Gmelin; and the habitat assigned is "New Holland and Isle of Tanna," evidently copied from Latham's account of the last-named species.

Geographical Distribution.

The genus *Myzomela* has rather a wide range, from Celebes on the west, to the Fiji and Samoan Islands on the east, and from Guam, in the Marianne group (in 13° N.) to S. Australia and Victoria (in 38° S.), but is strictly confined to the Australian region, in three out of the 5 subregions of which it occurs, being absent in New Zealand and in the Sandwich Islands.

The Papuan subregion is, as might naturally be expected, the richest in species, having 16, of which no less than 14 are peculiar. Australia proper has 5 species, of which three are peculiar, two occurring also in the Papuan subregion. In the Pacific subregion 7 species occur, of which all are peculiar.

Celebes has one species peculiar to itself (*M. chloroptera*), as likewise have Banda and Timor (*M. boiœi* and *M. vulnerata* respectively).

The Halmahera group (Gilolo, Batchian, Morty, Ternate, &c.) have one (*M. simplex*), which on Obi is replaced by *M. rubrotincta*. Curiously enough, the genus, as far as we yet know, is absent from the Sula Islands, from the Ceram group, and from the islands between Timor and the Arus, though represented in all the islands around this area, and even in the little island of Banda.

In the western half of New Guinea six species occur, of which *M. adolphinœ* is peculiar to the Arfak country. *M. rosenbergi* reoccurs in the mountains of southern New Guinea; and *M. cruentata* apparently extends to New Ireland. *M. nigrita* occurs on the mainland, as well as in Jobi and Miosnom (where it is the only species), and in the Aru Islands. Mysol, Waigiou, and Salwatti have only *M. eques*, which also occurs on the mainland both in the N.W. peninsula and on the south coast. *M. obscura* occurs both in S.W. and S.E. New Guinea, and also in N. Australia. Mysore is tenanted by a single peculiar species (*M. rubrobrunnea*); whilst the Aru Islands have two species, neither peculiar, one (*M. erythrocephala*) occurring in N. Australia and S. New Guinea, if specimens from all these three localities are really identical. New Guinea east of 140° has four species, none of which is peculiar, three occurring on the mainland of the west part, whilst two are Australian (*M. obscura* and *M. erythrocephala*). In the Admiralty Islands there is a single peculiar species, *M. pammelœna*, replacing *M. nigrita* of the further west. One species, also peculiar, is found in the Solomons (*M. lafargii*); but on which islands has yet to be ascertained. On New Ireland and in the Duke-of-York group only one species, which is pro-

P. Z. S. 1879, p. 277.

P. Z. S. 1879, p. 278.

	Papuan Subregion.																Australian Subregion.			Polynesian Subregion.													
																				N. Hebrides.													
	Celebes.	Timor.	Banda.	Halmahera group.	Obi.	Papuan Islands †.	W. New Guinea.	Jobi and Miosnom.	Mysore.	Aru Islands.	E. New Guinea.	Admiralty Islands.	New Britain.	Duke-of-York Islds.	New Ireland.	Solomon Islands.	N. Australia.	S.E. Australia.	W. Australia.	Mallikollo.	Vaté.	Api.	Erromango.	Aneiteum.	Tanna.	Lifu.	New Caledonia.	Rotumah.	Fijis.	Samoan Islands.	Caroline Islands.	Marianne Islands.	Pelews.
1. sanguinolenta																	*	*		?	?	?											
2. caledonica																				*	*	*					*						
3. chloroptera	*																																
4. adolphinæ							*																										
5. boiei			*																														
6. erythrocephala										*	*						*																
7. vulnerata		*																															
8. jugularis																													*				
9. lafargii																*																	
10. sclateri													*																				
11. nigrita							*	*		*																							
12. pammelæna												*																					
13. eques						*	*				*																						
14. obscura							*				*						*																
15. simplex				*																													
16. rubrotincta					*																												
17. rubrobrunnea									*																								
18. cruentata							*							?	?																		
19. rubratra																															*	*	*
20. nigriventris																														*			
21. cardinalis																							*	*	*								
22. lifuensis																										*							
23. chermesina																				*								*					
24. rosenbergi							*				*																						
25. nigra																	*	*	*														
26. pectoralis																	*																

† Mysol, Salwatti, &c.

bably *M. cruentata*, occurs; whilst *M. sclateri* alone represents the genus in New Britain, and is peculiar.

In N. Australia all five Australian species occur; and *M. pectoralis* is confined to that district. *M. obscura* and *M. erythrocephala* are confined to this region in Australia, but range into the Papuan Islands. *M. nigra* and *M. sanguinolenta* have a wider range over Australia; and the former is the only representative of the genus in W. Australia: both are peculiar. No species occurs in Tasmania.

Proceeding to the Polynesian subregion, we find the Fijis inhabited by a single peculiar species (*M. jugularis*); and the same is the case in the Samoas, where *M. nigriventris* occurs, a representative form of *M. cardinalis*. The New Hebrides have no less than three species, of which *M. cardinalis* is peculiar and found on the more southerly islands of the group (Erromango, Aneiteum, Tanna, &c.), where it is the sole species. Mallikollo is inhabited (if the localities given can be trusted) by *two* species—*M. caledonica*, which also occurs on Vaté and Api, and *M. chermesina*, which has managed to extend its range to the isolated islet of Rotumah. New Caledonia has but one species, *M. caledonica*; whilst on Lifu occurs *M. lifuensis*. The Pelews, Mariannes, and Carolines are all inhabited by one species peculiar to these groups, *M. rubratra*. It is rather remarkable that no species of the genus has yet been found on the Tonga Islands, although these are situated between the Fijis and Samoan Islands; but our present knowledge of the range of the Polynesian species is very imperfect.

Many other of these islands have no species of *Myzomela* recorded from them; but I have little doubt that several species remain to be discovered both here and further west in the islands east of New Guinea, as well as on the mainland of that great island itself.

The appended Table (p. 94) will show the geographical distribution of the species in a concise form.

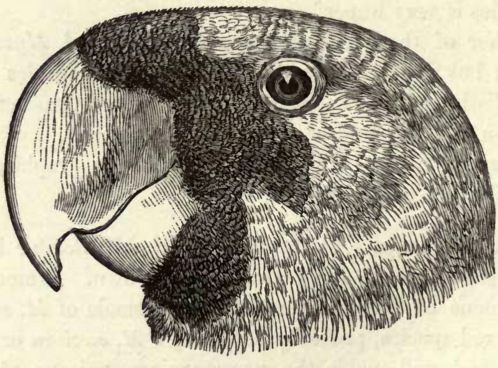
P.S.—Since the above has been in print, Mr. Sclater has received a further consignment of birds from Mr. Brown. Amongst these are three specimens of *Myzomelæ*, namely:—a female of *M. sclateri*; one of an entirely red species, probably=Ramsay's *M. coccinea* or *erythrina*, the receipt of which will enable the necessary comparisons of these species with *M. cruentata* to be made; and one of a species new to science. P. Z. S. 1879, p. 279.

Ibis, 1879 p. 303.

17. ON THE SYSTEMATIC POSITION AND SCIENTIFIC NAME OF "LE PERROQUET MASCARIN" OF BRISSON.*

DURING a visit to Paris last autumn in company with Mr. Sclater and Dr. Hartlaub, I had an opportunity of seeing for the first time, in the gallery of the Museum of the Jardin des Plantes, one † of the two sole extant specimens of "Le Perroquet mascarin" of Brisson, the "*Coracopsis mascarina*" of most authors. This specimen is not improbably that described by Brisson, and is still in a fair state of preservation, though its wings and tail are rather damaged. On seeing it I was at once struck with several points in which it differed conspicuously from the other species usually placed in the genus *Coracopsis*; and after my return to England, at my request, Prof. Alphonse Milne-Edwards was kind enough to have life-sized sketches of the head and foot of this specimen made for me, which are here reproduced, all the figures we have of this species being more or less reduced in size. As will be

Fig. 1.



Head of *Mascarinus duboisi*.

seen from the drawing (fig. 1), the beak in this species is very large and deep, not so compressed and elongated as in *Psittacus* or *Coracopsis*, but more like in shape that of a large-billed species of *Tanygnathus* or

* Ibis, 1879, pp. 303–307.

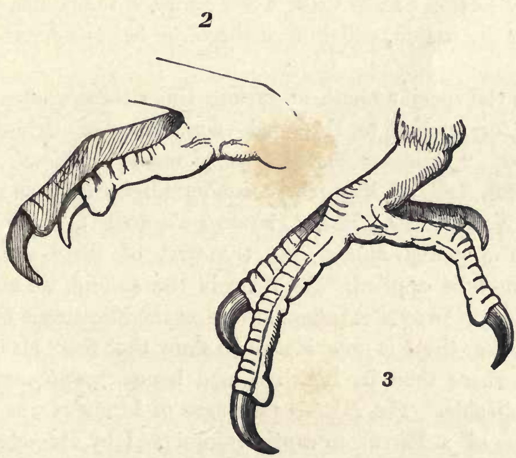
† The other is in the Vienna Museum (*cf.* Pelzeln, Ibis, 1873, p. 32).

Palæornis. Moreover the beak is *red* *, as in most of the species of the two last named genera; whereas in *Psittacus* or *Coracopsis* it is black, or dirty white. The head is fully feathered †, the frontal plumes covering the cere, so that the nostrils are concealed by them. The lores also are fully feathered, and there is only a narrow circumorbital ring left naked. In all the species of *Coracopsis* the cere is large and conspicuous, being quite bare of feathers, there is a large nude circumorbital ring, and, particularly in *C. vasa*, the lores are sparingly feathered ‡. In *Psittacus* the cere and nostrils are equally conspicuous, and the lores and cheeks even more sparingly feathered.

Ibis, 1879, p. 304.

The feet (figs. 2, 3) differ from those of *Coracopsis* in their shorter and thicker tarso-metatarsi and shorter nails. Prof. Alphonse Milne-

Figs. 2 & 3.



Feet of *Mascarinus duboisi*.

Edwards extracted the lower mandible from the stuffed specimen in the gallery of the Museum, and has figured it in his article on the various forms of that bone in the different groups of Parrots §. He says that it differs markedly from that of the species of *Coracopsis*, and perhaps more

Ibis, 1879, p. 305.

* Du Bois (*cf.* Ibis, 1876, p. 286) calls it "couleur de feu."

† The figures, both of D'Aubenton (Pl. Enl. 35) and Levaillant (Hist. Nat. Perr. ii. pl. 139 [1805]), show a red beak, narrow naked orbital ring, and feathered lores and cere. Hahn's figure does the same; but Wagler says the cere was uncovered (*cf.* Finsch, Pap. ii. p. 297).

‡ Wagler, who founded the genus *Coracopsis* (Abh. Math. Phys. Akad. Mun. i. p. 501, 1832), says, in his characters of the genus, "*Rostrum basi cerâ latâ nudâ cinctum* . . . . . *nares maximæ, patulæ* . . . . . *Pili in loris et prope nares.*"

§ Ann. Sci. Nat. Zool. 5me série, vol. vi. p. 105, t. ii. fig. 4, and t. iii. fig. 8 (1866).

nearly resembles that of the genus *Chrysotis* than any other. It is not at all related to the mandible of *Lophopsittacus*.

From these considerations it is, I think, clear that the "Perroquet mascarin" is not related closely to *Coracopsis*, but must be referred to another genus. It is also clear that, of the two species, *C. mascarina* and *C. nigra*, for which Wagler (*l. s. c.*) founded the genus *Coracopsis*, the latter must be considered the type, as it alone agrees with several of the generic characters he gives as diagnostic *.

Lesson, in 1831 (Traité d'Orn. p. 188), founded a genus *Mascarinus*, characterized, amongst other things, by "*narines cachées par les plumes sur le bord du front*," in which he included, besides the present bird, two species of *Eclectus* and a *Tanygnathus*. *Mascarinus* is obviously a Latinized form of the epithet "*mascarin*;" and although an *Eclectus* is
Ibis, 1879, p. 306. mentioned first in the list of species included, there can be little doubt that in reality Lesson had in view, when he made the genus, the bird at present under discussion, which must therefore be considered the type of *Mascarinus*.

As regards the specific name, at various times three names have been proposed for, or applied to, this bird—*mascarinus* of Brisson (Orn. iv. p. 315, 1760, "*Psittacus mascarinus*"), *madagascariensis* of Lesson (Traité, p. 189, 1831, "*Mascarinus madagascariensis*"), and *obscurus* of Linnæus (S. N. i. p. 140, 1766, "*Psittacus obscurus*"). If the bird is to be placed in a genus *Mascarinus*, the first of these specific names obviously cannot be applied. As regards the second, we already know from the Messrs. Newtons' excellent article on the Mascarene *Psittaci* (Ibis, 1876, p. 285) that there is no evidence to show that the "Mascarin" ever occurred elsewhere than in Bourbon, and hence "*madagascariensis*" is equally inapplicable. The *Psittacus obscurus* of Linnæus was founded on the description of a Parrot in captivity observed by Hasselquist during his travels in the east (Iter Pal. p. 236, 1757), and about which no subsequent information has ever been obtained. Hasselquist's description does not fit any species of Parrot at present known, and certainly not *Mascarinus*; and as Linnæus's diagnosis, "*Psittacus macrourus, fuscus, genis nudis rubris, vertice cinereo-nigrescente vario, cauda cinerea*" (S. N. i. p. 140, 1766), is equally inapplicable, the name "*obscurus*" had better be relegated to the region of mysteries, and entirely dropped †.

This being the case, there is no other course open than to use a new

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* It is, indeed, doubtful, on reading some parts of Wagler's diagnosis of the genus (*e. g.* "*Nares maximæ, patulæ . . . Plumæ corvinæ*," &c.), whether he had, at that time, seen a specimen of *C. mascarina*.

† Linnæus, indeed, quotes *Psittacus mascarinus* of Brisson as a synonym of his *P. obscurus*; but the words "*capistrum nigrum*," after the diagnosis, as well as "*genis*

specific name; and, at Prof. Newton's suggestion, I propose that of *duboisi*, in memory of the French voyager Du Bois, who visited Madagascar and Bourbon in 1669–72, and described the various Parrots observed by him on the latter island, including one which is clearly the present bird (*cf.* Ibis, *l. c.* p. 286). Ibis, 1879, p. 307.

As regards the systematic position of *Mascarinus duboisi*, the available material is so scanty that we shall probably never (for the bird is certainly extinct) be able to arrive at any satisfactory conclusion about it. In the form of the beak, the feathered nostrils and lores, the narrow orbital ring, and the structure of its feet, it more resembles the genera *Tanygnathus* and *Palæornis* than any of the African genera of Parrots now existing (*Psittacus*, *Coracopsis*, *Pœocephalus*, and *Agapornis*); and the forms of the wings and tail point to a similar conclusion. In its general coloration it is decidedly aberrant; but the fact of its beak being red is also a confirmation of its Palæornithine affinities, Prof. Garrod having shown (P. Z. S. 1874, p. 598) that none* but species with normal carotids (a group including *Palæornis*, *Tanygnathus*, &c., but not *Coracopsis*, *Psittacus*, and *Pœocephalus*) have their beaks so coloured. We already know that in both Mauritius and Rodriguez a very different genus† of Parrots existed in each island, along with a species of *Palæornis*, and therefore there is no *primâ facie* reason against a similar state of things having also been the case in Bourbon. On the other hand there is no evidence that *Coracopsis* ever occurred in a state of nature on any of these three islands.

To briefly recapitulate, then, I submit:—

(1) That the "Perroquet mascarin" of Brisson belongs to a genus, *Mascarinus*, distinct from *Coracopsis*.

(2) That, failing any older name that can with propriety be applied to it, it may be termed *Mascarinus duboisi*.

(3) That, so far as can be judged from the material that exists, *Mascarinus* is allied rather to such Palæornithine genera as *Palæornis* and *Tanygnathus* than to *Psittacus*, *Coracopsis*, or allied forms.

Cambridge, May 8, 1879.

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nudis rubris," about which Hasselquist, in his very lengthy description, says nothing—so that they are probably only a paraphrase of Brisson's phrase "*oculorum ambitu nudo, coccineo*,"—suggest that his diagnosis was compounded by grafting on part of Brisson's diagnosis an abstract of Hasselquist's description.

* *Pionus corallinus* is the only exception to the above rule that I have yet met with.

† *Lophopsittacus* and *Necropsittacus*.

Ent. M. M. xv. p. 275 (1879).

18. NOTES ON BUTTERFLIES OBSERVED IN THE VALAIS OF SWITZERLAND IN 1878.*

DURING the early part of last summer, in company with my friend, Mr. P. L. Sclater, F.R.S., and party, I spent about three weeks in the Valais of Switzerland, and, during that time, we devoted a considerable part of our energies to butterfly-catching. As the two valleys where we spent the greater part of our time are rather out of the beaten track of tourists, and have possibly not been visited by English entomologists before, I think a few notes on our captures may be worth inserting in this Magazine. The valleys visited, the Vals d'Hérens and d'Anniviers, are two of the lateral valleys which run from the main chain of the Pennine Alps into the Rhone Valley, debouching into it between the better known valleys of Chamounix and Visp.

In the Val d'Hérens, we made Evolena (about 4,500 ft. above the sea) our head quarters, staying there a week, and making excursions thence higher up the valley, including a two days' stay at Arolla, at the head of the valley of the same name, a most lovely spot (about 6,500 ft.), close to the Glacier d'Arolla, and overshadowed by many magnificent snowy peaks, such as Mont Collon, the Dent d'Hérens, and others. Unfortu-
Ent. M. M. xv. p. 276 (1879).
nately, the weather at this period was not propitious, but one beautiful day in the Val d'Arolla showed what might have been done with better weather. From the Val d'Hérens we went over the Col du Torrent (about 8,000 ft.) into the Val d'Anniviers, where we spent a week at Vissoye (about 4,500), and from there, after an ascent of the Bella Tola (10,000 ft.), Sclater descending the other side to the Turtman Thal, returned to Sierre, whence I returned home, viâ Brieg and Paris, whilst Sclater continued over the Furka and thence home by Lucerne, obtaining thus a few additional species.

The time (from about June 25th to July 15th) was probably, on the whole, as good as any we could have chosen, though certainly too early for the highest ranging species. The weather was only moderately good, fine and wet days being in about equal proportion. Nevertheless, we managed to see or capture in that time 83 species of butterflies, and brought back about 600 specimens of these, as well as about 150 Heterocera, more than double that number of Coleoptera and Hemiptera. In the present notes, however, I only notice the Rhopalocera, not having as yet determined fully the other groups. I may perhaps mention, to show the abundance of butterflies in the Alps under favourable circumstances (*i. e.*, on a fine day), that one day (July 6th), at Vissoye, we captured (or saw) no less than 45 distinct species, and on two or three other days,

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* Ent. Month. Mag. xv. pp. 275–278 (1879).

CALIFORNIA

both there and in the Val d'Arolla, the number observed exceeded 40. In the following list I have only enumerated the more interesting species, and have followed Dr. Staudinger's catalogue (1871) throughout.

Papilio machaon—only a few specimens, occurring singly in various localities, but never very high up. *Parnassius apollo*—common about Vissoye, also a few at Evolena and in the Arolla Valley; this species flies slowly and steadily, but, if alarmed, goes off at a great pace, and is not then easily caught: *P. delius*—this species occurred, flying with the last, in the Val d'Arolla, and was rather abundant on the slopes of the Col du Torrent, above the Val d'Hérens; both it and *P. apollo* vary much in the size, number, and intensity of the red ocelli and spots; this species is not found so low as *P. apollo*, not, according to our experience, much below 6,000 ft.: *P. mnemosyne*—this species occurred with the last in the Val d'Arolla, and on the Col du Torrent; the curious ovisac, with which, in this genus, the females are provided, is, in *P. mnemosyne*, much larger than in the other two, and of a white colour; all the three species frequent the wetter slopes on the sides of the valleys: the occurrence of *three* species of this genus together in exactly the same locality, as was the case at one point in the Val d'Arolla, is certainly very remarkable, considering the resemblance in habits of the different forms. *Aporia cratægi*—one of the most abundant butterflies in Switzerland, and extending some height up. *Pieris napi*, ab. ♀ *bryoniæ*—a few in the Val d'Arolla, and on the Col du Torrent and Furka, with males of the ordinary form; specimens vary considerably in darkness: *P. callidice*—not common in the Arolla Valley, especially at Arolla itself, and a few on the Col du Torrent, Furka, and Bella Tola at high elevations (8,000 ft. or so); the flight of this species resembles that of a *Colias*, more than that of our ordinary English whites. *Euchloë belia*, var. *simplonia*—this species occurred with the last in the Val d'Arolla, and was rather numerous in the meadows outside the inn there. *Leucophasia sinapis*—very common at Evolena and elsewhere. *Colias phicomone*—a few of this mountain species in the valley at Evolena, but commoner on the slopes around and higher up the valley towards Arolla; also on the Furka and Bella Tola. *Thecla rubi*—two or three specimens at various places; on the Bella Tola at about 6,500 ft. *Polyommatus virgaureæ*—males very common in the valley at Vissoye, also in the Turtman Thal and near Zinal, but I only saw a single female; one male from Vissoye is remarkable for being of a yellow colour above: *P. hippothoë*, var. *eurybia*—this alpine form of *hippothoë*, from which it differs in the duller colours of the male, and in the female being almost unicolorous brown above, and greyer beneath, occurred sparingly at Evolena, more commonly at Vissoye, where it occurred with *P. virgaureæ*, and also on the St. Gothard route, between Andermatt and Amsteg: *P. dorilis*, var. *subalpina*—two specimens, one at Evolena, the other on the Bella Tola;

Ent. M. M. xv. p. 277 (1879).

of the alpine form of *dorilis*, which differs from the type in being unicolorous above, and with no redness beneath. *Lycæna argyrotoxus* (*ægon*)—this blue swarmed in the lower part of the Val d'Arolla, rising in crowds from the muddy water in the roads, &c. *P. argus*—I secured two specimens from amongst the crowds of the last, and doubtless passed over many more; will somebody explain why, in two such closely allied species, one (*ægon*) should possess, the other (*P. argus*) want, the "hornstachel" on the fore tibiæ: *P. eumedon*—rather common at Evolena, and one on the Furka. *L. escheri*—two specimens, one in the upper part of the Val d'Anniviers, coming down from the Col du Torrent, and another at Evolena: *L. corydon*—Evolena, Zinal, &c., and one, remarkable for the brightness of its blue, which approaches that of *bellargus* (*adonis*), at about 6,500 ft. on the Bella Tola: *L. hylas*—several at Vissoye, and also occurred at Evolena and in the Val d'Arolla, but only one female: *L. damon*—only one, a male, above Evolena: *L. minima* (*alsus*)—very common; I was surprised to see our little "Bedford blue," so local an insect in England, in the Alps at elevations of 6–7,000 ft., as at Arolla and on the Col du Torrent; also on the Furka: *L. semiargus* (*acis*)—common at Evolena, Vissoye, Arolla, &c.: *L. alcon*—rather common at Evolena, and one at Vissoye: *L. arion*—occurred at every place we visited. *Limenitis populi*—a single specimen of this fine species in the river-valley at Vissoye sitting on the poplars, and safely secured by Sclater. *Melitæa cynthia*—Sclater secured a single male of this species on the Furka; we were probably too early for it elsewhere: *M. aurinia*, var. *merope*—a single specimen at Arolla, one in the Turtman Thal, and a fine series from the Furka: *M. cinxia*—Vissoye, Evolena, &c., common: *M. phœbe*—Evolena, Val d'Arolla, and common about Vissoye and at Sierre. *M. didyma*—common at Vissoye and Sierre: *M. dictynna*—fairly common at Evolena, Vissoye, Arolla, &c.: *M. athalia*—common, Evolena, Vissoye, Arolla, &c.: (*M. parthenie*—one at Lausanne). *Argynnis pales*—one at Arolla, and tolerably numerous at high elevations (7–8,000 ft.) on the Col du Torrent and Bella Tola; also occurred on the Furka, and between Andermatt and Amsteg; we did not see the var. *arsilache*: *A. dia*—one at Sierre: *A. amathusia*—fairly common at Vissoye and Evolena, in damp places along the valleys: *A. ino*—with the last: *A. lathonia*—one near Vissoye: *A. niobe*, var. *eris*—one at Vissoye, others on the St. Gothard route; we did not see *paphia* or *adippe*: *A. aglaia*—rather common. *Erebia epiphron* (the form *helamus*?)—sparingly in the higher parts of the Vals d'Hérens and d'Anniviers; also on the Bella Tola, Furka, and the St. Gothard route: *E. ceto*—very common in the valley at Evolena, and a few elsewhere: *E. stygne*—this species also abounded at Evolena, but occurred higher than the last, frequenting, not the meadows near the river, but the rocky slopes at the side of the valley; also sparingly at Arolla, Zinal, in the Val d'Anniviers, and on the St. Gothard;

nearly every specimen is a male: *E. glacialis*, var. *alecto*—a single specimen of an *Erebia* which I saw at the end of the Arolla Glacier (about 7,000 ft.), and, after a hard run over the stones of the terminal *moraine*, secured, turns out to belong to this species: *E. lappona*—this species had the highest range of any, according to our experience; it occurred tolerably common about the higher slopes of the Col du Torrent, and also on the top of the pass (about 8,000 ft.); in descending from the Bella Tola I caught one specimen on the snow at about 9,000 ft., and saw others at nearly the same elevation; it was common on the Furka: *E. tyndarus*—this species we only met with on the Col du Torrent, at from about 6,500 ft. upwards; it was not common: *E. ligea*?—I believe that several *Erebias*, from Evolena and Vissoye, are referable to the true *ligea*: *E. euryale*—being common at Vissoye and Evolena, in the valleys, and a few in Arolla Valley and the Furka. *Chionobas aëllo*—I caught two specimens in the Val d'Arolla, at about 6,000 ft., and afterwards another in the Val d'Anniviers at the foot of the Col du Torrent, at about the same elevation; Sclater found it commonly on the Furka, and secured both sexes. *Satyrus hermione*—this fine species was common about Vissoye, particularly frequenting the slopes of some dry rocky ground in the valley, exposed to the sun; it has a sailing *sibylla*-like flight; also in the Turtman Thal: *S. actæa*, var. *cordula*—this species was also common at Vissoye, occurring in the same localities as the last, but nearly all caught were males. *Pararge mæra*—this is one of the commonest butterflies in the Swiss valleys, at moderate heights; it loves to rest on the surfaces of rock overhanging the roads, and on walls, &c., exposed to the sun, starting out moderately like a grayling, the grey under-surface matching well with its chosen haunts: *P. hiera*—we were apparently too late for this species, only securing a few worn specimens in the Val d'Hérens, between Evolena and Arolla. *Cœnonympha satyrion*—this pretty little "heath" was common at Arolla on damp ground, but also occurred more sparingly around Arolla, in the Turtman Thal, on the Col du Torrent, and on the St. Gothard route; the males were much commoner than the more brightly coloured females. *Syricthus carthami*—not common; a few in the Val d'Anniviers, at Arolla, Vissoye, and Zinal: *S. alveus*?—Vissoye and on the Bella Tola, but I am not sure that the specimens are rightly determined, owing to the difficulty of this group: *S. cacaliæ*—sparingly at Vissoye and Evolena, but tolerably common at higher elevations on the Col du Torrent, the Bella Tola, and Furka: *S. sao*—one at Vissoye. *Nisoniades tages*—abundant, flying over wet ground, at Arolla.—W. A. Forbes, St. John's College, Cambridge: 16*th February*, 1879.

Ent. M. M. xv. p. 278 (1879).

'Nature,' Feb. 20, 1879.

19. THE GLACIAL PERIOD AND GEOGRAPHICAL DISTRIBUTION.*

Prof. Asa Gray, in his very interesting lecture on the distribution of the forest trees of the northern temperate region ('Nature,' vol. xix. p. 327), after pointing out the remarkable differences that exist between the forests of the eastern and western sides both of North America and the Old World, suggests that the great poverty of the European as compared with the Japan-Manchurian region in this respect was caused by the Mediterranean cutting off the retreat of the flora which then occupied Europe, as it retired, at the approach of the glacial epoch, before the ice from the north. This explanation derives considerable support from some other facts in geographical distribution. The most characteristic Alpine and Arctic butterflies of the Palæarctic region belong to the three genera, *Parnassius*, *Chionobas*, and *Erebia*. Of *Parnassius*, Dr. Staudinger in his latest catalogue (1871) enumerates fourteen Palæarctic species, of which three occur in North and Central Europe, ranging as far south as the Balkans, but always in or near high lands, about a dozen occur in temperate Asia, ranging as far east as the Amur, and probably as many in North America, where they also are truly Alpine butterflies. Of *Chionobas* one species (*C. aëllo*, confined to the Alps) occurs in Central Europe, whilst six or seven others range from Lapland over Russia and Siberia, Mongolia, &c., to the Amur, and there are numerous species in Arctic and Alpine North America. Of *Erebia* there are forty-five Palæarctic species enumerated by Staudinger, and of these no less than twenty-five occur in the central Alpine chains of Europe. The genus likewise ranges all over temperate Asia, going as far south as the Himalayas and Moupin, and in North America is represented by a dozen or more species. Now, though an *Erebia* (*E. tyndarus*, var.) occurs as far south in Europe as the Sierra Nevada, *not a single species of any* of these three genera occurs in North Africa, although the Atlas Mountains would seem eminently well suited for such Alpine insects. In this case, then, it seems clear that the same cause—the barrier of the Mediterranean—which in the case of the miocene flora of Europe prevented any further retreat south, has operated to prevent any similar southerly spread amongst the victorious invaders from the north which pressed on the retiring host.

With regard to the general similarity in facies and richness between the East American and East Asiatic tree-flora, certain facts pointing in the same direction will at once occur to the zoologist. Thus the *Meno-*

* Nature, Feb. 20, 1879.

pomas of the Ohio and Alleghany have their only near relations in the gigantic *Sieboldias* of north-east Asia, one species of these occurring in Japan, the other being one of Père David's discoveries in Moupin. Similarly with the genus *Polyodon* amongst ganoids. Only two species of this genus are at present known, *P. folium*, inhabiting the Mississippi, *P. gladius*, the Yang-tse-kiang. The recent discovery of at least two species of *Scaphirhynchus* in Turkestan makes it probable that ere long species of that Americo-Asian genus will be found in the Chinese rivers as well. The parallelism in the case of the salamanders is particularly interesting, when one remembers the celebrated *Andrias scheuchzeri* of the Œningen beds, and it tends to favour the view that at that time practical identity in the forms of animals and plants reigned throughout the northern temperate zone.—W. A. Forbes, Cambridge, 14*th February*, 1879.

P.S.—The reported discovery ('Nature,' vol. xix. p. 351) of a true *alligator* in the Yang-tse-kiang, will, if confirmed, add a still more remarkable case to those mentioned above.

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20. ON THE EXTERNAL CHARACTERS AND ANATOMY OF THE RED UAKARI MONKEY (*BRACHYURUS RUBICUNDUS*); WITH REMARKS ON THE OTHER SPECIES OF THAT GENUS.*

P. Z. S. 1880, p. 627.

(Plates IV.-VI.)

On May 24th, 1879, the Society purchased a female specimen of a red-haired short-tailed American Monkey, which on its arrival was somewhat doubtfully entered as an example of *Brachyurus rubicundus* of Isidore Geoffroy †. This animal lived in fair health till April 22nd last, when it died without any premonitory symptoms. On dissection, both lungs and liver, so frequently the seat of disease in Monkeys kept in captivity, were found to be perfectly healthy; indeed, with the exception of a little inflammation of the stomach and small intestines, and a slight intussusception of the transverse colon, no morbid appearances whatever were found.

The death of this animal has enabled me to give that further notice of it promised on its arrival (*vide* Mr. Sclater's monthly report, *infra cit.*), as well as to give some notes on its anatomy. For though, as might have been expected, *Brachyurus* differs in no essential respect from its allies, the great rarity of Monkeys of this genus in captivity makes it advisable to record any facts concerning the anatomy of its soft parts. In

* Proc. Zool. Soc. 1880, pp. 627-647, Pls. LXI.-LXIII. Read Nov. 30, 1880.

† P. Z. S. 1879, p. 551.

particular, the brain of this genus of Monkeys being hitherto unknown, the description of it will fill up one of the few gaps till now left in our knowledge of this organ amongst the Primates.

Our specimen of *Brachyurus* was a female, not yet adult, though perhaps nearly full-grown. All the teeth are in place, but the canines, both above and below, have not yet finished cutting, and the epiphyses of the bones are still unanchylosed.

As regards the name of our animal, I may at once state that, Mr. Blanford having been kind enough to take the skin to Paris for comparison with the types of *Brachyurus rubicundus* in the gallery of the Jardin des Plantes, no doubt remains that it really belongs to that species. The specimen from which Isidore Geoffroy's figure * was taken is still extant in Paris; and the apparent shortness of its tail, reproduced in the figure, is due in all probability to the "make" of the skin, the skin of
P. Z. S. 1880, p. 628. the tail having apparently shrunk much after the removal of the bones inside. Other specimens in the Paris Museum, Mr. Blanford informs me, have tails of about the same length as ours, while they closely correspond in other respects, the amount of grey on the crown of the head varying in different specimens.

The accompanying plate (Plate IV.), taken from a sketch made by Mr. Wolf shortly after the animal's arrival, will give a more correct impression of this Monkey than the figures hitherto published of it.

The weight of our specimen, considerably emaciated, was 2 lb. 11 oz. The following measurements were taken on the body before being skinned or otherwise interfered with:—

	inches.
Total length (measured in a straight line from superciliary ridges, over head and body, to tip of tail) ..	21·0
Length of tail, including hairs	6·5
Fleshy part of tail	5·65
Length of head, from occipital prominence to glabellum	2·65
From occiput to anterior margin of upper lip, in a straight line	3·65
Breadth of face (just above the eyes, from outer margin of orbits)	2·0
Breadth of nasal septum	0·75
Breadth of mouth	1·2
Length of arm	5·5
Length of forearm	5·0
Length (extreme) of manus	3·5
Length of thigh	6·5
Length of leg	5·75
Length (extreme) of pes (plantar surface)	5·25

* Arch. d. Mus. v. pl. 30.

The face, chin, and sides of the head, as far as the ears, are nearly naked, with only a scanty covering of hairs. The nose and the interval between the eyes (measuring $\frac{1}{2}$ inch) are very nearly bare, there being here only a very few most minute hairs, only seen in a side light. Along the superciliary ridges are a few long, forwardly directed, black hairs, white at the base, and slightly curved forwards. There are a few similar hairs also on each side of the face between the nostrils and the angle of the mouth, as well as on the chin.

The muzzle, which is somewhat truncated, and the chin are sparsely covered with short bristly white hairs, directed more or less downwards and forwards.

The naked skin of the sides of the head was in life flesh-colour, the naked ears being slightly redder. The face and muzzle were, as will be seen from Mr. Wolf's sketch (Plate IV.), during life bright vermilion-red, so red, indeed, as to give the animal the appearance of being painted; but the amount of this bright red varied much from time to time, depending, apparently, both on the animal's health and on its emotions. Mr. Bartlett tells me he has seen the animal flush up, as it were, in a P. Z. S. 1880,
moment a brilliant red all over the naked parts of its face, and as soon p. 629.
become pale again when the disturbing cause had subsided. After death the brilliant red colour was confined to the region of the nasal openings and the interval between them and the upper lip *. The eyelashes are represented only by very fine silky minute hairs. The irides were light hazel-brown, the sclerotic white. These points may be well seen in the accompanying figure of the head (Plate V.), of the natural size, drawn soon after death by Mr. Smit †. The ears are of a somewhat squared shape—much more so than in a specimen of *Pithecia satanas* I was able soon afterwards to examine in the flesh—with the angles rounded off. There is no lobule; and both tragus and antitragus are little developed. The helix has a small recurved flap above, lying over the top of the helical fossa. They are quite naked. At a point about corresponding with the top of the occiput there is a parting of the hairs of the head, these radiating forwards, outwards, and backwards from this point—the long red hair which covers the sides of the head, passes over and behind the ears, passing outwards and then forwards, whilst the hairs of the back of the head and neck pass backwards. The short silky grey and white hairs covering the top of the head pass directly forwards. These are very fine, and closely appressed to the scalp; white for the greater part of their length, they become black at the tips; towards the sides and front of the scalp they become tinged with reddish, so

* Cf. Bates, 'Naturalist on the Amazons,' ii. p. 310.

† In this figure the extent of the red colour of the face has been restored, partly from memory and notes taken from the living animal, and partly from the sketch made by Mr. Wolf.

P. Z. S. 1880, p. 630.

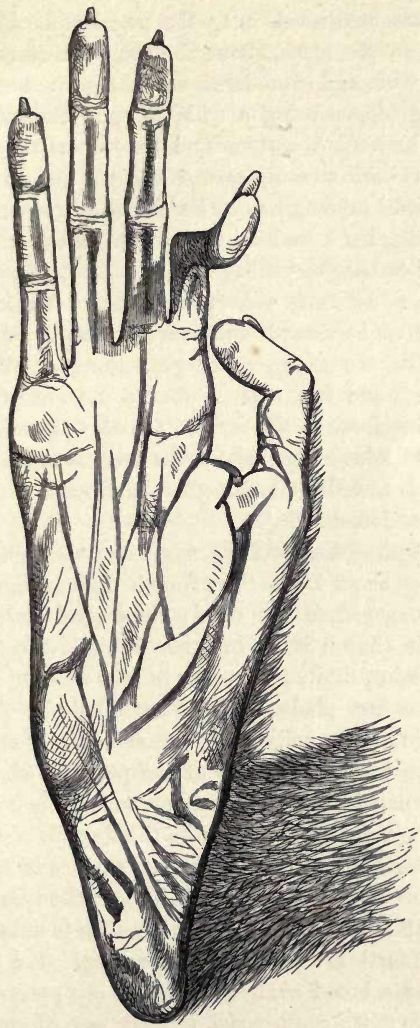
Fig. 1.

Hand of Red Uakari. Palmar aspect; natural size.

P. Z. S. 1880, p. 629.

gradually passing into the red of the sides of the head. This reddish tinge is produced by the presence on these hairs of a rufous zone between the white of their bases and the black of the tips; a few, however, are black throughout. These short hairs almost entirely disappear a little behind the superciliary hairs. The hairy covering of the scalp ceases along a line between the top of the ears and the top of the orbits. Below this limit the sides of the head are only very sparsely covered with rather long, fine, forwardly-directed hairs, which are mostly rufous, paler at the base, and black-tipped; here, as elsewhere, however, some are quite black. The skin round the angles of the mouth is, for a small area, almost completely naked. The posterior border of the lower jaw, on the contrary, as well as the sides of the throat, are covered by long

Fig. 2. P. Z. S. 1880, p. 631.



Foot of Red Uakari. Plantar aspect; natural size.

rich chestnut largely black-tipped hairs, which are directed forwards; these run as far as the symphysis, and form a sort of whiskers. The hairs of the back of the head, nape, and neck are paler in colour than those on the rest of the body, being pale fulvous, many having, however, black tips, whilst a few are entirely of that colour. The rest of the body is covered with very long, fine, backwardly-directed hairs of a bright rich chestnut colour, as usual more or less black-tipped, with a sprinkling of quite black ones. P. Z. S. 1880, p. 629.

P. Z. S. 1880, p. 630. In general colour and texture the coat of the Uakari greatly resembles that of the Orang, as was noticed by many who saw the animal alive. These red hairs are continued on to the limbs and tail, the hair being particularly long on the arms, about the shoulders (forming here a sort of cape over the back and shoulders), and along the posterior border of the thigh and leg—there being a wide patagial-like expansion of skin behind the knee, between the thigh and lower part of the limb. Some of the hairs on the back measure over 4 inches; and those on the limbs are from 3–3¼ inches in length*. The tail is pretty uniformly covered with moderately long hairs, and is in no degree, in the fresh state, bushy. It is not flattened or bare beneath. [P. Z. S. 1880, p. 632.]

On the forearms the hairs converge on the posterior margin to the elbow, being directed backwards and more or less upwards as the elbow is approached. On the anterior margin, however, all the hairs are directed downwards and forwards, so that a parting of the hairs runs down here from the elbow to the wrist. On the posterior limbs this is not observable. The lower surface of the body is much less hairy than above; and there is a well-defined median parting running along it from the thorax to the abdomen.

The greatest length of the hand (fig. 1, p. 108) is 3·5 inches, the breadth across the knuckles about 1·35. The fourth digit is the longest (2·15), being 0·15 inch longer than the third; the second and fifth are about equal (1·75). The thumb is, as in other Cebidæ, directed in the same plane as the remaining digits; it measures 1·15 inch in length, reaching slightly beyond the first phalanx of the second digit. The interdigital membrane is slight. The nails are compressed, and rather elongated, particularly on the fifth digit; that of the pollex is shorter, and more compressed and "nail"-like. The palmar surface is nude; the dorsal sparingly hairy, the hairs extending on to the fingers.

The greatest length of the nude plantar surface is 5·25 inches; its breadth, at the base of the hallux, is 1·5 inch. The toes have about the same relations as the fingers, except that the fifth is notably longer than the second. The fourth is about 2·25 inches long. The hallux measures 1·25 inch, and has a broad oval nail, slightly compressed; the nails of the other digits are much compressed, slightly curved, and rather claw-like. The inferior aspects of the hand and feet, of the natural size, are represented in the accompanying figures (fig. 1, p. 108, and fig. 2, p. 109)†.

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* One of the characters of Dr. Gray's genus "*Ouakaria*" is "Fur *short*, silky"! (Cat. Monk. p. 61).

† In fig. 2 the second digit of the foot is seen to be twice bent abruptly on itself. This position was constant after death, and if altered it was always returned to. I am not, however, prepared to say that it is natural, as I never observed it in the living animal. The other digits showed no trace of it.

The axillary folds are well marked; and the axillæ are quite nude, as is a space continuous with them on the inner aspect of the arm for nearly one third its length. The teats, two in number, are situated about $1\frac{1}{2}$ inch from the middle line, just on a line between the ends of the axillary folds *, about 1·25 inch from the apex of the axilla.

The umbilicus is represented by a slight, scarcely perceptible slit-like mark $4\frac{1}{2}$ inches from the pubic symphysis. The anus is a transverse slit; the vulva, which is provided with a short clitoris, is vertical. The perinæum measures about ·35 of an inch. The ischiatic prominences, perinæum, and root of the tail are covered by greyish skin forming a rhomboidal space, about 1·5 inch broad and high; under the tail there is a slight hollow, with a raised fold of skin at each side. P. Z. S. 1880, p. 633.

The skin of the cheeks is thin and smooth throughout inside. The hard palate has about ten slightly curved (lunate) ridges on each side, best marked anteriorly, and not meeting mesially. The first two lie between the canines, the last on the level of the last molar. The more posterior ones are faint and irregular, and straighter; the two most anterior the strongest and most curved. In front of the most anterior are two small slits, one on each side of the centre, directed antero-posteriorly, and lying in a line with the inner margin of the median incisor.

The tongue is elongate and parallel-sided, being bluntly squared off at the tip. In front of the palato-glossal folds, which are well developed, it is covered, above and on the sides, with filiform papillæ; below it is smooth. The fungiform papillæ are numerous, and distributed over the sides and tip of the tongue in front of the circumvallate papillæ; of these there are four, arranged in the usual reversed Λ-shape, the extra one lying on the right side. In *Pithecia satanas* I found three only. There is a "Mayer's organ" of about 15 slits, in the usual position in front of the palato-glossal folds. There is a *frenum linguæ*, and a smooth, fleshy, well-developed *sublingua*, bifid apically, with the duct of the submaxillary glands opening on the two papillæ behind this. The uvula is blunt and feebly developed. All the salivary glands are well developed. The parotid is large, measuring 2 inches across at its greatest development; it occupies part of the "anterior triangle," sending a lobe up and behind the auditory meatus; it then runs forward over the masseter muscle, the superior border coinciding with the zygoma, as far as its anterior border, where on one side there is a small downwardly directed lobule developed. Below it extends far into the fossa behind the jaw, and is in contact beneath with the submaxillary. The duct opens opposite the last premolar.

* In a female of *Mycetes seniculus*, examined some years ago by Prof. Garrod and myself, the mammæ were found to be situated *in* the axillæ.

The submaxillary glands are also large; in contact with the parotids above, they nearly meet each other below. A few small accessory lobules appear superficially towards the anterior part. The glands are covered to a large extent by the jaw, running up on the deep side of the ascending ramus of the mandible, and covering there the digastric muscle; at the angle of the jaw they appear superficially. The sublingual glands, well developed, extend back in the floor of the mouth for 1 inch behind the *sublingua.*

On opening the abdomen, the great length and narrowness of the abdominal cavity are striking. The cæcum occupies superficially nearly all the posterior part of the abdominal cavity, filling up thus nearly one third of the whole. Behind, it rests on the bladder, covering the rectum; its apex, directed downwards, lies in the right iliac region. The descending colon is quite superficial and lengthy, as is the ascending, which is also superficial, except in the middle; the transverse, on the contrary, is very short*. (It was partly intussuscepted.) The stomach was visible in the left hypochondriac region, the liver appearing all across the abdomen. The great omentum did not cover any of the viscera as now exposed; it was attached only to the upper part of the ascending colon, for about 2 inches. It contained no fat, the animal being, it is to be remembered, considerably emaciated.

P.Z.S. 1880, p. 634.

The stomach is of the usual Simian form, with a globular cardiac cul-de-sac, and fairly distinct tubular pyloric part; it measured 3 inches in length by $1\frac{1}{2}$ deep. The pyloric constriction is distinct; and towards that part the walls become thicker. Internally there is a distinct thick ridge on the lesser curvature, $\frac{3}{4}$ inch to the right of the œsophagus, dividing off the pyloric part, which is quite smooth internally, whilst the mucous membrane of the cardiac part has a few irregular, slightly developed rugæ.

The length of the intestines is as follows:—

	inches.
Small intestine	103·5
Large „	19·0
Cæcum (distended)	6·0

I append (p. 113) a few measurements of the alimentary canal of other species of Cebine Monkeys for comparison.

P.Z.S. 1880, p. 635.

As far as can be judged from the few examples given in this table, *Brachyurus rubicundus* apparently has a greater absolute, and even greater relative, length of intestines and cæcum than any other New-world Monkey, including even the considerably larger *Lagothrix.* This

* In *Pithecia satanas* the transverse colon hardly exists, the descending colon being bent sharply back upon the ascending. The cæcum lay altogether to the right of the descending colon and rectum; the latter, therefore, was not hidden by it.

P. Z. S. 1880, p. 634.

Name.	Sex.	Length of				Authority.
		Trunk.	Small in-testine.	Large in-testine.	Cæcum.	
		in.	in.	in.	in.	
Ateles geoffroyi (nearly adult)	♀	...	95	17	3·5	Prof. Flower *.
—— ——	♀	...	99	15	4	A. H. Garrod (MS.).
—— —— (young)	♀	15	92·5	13	2·75	W. A. F.
Cebus capucinus	...	13	58	11	2	Prof. Flower *.
—— ——	♂	...	56·5	8·5	1·75	W. A. F.
Lagothrix humboldti	♂	18	102	19	4	A. H. Garrod (MS.).
Nyctipithecus vociferans	♂	13	37	12	2	" "
—— ——	♂	...	29·5	12	1·5	W. A. F.
—— *rufipes*	♀	...	48	12	2	A. H. Garrod (MS.).
Callithrix amicta	♀	...	42	11·5	2·5	W. A. F.
Pithecia monachus (nearly adult)	♀	11	50	22	4·5	Prof. Flower *.
—— —— (young)	♂	12·5	52·5	12·75	2	W. A. F.
—— *satanas* (young)	♀	...	68	9	2·75	W. A. F.
—— —— (not adult)	♂	16	108	12·5	2·75	W. A. F.
Brachyurus rubicundus (not adult)	♀	15·5	103·5	19	6	W. A. F.

would seem to indicate that in its native forests *Brachyurus* is more of a vegetarian than its allies.

P. Z. S. 1880, p. 635.

There are no valvulæ conniventes. Peyer's patches are almost confined to the last yard of the ileum, there being 14 large and well-defined ones in that space, the largest ¾ inch long. There is a large one close to the ileo-cæcal aperture. Higher up only a few can be found; and they disappear in the jejunum. The cæcum is in no degree sacculated, neither is the colon. The former, which is of considerably larger calibre, is cylindrical, blunt, and curved on itself when distended into more than a circle, with a well-developed median peritoneal frænum.

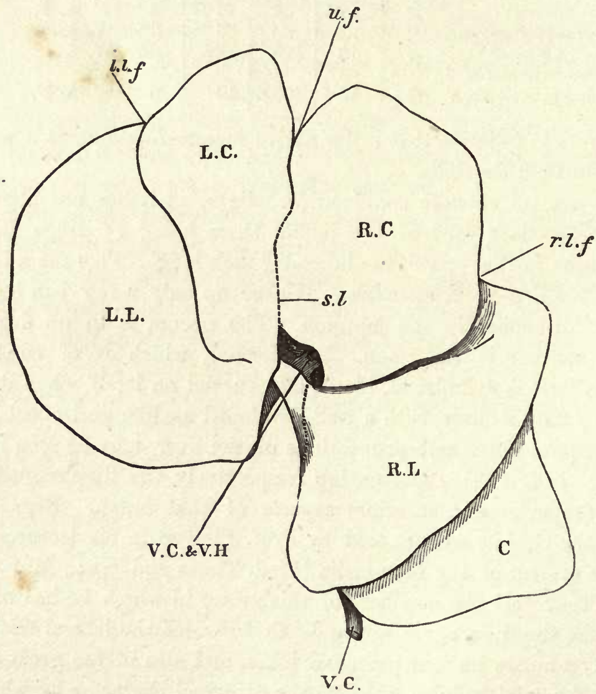
The general form and proportions of the liver may be seen in figs. 3 & 4 (pp. 114, 115), representing respectively the diaphragmatic and visceral (superior and inferior) aspects of that organ. Regarding its form in the Cebidæ we are told by Prof. Flower, in his lectures on the digestive system of the Mammalia (Med. Times and Gaz., May 4, 1872, p. 509), that "all the members of this group in which he has been able to describe the liver, agree in the depth to which the lateral fissures cut up the organ into its four principal lobes, and also in the great development of the caudate lobe, which is the principal character by which they can at once be distinguished from the Old-world families." In both these respects, as will be seen by an inspection of the figures, the liver of *Brachyurus* is perfectly Cebine. The two lateral fissures extend very nearly, at least on the superior surface, back to the posterior (attached) margin of the liver. The four principal lobes are very distinct; the left

* Taken from his lectures, Med. Times &c., May 4, 1872.

central is markedly smaller, as is often the case in the Cebidæ, than the three others, which are here all very nearly equal. The left lateral lobe is decidedly thin along its outer margin; the other lobes are thick, and of simple form; the right lateral is much longer anterio-posteriorly than transversely. The caudate is large and square; on its visceral surface it is marked by a conspicuous diagonal ridge running from the entrance of the *vena cava* towards its postero-external angle. It develops two well-marked though small fissures, but is otherwise simple. The right lateral lobe appears internally to it, when viewed from below. The Spigelian is an elongated, somewhat clavate thickening, which is not free, but is most developed on the left side. The umbilical fissure is well-marked, extending for about one third of the total median depth of the liver. There is no trace

P. Z. S. 1880, p. 636.

Fig. 3.



Liver of Red Uakari, from above. About natural size.

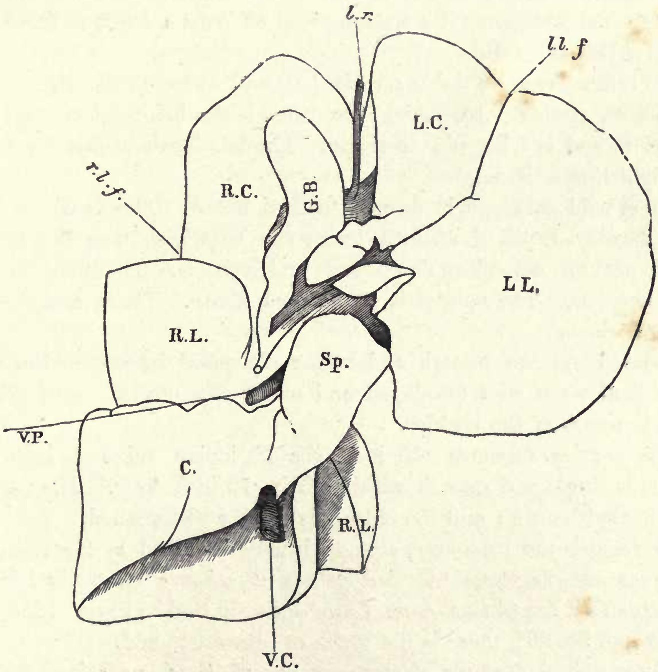
P. Z. S. 1880, p. 635.

of a cystic notch; and the gall-bladder, which is large, does not reach by some little distance the anterior (free) margin of the liver. It lies very superficially, and, as in most of the Cebidæ (though not in *Cebus* itself or in *Ateles*), lies very close to, and almost in, the umbilical fissure. An accessory lobule, developed at the internal angle of the left central lobe, helps in large part, on this side, to form a shallow cystic fossa. A second similar, but smaller, partly free lobule is also developed by the left lateral lobe at its antero-internal angle. The *vena cava inferior* is almost entirely bridged over by hepatic tissue between the Spigelian and caudate lobes. The development or otherwise of this bridge, however, is an unimportant feature in the liver of the Primates, and is largely an individual structure. P. Z. S. 1880, p. 636.

On the whole, this liver of *Brachyurus rubicundus* more resembles that of *Callithrix amicta* in its structure and proportions than that of any other species I am acquainted with, though I have not seen that of *Pithecia monachus* *, which, judging from Prof. Flower's description †, must much resemble that of *Brachyurus*. In two specimens I have by

P. Z. S. 1880, p. 637.

Fig. 4.



The same, from below.

R.C. Right central lobe. *L.C.* Left central lobe. *R.L.* Right lateral lobe. *L.L.* Left lateral lobe. *C.* Caudate lobe. *Sp.* Spigelian lobe. *u.f.* Umbilical fissure. *r.l.f, l.l.f.* Right and left lateral fissures. *G.B.* Gall-bladder. *V.P.* *Vena portæ.* *V.H.* Hepatic vein. *V.C.* *Vena cava inferior.* *s.l.* Suspensory ligament. *l.r.* *Ligamentum rotundum.*

* P.S. Jan. 27, 1881.—The recent death of a specimen of this species allows me to confirm the resemblance of its liver to that of *Brachyurus*.

† P. Z. S. 1862, p. 332, and Med. Times, &c. *s. c.* p. 508.

me of the liver of *P. satanas*, the caudate lobe is triangular and forked instead of square, and the left lateral lobe is proportionally smaller than in *Brachyurus*; this develops moreover a very marked, subtriangular, inwardly directed process at its antero-internal angle, which is not seen in the other genus.

P. Z. S. 1880, p. 637.

The pancreas is fairly compact, and is, at its greatest extent, 3 inches long; its duct opens, with that of the bile-duct, ½ inch from the pylorus. About ½ an inch from the common aperture of these in the duodenum is a smaller opening, apparently that of a secondary pancreatic duct.

The spleen is elongated and flattened, and attached to the left of the greater curvature of the stomach; it is of a red colour, and 2⅛ inches long.

The great vessels are given off as in Man and the other Primates. The external and internal iliacs are given off from a common trunk; the caudal artery is small.

P. Z. S. 1880, p. 638.

The lungs have two lobes on the left and three on the right side *, besides an azygos lobe, which lies behind the heart in a transverse direction, and is triangular in shape. The left lower lobe is the largest, the right lower the next.

The cricoid cartilage is deeply notched above. The vocal cords are well developed, ·35 of an inch long; the ventricles have the shape of watch-pockets, extending downwards and inwards. There are no laryngeal pouches. The epiglottis is notched above. There are about 27 tracheal rings.

The kidneys are smooth and rather elongated in shape; the suprarenal bodies are well developed and oval. The ureters open ·75 inch from the neck of the bladder.

The ovaries measure ·45 inch, the Fallopian tubes 1 inch. The uterus is single and smooth within; it is ·75 inch long. The vagina is double that length; and the clitoris is small and flattened.

As regards the osteology, already briefly described by Gervais ("Remarques ostéologiques sur les genres *Brachyure* et *Callitriche*") in Castelnau's 'Expédition dans l'Amérique du Sud' [Paris, 1855, Anatomie, pp. 93–99], there is not much of interest to add.

The vertebral formula of my specimen of *Brachyurus* is C. 7, D. 13, L. 6, S. 4, C. 15 or 16†.

Gervais gives C. 7, D. 14, L. 6, S. 4, C. 17 for *B. rubicundus*; the

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* In a ♀ *Pithecia satanas* the right lobe was only two-lobed, the extra superior lobe being only indicated and not cut off.

† In my specimen the few minute terminal caudal vertebræ have unfortunately been laid aside, and cannot now be found. There were not, however, more than three or four of them, which, added to the twelve that remain, give the above numbers.

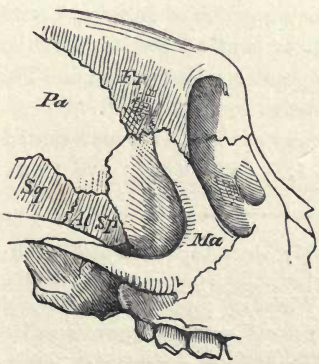
British Museum Catalogue 7, 13, 6, 3, 18, for both *B. calvus* and *B. melanocephalus.* In the latter skeleton ("*Ouakaria spixii,*" 806 *b*) I counted, however, nineteen or twenty caudal vertebræ, the first five of which bear transverse processes, whilst the terminal ones are very minute and styliform.

The carpus has an *os centrale*, and the humerus a well-marked supracondylar foramen. The clavicles are well-developed, and strongly curved sigmoidally. The manubrium sterni is broad.

I may, however, take this opportunity of pointing out a useful means of discriminating, in most cases, between the skulls of the Platyrrhine and Catarrhine Monkeys, in addition to the well-known differences in their dentition and in the form of their external auditory *meatus.*

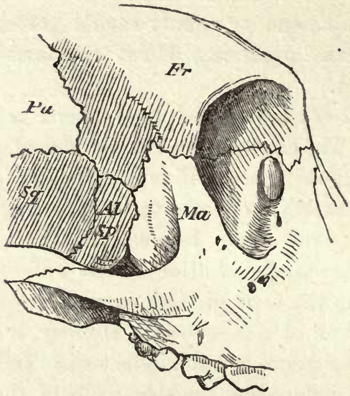
In nearly every skull of a New-world Monkey, it will be found that the *parietal* and *malar* bones are in contact with each other, for a more or less considerable extent, on the side walls of the skull (*vide* fig. 5). In the Old-world Monkeys, on the contrary, this contact *never* (with the exception named below) takes place, the frontal and alisphenoid bones articulating with each other, and so cutting off the connexion between the parietals and malars (*vide* fig. 6). In the skulls of the genus *Hylobates* that I have examined this isthmus is very narrow, so that the parietals and malars approach much nearer each other than is usually the case in the Catarrhini; indeed, in one specimen in the College of Surgeons Museum (5027B) the malar and parietal of *one side* only touch each other for a very short distance, the frontal and alisphenoid *not* meeting. On the other hand, in all the New-world Monkeys' skulls that I have examined, the arrangement above described obtains, except in some skulls of the genera *Mycetes* and *Ateles*. Thus P. Z. S. 1880, p. 639.

Fig. 5.



Part of side walls of skull of a New-world Monkey (*Brachyurus rubicundus*). The parietal (*Pa*) and malar (*Ma*) articulate, as in other members of this group.

Fig. 6.



The same parts in an Old-world Monkey (*Cercopithecus pyrrhonotus*), showing the parietal and malar separated from each other by the intervention of the frontal (*Fr*), alisphenoid (*Al*), and squamosal (*Sq*), which are shaded obliquely.

of five skulls of the first genus in the Royal College of Surgeons Museum, in one the sutures are invisible on account of age, whilst in the
P. Z. S. 1880, p. 640. remaining four the union takes place in one only on both sides, and not at all in the remaining three. In the same collection, a single skull of an *Ateles* (4717*a*) also shows no trace of this union.

In all the remaining genera, so far as I have yet seen, the rule holds good. I was first struck with the arrangement here described when examining the collection of Monkeys' skulls in the Cambridge Museum; and finding that there was no exception whatever, either there or in the skulls belonging to the Prosector's department, I examined the entire collection of unmounted skulls in the College of Surgeons Museum (including nearly every known genus of Monkey), with the results already mentioned. The character is at all events worth knowing for practical purposes, even if of no greater scientific value. This, of course, must be left open for more extensive examination *.

The brain of *Brachyurus rubicundus* is represented in the accompanying figures (figs. 7–10, pp. 120, 121), which give views of its superior, in-

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* P.S. Jan. 27, 1881.—My views have been both confirmed and anticipated by Dr. Gustav Joseph, in a paper in the first volume of the 'Morphologisches Jahrbuch' (i. pp. 453–65, Taf. xv.). Whilst my paper was going through the press, Prof. Flower was kind enough to call my attention to this paper, as well as to another by the same author in the 'Bericht der Schlesischen Gesellschaft'—which, as yet, I have not been able to see—both being referred to in a recently published ethnological paper (in Russian) by Demetrius Arnoutchine, which also, apparently, contains some more information on the same subject.

ferior, external, and internal aspects, of the natural size, drawn after the organ had been hardened in spirit for a short time.

The total length of the hemispheres is 2·3 inches, their greatest breadth 1·8 inch, whilst the vertical depth is about 1·25 inch. Viewed from above, the hemispheres have a fairly rounded contour, and the cerebellum does not project beyond their posterior margin, though it appears above in the middle line between the somewhat cut-away inner margins of the occipital lobe. From the side, the hemispheres are seen to be but slightly arched. The occipital lobe is well developed, and the orbital surfaces but little excavated. The temporal lobes are also well developed.

The hemispheres possess the most important sulci characterizing the Simian brain well developed; as regards their complexity, they stand between *Ateles*, *Cebus*, and *Lagothrix*, on the one side, and *Callithrix*, *Mycetes*, *Pithecia*, &c., on the other.

The Sylvian fissue * (*s.*) is well developed, running upwards and backwards to end, ·3 inch from the middle line of the hemispheres, a little in advance of the spot where the temporo-occipital sulcus (*scissure occipitale externe*) first appears externally. It is at first slightly concave forwards, then convex. At about two thirds of its course it is joined by the well-marked *antero-temporal* sulcus (*a.t.*) (*scissure parallèle*, Gratiolet; *premier sillon temporal*, Broca), which commences near the lower margin of the temporal lobe. This is a condition not found in *Ateles*, *Lagothrix*, *Mycetes*, or *Pithecia monachus*; it is represented by Gratiolet as existing in *Cebus capucinus* (Mém. Plis. Cér. Atlas, pl. x. figs. 7 & 8), and likewise occurs in *Cynocephalus*, *Macacus*, and other Old-world genera.

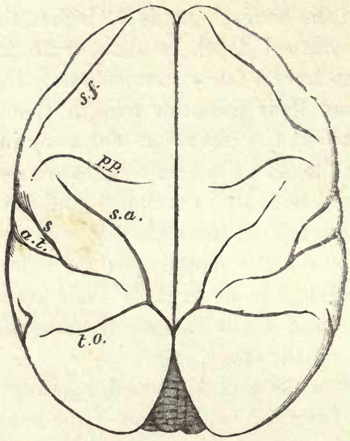
P.Z.S. 1880, p. 641.

Embracing the upper extremity of the Sylvian fissure is a somewhat Y-shaped sulcus, the "stem" of the Y being short and springing from the median line, whilst the two arms are much longer and run downwards and outwards, and in the case of the anterior one forwards as well, on to the external surface of the hemispheres, appearing there one on each side of the upper part of the Sylvian fissure (fig. 9). The posterior of these is, no doubt, the aforesaid *temporo-occipital* sulcus (*t.o.*) (*scissure perpendiculaire externe* of Gratiolet, *scissure occipitale externe* of Broca). The anterior limb no doubt corresponds to the anterior part of

* In the following description of the sulci, &c., I have in the main followed the nomenclature proposed by Prof. Huxley in his valuable paper on the brain of *Ateles paniscus* (P. Z. S. 1861, pp. 247–260, pl. xxix.), and adopted by Prof. Flower in his descriptions of the brains of *Mycetes seniculus* (P. Z. S. 1864, pp. 335–338, pl. xxix.) and *Pithecia monachus* (P. Z. S. 1862, pp. 328–331). The late Dr. Paul Broca has more recently written an elaborate article on the subject of cerebral nomenclature ("Nomenclature Cérébrale, dénomination des divisions et subdivisions des hémisphères et des anfractuosités de leur surface," Revue d'Anthropologie, (2) i. 1878, pp. 193–236). In this he endeavours to limit more strictly than has hitherto been done the terms used by various writers on the structure of the brain, and to introduce a uniform nomenclature. I have, where necessary, added his names in brackets after those here used.

P.Z.S. 1880, p. 642.

Fig. 7.



Brain of Red Uakari, seen from above.

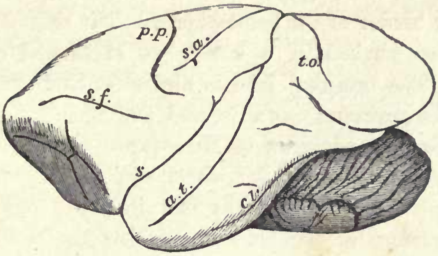
Fig. 8.

Right half of the same, seen from below.

P.Z.S. 1880, p. 641.

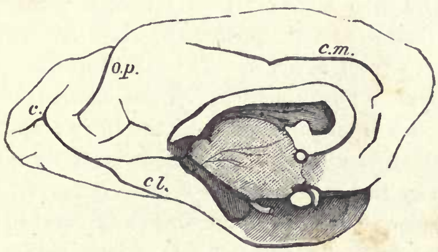
the "sulcus (4) bounding the upper border of the angular gyrus, having the form of a broad pointed arch," described by Prof. Flower in *Pithecia monachus* (*l. c.* p. 330). A comparatively slight modification of the condition of these parts in that species as represented in his fig. 1 would bring about that which obtains in *Brachyurus*, which also is represented in Gratiolet's figures of *Cebus capucinus* and *C. apella* (*l. c.* pl. x. figs. 7 & 11). This "supraangular" (*s.a.*) sulcus defines anteriorly the well-

Fig. 9. P. Z. S. 1880, p. 643.



The same, left half, seen from the outside.

Fig. 10.



The same, from the inside; the cerebellum and medulla have been removed. All the figures of the natural size.

s. Sylvian fissure; *p.p.* Postero-parietal; *s.f.* Supero-frontal; *s.a.* Supra-angular; *a.t.* Antero-temporal; *t.o.* Temporo-occipital; *c.m.* Calloso-marginal; *c.* Calcarine; *cl.* Collateral; *o.p.* Occipito-parietal.

developed angular gyrus. The union of the temporo-occipital and occipito-parietal (the two parts of the *scissure occipitale* of Broca) sulci divides off perfectly the occipital and parietal lobes; so that there is here no such superficial "pli de passage" between these two lobes as exists in *Cebus capucinus* and *Pithecia satanas.* In *P. monachus* there is, in addition, a second, more superior passage-fold between these two lobes (Flower, *l. c.*)*. In *Cebus apella* (according to Gratiolet's figure, *l. c.* pl. 10. figs. 12, 12 *bis*), as in *Brachyurus*, the "pli de passage" is concealed, so that superficially the two lobes appear perfectly distinct. P. Z. S. 1880, p. 641.

Anterior to the supraangular sulcus, the fissure of Rolando (*p.p.*) (*postero-parietal*, Huxley) is seen as a well-developed sulcus forming a

* As regards this and sundry other differences between *Pithecia monachus* and *P. satanas*, it must be remembered that the two are not perhaps strictly congeneric, *P. satanas* having been separated, with *P. chiropotes*, as a genus *Chiropotes*.

sigmoid curve extending very nearly to the middle line. Anterior to this is the superofrontal sulcus (*s.f.*), also curved, though roughly parallel with the external border of the hemispheres. The orbital surface of the hemispheres is also marked by a somewhat H-shaped complex sulcus (*incisure en*-H). The occipital lobe is almost entirely smooth; below a sulcus is observable, curving upwards, and ending in a bifurcate manner in front of the lower termination of the occipito-temporal sulcus. Posterior to this is a very much smaller, short sulcus, easily seen internally, but only just appearing on the inferior margin of the lobe externally.

P. Z. S. 1880, p. 642.

The internal surface of the hemispheres has the ordinary sulci well displayed. The calloso-marginal sulcus (*c.m*) (*scissure sous-frontale*), somewhat broken up anteriorly, inclines posteriorly towards the margin of the hemispheres, but does not reach it by about ·1 inch. The occipito-parietal fissure (*o.p*) (*scissure perpendiculaire interne*) is distinct, inclined first backwards, and then abruptly bent forwards for a small distance. Between its termination and the posterior end of the corpus callosum is a faintly impressed triradiate mark. The calcarine sulcus (*c*) is well developed, and terminates posteriorly by its characteristic fork; the point of division is ·15 inch from the margin of the brain; and the upper arm is slightly longer than the lower. The sulcus is continued forwards with an upward concavity to the end of the corpus callosum, where it passes into the dentate sulcus *. At a point ·3 inch in front of its bifurcation it is joined by the collateral sulcus † (*cl*), which passes forwards and slightly outwards, so appearing on the external face of the temporal lobe (fig. 9). The temporal lobe has, in addition, a slight impression anterior and internal to this, but is otherwise quite smooth below.

P. Z. S. 1880, p. 643.

P. Z. S. 1880, p. 644.

The corpus callosum is well developed; it is nearly 1 inch in total length; the præcallosal part of the cerebrum is 0·45 inch, the postcallosal 0·9 inch in length.

The cerebellum is well developed; the superior vermis is 0·85 inch in

* According to Broca (Revue d'Anthrop. viii. p. 470, 1878) the bridging convolution between the callosal and uncinate convolutions, which here interrupts the apparent continuation of the calcarine into the dentate sulcus, is nearly always present in Monkeys, although it may be deep and in some cases extremely delicate also. He considers, however, that it is wanting in the Hapalidæ. It is certainly present in *Brachyurus*, though small and deep. Prof. Flower says of *Mycetes* (*l. c.* p. 337), "the dentate sulcus is continuous with the calcarine." On the other hand, in *Ateles* (cf. Huxley, *l. c.* p. 255, fig. 2) it is superficial and obvious. Broca also figures its existence in *Lagothrix* (*l. c.* p. 471, fig. 31).

† This junction, at least superficially, of the calcarine and collateral sulci I also find exists in *Cebus capucinus* (cf. also Gratiolet's figure, Atlas, pl. x. fig. 9) and *Pithecia satanas*; in *Ateles* and *Nyctipithecus*, &c., however, it does not exist, as far as I have seen, nor do I find any allusion to such a condition existing at all in any of the memoirs already quoted on the brain of Primates.

length; with the lateral lobes it is altogether 1·25 inch transversely. The flocculi are large, and the pons Varolii well developed. The medulla has distinct olivary bodies.

In the general characters of its brain, as will be thus seen, *Brachyurus* approaches most nearly the genera *Cebus* and *Pithecia* (including *Chiropotes*), and especially the type found in *Cebus apella*. With *Ateles* and *Lagothrix* it has no close relationship; and the same may be said as regards *Mycetes*; it also departs widely in the greater complication and development of the brain from *Callithrix*, *Chrysothrix*, and the smaller Cebidæ generally.

Reviewing the facts already stated as to the structure of *Brachyurus rubicundus*, it is evident that *Brachyurus* is a perfectly good genus, more or less intimately related to a number of the larger Cebine forms, but nevertheless characterized by a combination of characters peculiarly its own. A relationship to *Mycetes*, suggested by its external appearance and the form of the lower jaw, is not borne out by its visceral anatomy, the brain and liver both pronouncing decisively against the idea, besides other peculiarities. With *Ateles* and *Lagothrix* it has no particular features in common, but it undoubtedly approaches *Cebus* in the structure of its brain; and it is with this genus and *Pithecia* (including *Chiropotes*) that it has probably the nearest affinities.

The institution of a genus *Ouakaria* for the reception of these short-tailed Monkeys by Dr. Gray (P. Z. S. 1849, p. 9) seems to me unnecessary. As he there remarks, the genus *Brachyurus*, as originally proposed by Spix (Sim. et Vespert. Bras. p. 11), contained two species, *B. israelita* (*l. c.* pl. vii.) and *B. ouakary* (pl. viii.). The former of these is now generally referred to the genus *Pithecia*, standing as *Pithecia chiropotes* (cf. Sclater, P. Z. S. 1871, p. 228). Having examined skulls of all the known species of *Brachyurus*, as well as of *Pithecia satanas*, which is P. Z. S. 1880,
merely a representative form of *P. chiropotes*, I am unable to agree with p. 645.
Dr. Gray (*l. c.*) as to Spix "having evidently described the teeth &c. of his first species in his generic character," for I find the characters there given apply equally well to both the forms under consideration. Indeed, as the "character essentialis" of the genus *Brachyurus* is "*Cauda non volubili, abbreviata*," *B. israelita*, in which that organ is of the normal length, can in no way be considered the type of the genus. With certain other points, too, of the "descriptio" there given, *B. ouakary* corresponds better than the first species. I therefore agree with Isidore Geoffroy (Expéd. Am. Sud, Mammif. p. 18) in retaining the generic name *Brachyurus*, of which *Ouakaria* thus becomes a synonym *.

* The name *Brachyurus* has also been used, but erroneously (cf. Sclater, 'Ibis,' 1877, p. 260), for the Ant-Thrushes (*Pitta*). Mr. Alston has, since this paper was read,

As regards the species of this genus, there are three well-marked ones, each inhabiting a distinct geographical area; of each of these I have seen skins and skulls. They may be arranged as follows:—

a. *Facie nigra.*

1. Brachyurus melanocephalus. (Plate VI.)

Simia melanocephala (Cacajao), Humboldt, Rec. pl. xxix. p. 317 (1811).
Pithecia melanocephala, Geoffr. Ann. Mus. xix. p. 117 (1812).
Brachyurus ouakary, Spix, Sim. et Vesp. Bras. p. 12, pl. viii. (1823).
Ouakaria spixii, Gray, P. Z. S. 1849, p. 10, fig.
Ouakaria melanocephala, Gray, Cat. Monkeys &c. p. 62 (1870).
Pithecia melanocephala, Schlegel, Mus. P.-B. vii. p. 227 (1876).

Ater, dorso lateribusque cum brachiis posticis plus minusve castaneo-brunneis.

Hab. Forests traversed by the Casiquiare and Rio Negro (*Humboldt*); forests between the Solimoes and Ica (*Spix*); Marabitanas, Rio Negro, and Moura, Rio Branco (*Natterer, fide Pelzeln apud Schlegel, l. c.*).

This species is at once distinguishable by its black face, as well as by the black hands, feet, &c. It is the most northern form of the three, and apparently the most wide-spreading also. No doubt it is the "black-faced, grey-haired" species heard of, but not obtained, by Mr. Bates as being found "180 miles from the mouth of the Japurá" (Nat. Amaz. ii. p. 313).

Of this species we have, at different times, had two specimens living in the Gardens (*vide* Sclater, P. Z. S. 1870, p. 1). From the first of these the water-colour drawing by Richter in the Society's possession, which is here reproduced on a diminished scale (Plate VI.), was taken. In all probability it is the skin and skeleton of this individual which are now preserved in the British Museum. [The stuffed skin is marked "Zool. Soc.'s collection," the skeleton 806 *b*.]

P. Z. S. 1880, p. 646.

b. *Facie rubra.*

2. Brachyurus calvus.

Brachyurus calvus, Isid. Geoffr. C. R. xxiv. p. 576 (1847), et Arch. Mus. v. p. 560; Expéd. Amér. Sud, Mammif. p. 17, pl. 4. fig. 1 (1855).
Ouakaria calvus (sic), Gray, P. Z. S. 1849, p. 10.

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pointed out to me that the same term also had been proposed some years previously to Spix by Fischer ('Zoognosia.' i. p. 24) for a genus of Rodentia (1813). As, however, this name has never, I believe, been adopted for use in that group, it seems to me quite unnecessary, on that ground, to reject the name for the Uakaris. Purists will have, I suppose, to adopt Lesson's barbarous term, proposed as a subgenus, *Cacajao* (Species des Mammifères, p. 181, 1840).

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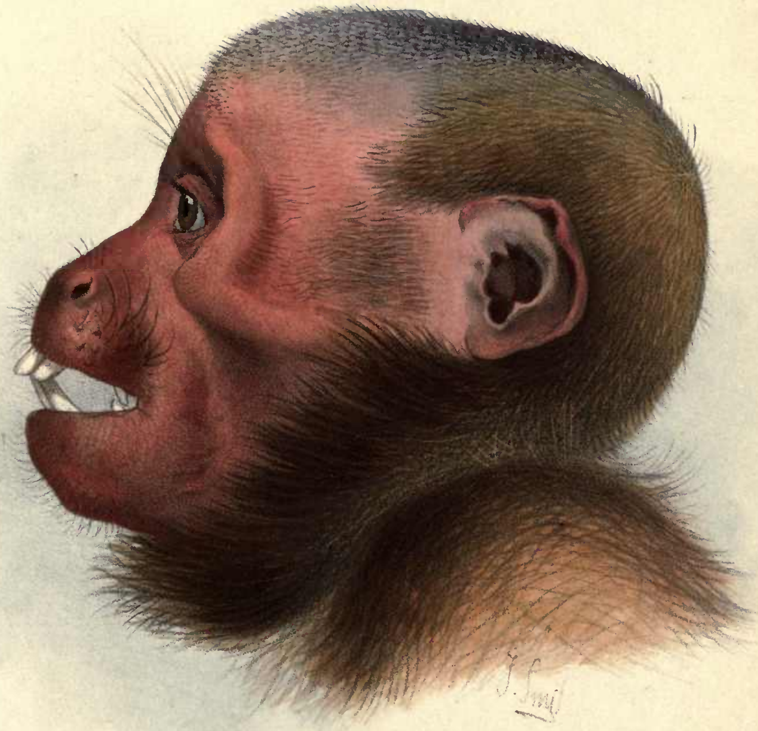
J. Smit lith.

Hanhart imp

BRACHYURUS RUBICUNDUS

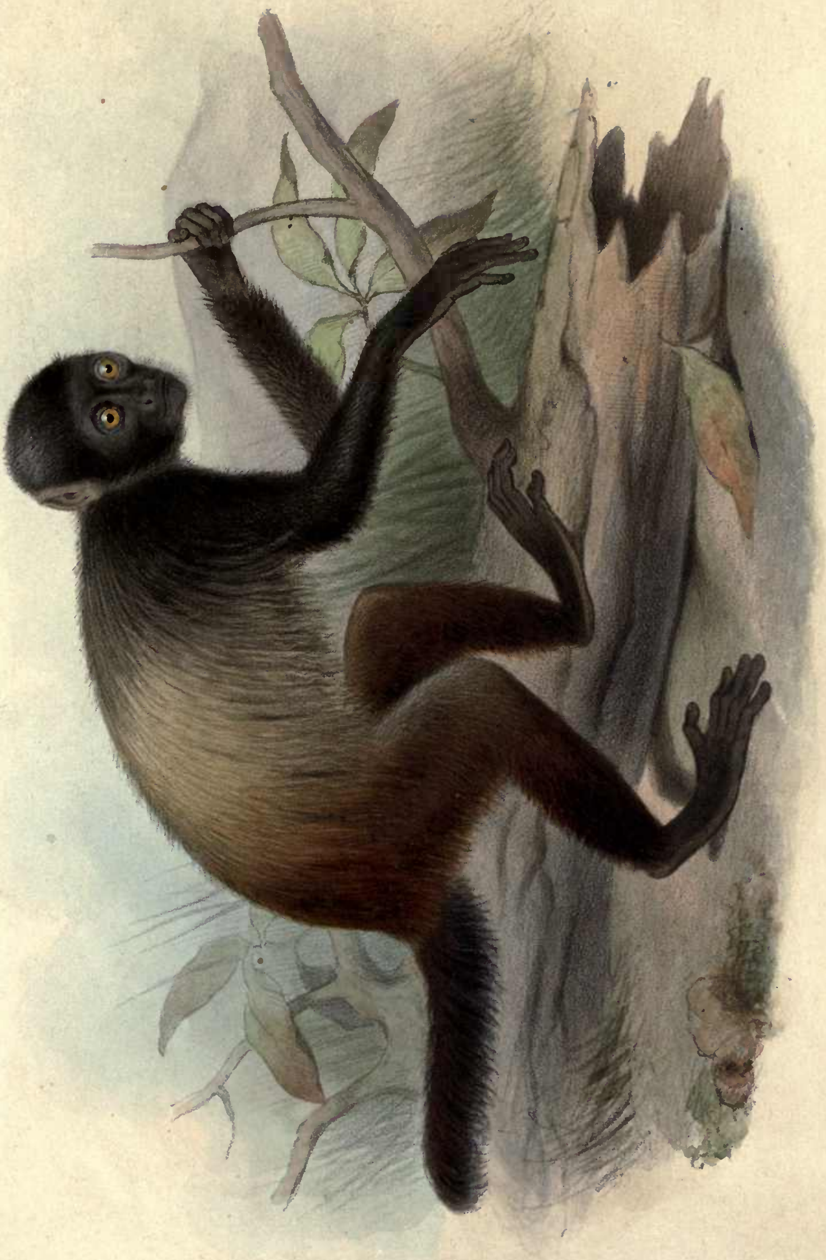


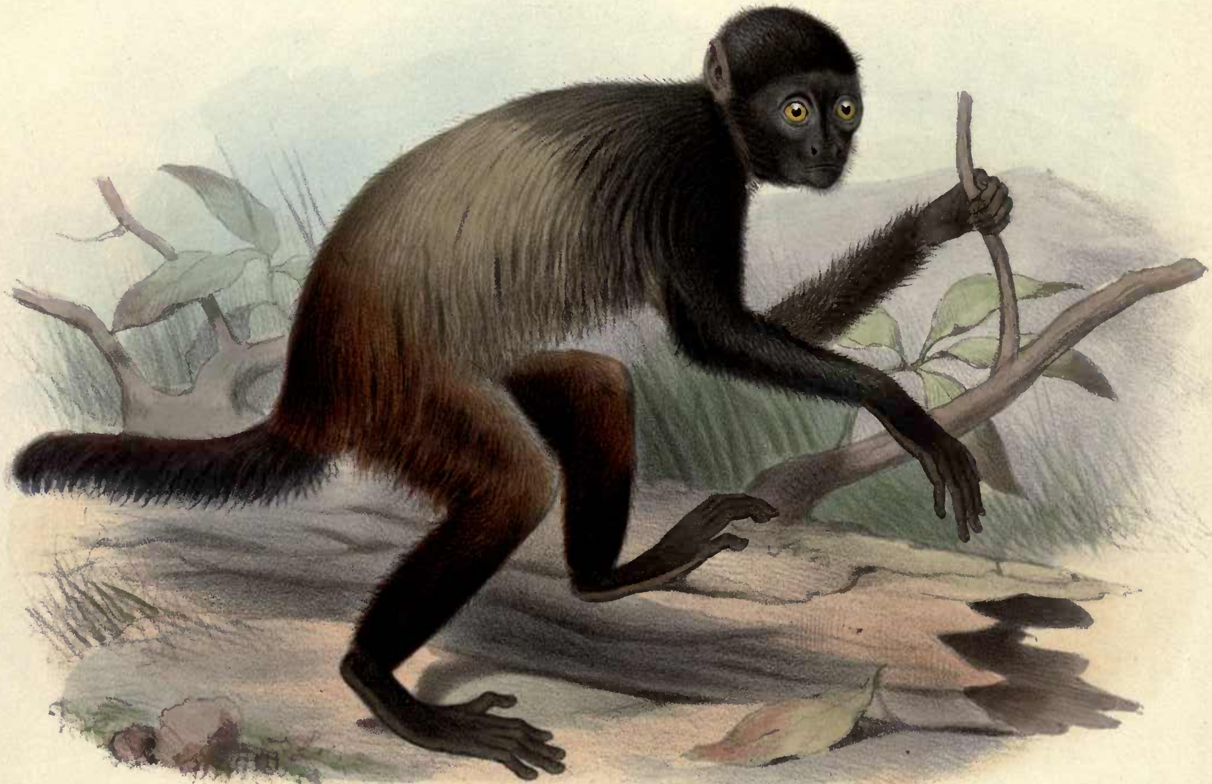
UNIV. OF
CALIFORNIA

J. Smit.lith.

Hanhart imp.

HEAD OF BRACHYURUS RUBICUNDUS. *Nat. Size.*





J. Smit lith.

Hanhart imp.

BRACHYURUS MELANOCEPHALUS.

Ouakaria calva, Gray, Cat. Monk. p. 62 (1870).
Pithecia calva, Schl. Mus. P.-B. vii. p. 228 (1876).
Pithecia alba, Schl. Mus. P.-B. vii. p. 229 (1876).

Corpore fulvido-albicante, subtus saturatiore.

Hab. Opposite Fonteboa (*Castelnau & Deville*); banks of the Japurá delta, west of its mouth (*Bates*).

According to Castelnau (*l. c.* p. 567), *B. calvus* is confined to the forests lying on the north bank of the Amazons, between the rivers Putumayo (or Ica) and Japurá.

The locality "Pará," given to the species by its discoverer M. Lisboa, and also marked on the mounted specimen in the British Museum, is of course a mistake, as already pointed out by Schlegel (*l. c.* p. 226). Mr. Bates's notes on this species and the next, and their distribution, are well known to naturalists. On his short description and the figure in the second edition of the 'Naturalist,' Prof. Schlegel has attempted to found a fourth species, "*Pithecia alba*." But, in the first place, the short description given, as well as the locality, suit *B. calvus* quite well; and, secondly, there is a specimen in the British Museum, purchased of Stevens, which in all probability was one collected by Mr. Bates himself, and is quite the same as three other specimens of that species.

3. Brachyurus rubicundus. (Plates IV., V.)

Brachyurus rubicundus, Isid. Geoffr. & Dev. C. R. xxvii. p. 498 (1848); Geoffr. Arch. Mus. v. p. 564, pl. 30; Expéd. Am. Sud, Mamm. p. 19, pl. 4. fig. 2 (head).
Ouakaria rubicunda, Gray, Cat. Monk. p. 62 (1870).
Pithecia rubicunda, Schlegel, Mus. P.-B. vii. p. 228 (1876).

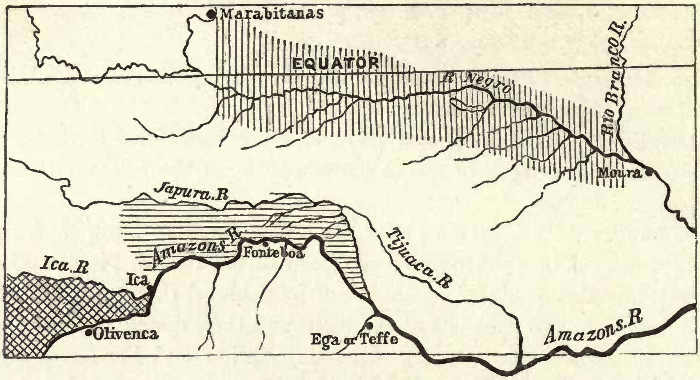
Corpore castaneo-rufo, collo pallidiore.

Hab. Forests on the north bank of the Amazons opposite Olivenca, not passing eastwards of the Ica (*Castelnau*).

The exact westward extension of this species still remains unknown. The young specimen seen at Fonteboa by Bates (*l. c.* p. 313) and by him referred to this species, was more probably *B. calvus*, as we know, from Geoffroy and Castelnau's account, that the young of *B. rubicundus* resembles in coloration the adult, and is *not* paler. Opposite Fonteboa, P. Z. S. 1880, moreover, is exactly the locality where the French expedition obtained p. 647. *B. calvus*, and is well within the limits assigned to that species by Castelnau.

B. rubicundus is the western representative of *B. calvus*, which it very closely resembles, but can at once be distinguished by its very different coloration, being nearly all over of a rich deep chestnut, only paler on the neck, instead of the pale sandy-white, slightly rufous below and on the inside of the limbs, of the last species. The fact of the series of individuals of each of these species obtained by Castelnau and Deville differing to no

Fig. 11.



Map of part of the basin of the Amazons, to show the distribution of the Uakari Monkeys.

Supposed area of *B. melanocephalus.*

" " *B. calvus.*

" " *B. rubicundus.*

important extent amongst themselves, as well as their different ranges, clearly show that, so far as our knowledge yet goes, there is no reason whatever for considering *B. calvus* an albino form of *B. rubricundus*; moreover in *B. calvus* a considerable number of hairs on the back &c. are *black* throughout, just as in *B. rubicundus*; this would hardly be the case in an albino.

Gray's arrangement of these species in the 'Catalogue of Monkeys' has already been dealt with by Schlegel:—" Il semble, d'ailleurs, que ce savant se soit formé une idée à lui propre de ces animaux, puisque, après avoir mis les *Ouakaria rubicunda* et *calva* dans une catégorie à part, laquelle porte en tête: 'pelage blanchâtre ou rougeâtre,' il ajoute: 'albinos de l'*Ouakaria melanocephala.*' *On avouera que ceci est trop fort pour le directeur d'un des plus grands établissements de Zoologie.*" (Mus. P.-B. p. 229.)

21. ON THE CAUSE OF DEATH OF A LEOPARD.*

P. Z. S. 1880, p. 358.

Mr. W. A. Forbes exhibited a small fragment of bone which had caused the death of a Leopard (*Felis pardus*) in the Society's Menagerie on April 20, under the following circumstances:—

For about a week previous to its death the animal, a fine adult male, had refused food, and, having been separated from its companions, was noticed by the keeper to be apparently suffering from some intestinal obstruction. The animal was in good condition and very fat. On opening the abdominal cavity after death, about a gallon of an opaque, dirty-red-coloured, chyly-looking fluid was found in it. There was a large clot of indurated fæces in the large intestine. In addition, near the commencement of the jejunum, was found a small bolus of straw that had been swallowed, as is often done by these animals in the absence of grass. In this a triangular splinter of bone, about $1\frac{1}{2}$ inch long by 1 inch high, with a very sharp edge, had become impacted firmly, so much so as to perforate the walls of the intestine, and to project outside into the abdominal cavity for about $\frac{1}{8}$ of an inch. The movements of the animal, or the peristaltic action of the intestines, had caused this sharply projecting angle of the bone to cut through the intestinal walls for the distance of some 2 inches. Through this wound the juices of the stomach and intestinal canal, together with the fluid swallowed by the animal, had apparently leaked, and had given rise to the accumulation of fluid in the abdominal cavity which had caused death.

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22. ON *ANTILOCAPRA AMERICANA*. †

P. Z. S. 1880, p. 540.

Mr. W. A. Forbes exhibited some drawings of the horns of the Prong-buck (*Antilocapra americana*), and made the following remarks:—

"Many of those here present to-night will doubtless remember the surprise created amongst naturalists by Mr. Bartlett's announcement, in 1865, of the shedding of the horns of the Prongbuck. The first surprise that this statement created having passed away, the deciduous nature of the horns of *Antilocapra americana* seemed in a fair way of being accepted as one of the commonplaces of zoology. About two years ago, however, the celebrated American zoologist Prof. E. D. Cope appended the following editorial note to a short account of this animal

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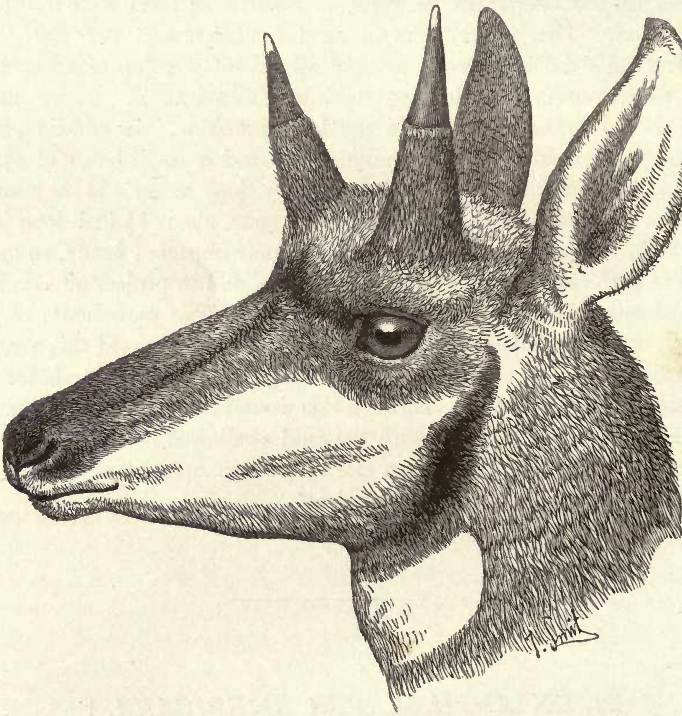
* Proc. Zool. Soc. 1880, p. 358. Read May 4, 1880.

† Ibid. 1880, pp. 540–543. Read Nov. 16, 1880.

published in the 'American Naturalist' (xii. 1878, p. 557) by a Mr. F. W. Endlich :—'After several years' familiarity with the Prong-horned Antelope in a wild state, I may say I have never met with an undoubted case of shedding of the horn-sheath. Shed horn-sheaths are not common

Fig. 1.



Head of Prongbuck, showing the new pair of horns the day after the shedding of the old ones : reduced.

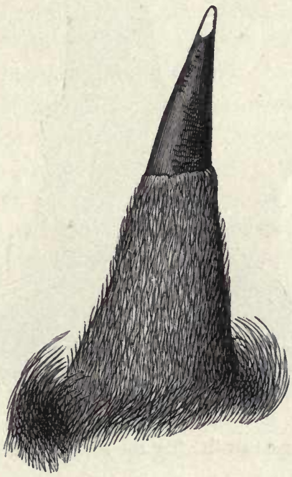
P. Z. S. 1880, p. 541. where these animals abound, as they would be were the phenomenon usual. Their appearance on the animal at times indicate that they may be shed; and I suppose the evidence is sufficient that the shedding occurs. *But it is not periodical, or even frequent.*'

"Fortunately, we have not had long to wait before being able to again test the accuracy of Mr. Bartlett's original position.

"On December 4, the Society purchased a pair of Pronghorns, the male of which was nearly or quite adult, and had 'apparently lately shed his horns, as the pair which he bears were quite soft when he arrived' (*cf.* P. Z. S. 1880, p. 23). In confirmation of this, Mr. Bartlett tells me that his horns also had then no trace of the 'prong,' which subsequently grew in the ordinary position. Our male animal lived in good health and condition through the summer, and grew a good (though by no means large) pair of horns.

"During the night of October 18–19th last, these horns were shed; but no trace of them could be found, after the most careful search; so that in all probability they were either devoured by the animal itself, or carried away by some predatory rat, or visitor!

Fig. 2.



Horn of Prongbuck, drawn the day after the shedding of the old horns: $\frac{1}{2}$ nat. size.

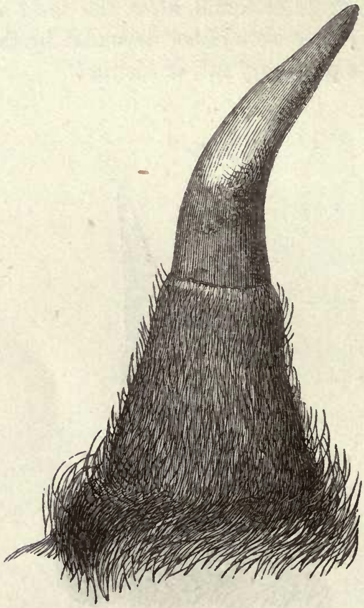
"Mr. Smit's drawings that I now exhibit were made on the spot, under my supervision, the day after the shedding (October 20).

"Fig. 1 shows the general form and size of the new horns. From it it is obvious that any person who was not acquainted with the mature horns of the animal would not for a moment suspect that any shedding had taken place. Fig. 2 shows one of the new horns, drawn of half the natural size, so far as the movements of the animal allow this to be done. The base of the newly uncovered horn is thicker and larger than the top part, and is of a different texture, being greyer and pretty thickly covered with long, whitish, closely appressed hairs. The integument is rather soft and decidedly warm to the touch; and growth is evidently going on here at a rapid pace. The top part, about one inch long, is smoother and blacker, though nearly white at the tip. It is nearly glabrous, with only a very few small hairs, and has the appearance and touch of ordinary horn. It is separated from the basal 'pedicel' part by

P. Z. S. 1880, p. 542.

a slight constriction, and is *movable* on this part in a slight degree from side to side.

Fig. 3.



Horn of Prongbuck, one month after the shedding of the old horns: ½ nat. size.

"Fig. 3 shows the condition of the horns to-day (November 16), exactly four weeks after the shedding took place. As will be seen, the horns have grown rapidly, and have already acquired a characteristic inward curve. The hair-covered 'pedicel' and the black apical part still retain their original character unaltered; and all the increase of length in the horn is due, as far as I can make out, to the lengthening-out of the 'node' (to use a botanical term), which is marked off as a slight constriction on the fresh horn (*vide* fig. 2). The horn above the 'pedicel' is still slightly movable on this latter part, which is still markedly warm to the touch, particularly in its upper half, just below the annular constriction which separates the two parts of the horn. It is here, I am inclined to believe, that the new formation of horn is going on, the apical, harder part being pushed, by the growth of new matter, further and further away from the pedicel. I may add that the 'snag' or 'prong' is not yet visible, but may be felt as a slight eminence at the *base* of the 'pedicel,' close to the skull, on the anterior margin of the horn.

P. Z. S. 1880, p. 543.

"On making a longitudinal vertical section of a horn of *Antilocapra*, I find that there is a more or less open canal in the substance of the horn, continued for nearly the whole extent of the main part of the horn, but considerably nearer its posterior than its anterior margin. In its upper part are still observable minute blood-vessels, which have become naturally injected. The horn has obviously been formed around this dermal papilla, which, whilst the surrounding parts have become hard and corneous, has remained soft and vascular for a while; but eventually its tissues have shrivelled up. It will be readily understood how in this way the papilla has gradually been converted into a hollow channel by the growth and elongation of the horn formed originally round it.

"In conclusion, I can only express my surprise that Prof. Cope has apparently overlooked Judge Caton's excellent chapter on the Prong-buck in his 'Antelope and Deer of America' (1877). Judge Caton himself has apparently witnessed the phenomenon several times; and his account of the growth of the horns (pp. 25–35) agrees very well with my own observations, excepting as regards the point of origin of the 'prong.' If the shedding of the horns is '*not* periodical or even frequent,' it is certainly strange that both his and the Society's specimens should all have exhibited it. I may remark that the period of the year assigned for shedding the horns by Mr. Caton also quite corresponds with the dates of shedding here (November 7 and October 19)."

[P.S. To-day (Dec. 2) the "prong" is still concealed beneath the hairy covering of the pedicel, but is now very easily perceptible to the touch. The hairy covering of the "pedicel" is thicker now than six weeks ago, apparently owing to the growth of new hairs round it. The horn above is still movable on the "pedicel."—W. A. F.]

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23. ON SOME POINTS IN THE STRUCTURE OF *NASITERNA* BEARING ON ITS AFFINITIES.*

P. Z. S. 1880, p. 76.

For many years the true position in the series of Parrots of this very singular little form, of which about seven species are now known, has been a moot point amongst ornithologists, most authors placing it amongst the Cacatuinæ.

Although two accounts have been published of some points in the anatomy of *Nasiterna pusio*—first by Mr. Sclater when describing that species †, and secondly by Signor Camerano, in a paper read before the

* Proc. Zool. Soc. 1880, pp. 76, 77. Read Feb. 17, 1880.

† P. Z. S. 1865, p. 620.

Turin Academy of Sciences *,—nothing very definite has resulted from them tending to elucidate this doubtful point. Mr. Sclater was inclined to regard it (*l. c.* p. 622) as "an aberrant form of the Psittacinæ . . . . unless it can be allowed to stand as the type of a distinct subfamily, which would probably be more correct."

At my request, some fifteen months ago, M. Alphonse Milne-Edwards was kind enough to forward to the late Prof. Garrod a specimen (in spirit) of a *Nasiterna*, probably *N. pygmæa*, for dissection; and I now place before the Society a few statements on its structure as recorded in his MS. notes.

As in all other Parrots, except in certain species of *Cacatua* and in *Licmetis tenuirostris*, there are two carotid arteries in *Nasiterna* (a fact previously recorded by Camerano), both of which run in the normal manner in the hypapophysial canal. As in all Parrots with the carotids so disposed (except some individuals of *Stringops*), the ambiens muscle is absent. The furcula is represented only by a rudiment at the upper end; and the orbital ring is incomplete. As the oil-gland is present, the formula for *Nasiterna*, adopting the system used by Prof. Garrod in his paper on the anatomy of the Parrots †, will be 2, –, –, +, as in *Agapornis*, *Stringops*, *Geopsittacus*, and their allies.

Pterylographically, I have been able to ascertain that *Nasiterna pygmæa* agrees generally in the form and disposition of the tracts with such genera as *Cyclopsitta*, *Psittinus*, &c., and differs from the Cacatuinæ in the absence of the crest and naked head-space (*cf.* Sclater, *l. c.* p. 622)
P. Z. S. 1880, p. 77. universally present, as far as I have yet seen, in that group, as also in the absence of powder-down feathers, very frequently, though not invariably, present in those birds, though absent in the other *Psittaci* with "normal" carotids. In the Cockatoos, too, the orbit is completely encircled by bone ‡, and, as a rule, doubly so (*vide* P. Z. S. 1874, pl lxxi.). In *Nasiterna*, as already stated, it is not so. Of the other "Palæornithidæ," as defined by Prof. Garrod, the Trichoglossinæ form a well-marked group, characterized by numerous features to which there is no approach in *Nasiterna*.

Its nearest allies must therefore be in the remaining forms of that family, which I propose to call Eclectinæ, including all those not either Cacatuine or Trichoglossine, with the exception, perhaps, of the ground-frequenting forms, *Stringops*, *Pezoporus*, &c. The spiny tail-feathers of *Nasiterna* are, no doubt, very peculiar, and with its curious beak and

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* Atti Reale Accad. Torin. xiii. 1878, p. 301.

† P. Z. S. 1874, p. 595.

‡ This was not the case, however. in a specimen of *Calyptorhynchus funereus*, lately examined by me.

diminutive size must always make this a very well-marked genus. But I fail to see in its spiny tail sufficient importance to elevate *Nasiterna* into a special subfamily, as suggested by Mr. Sclater. *Chætura* is not separated on similar grounds from the other Chæturinæ; nor has the spatulate tail of *Prioniturus* been advanced as entitling that genus to form a special subfamily.

The anatomy of the small short-tailed genera *Cyclopsitta*, *Psittacella*, &c. is as yet unknown; but I believe that it is amongst these forms—related, as far as can be judged from external appearance, through this last to *Pezoporus*, *Geopsittacus*, &c.—that *Nasiterna* has its nearest allies. *Agapornis* and *Psittinus* are also not very distantly related, though I believe that the loss of its furcula by *Agapornis*, in which it resembles *Nasiterna*, is probably due to independent causes *. That the loss of the furcula is *not* exclusively correlated with terrestrial habits is shown by its absence in three such essentially arboreal genera as *Agapornis*, *Nasiterna*, and the Neotropical *Psittacula*.

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24. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—Part I. ON THE STRUCTURE OF THE STOMACH IN CERTAIN GENERA OF TANAGERS.† P. Z. S. 1880, p. 143.

Under this heading I propose to continue from time to time, as material may occur, the "Notes on the Anatomy of Passerine Birds," of which the late Prof. Garrod published four parts in the Society's 'Proceedings' ‡.

In the vast majority of Passerine birds the structure of the anterior part of the alimentary canal conforms to the type present in the Fowl—that is to say, to an œsophagus, which may or may not be dilated into a crop, succeeds a stomach consisting of two parts :—an anterior glandular part, the *proventriculus*; and a posterior part, separated off from both proventriculus and duodenum by more or less distinct constrictions—the gizzard or *ventriculus*, of which the muscular walls are always more or

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* Judging by its behaviour in captivity, *Agapornis* is extremely sluggish in its movements.

† Proc. Zool. Soc. 1880, pp. 143–147. Read Mar. 2, 1880.

‡ Part I. P. Z. S. 1876, p. 506; Part II. 1877, p. 447; Part III. 1877, p. 523; Part IV. 1878, p. 143.

less thickened, and provided with a central tendon on each side (*vide* fig. 1).

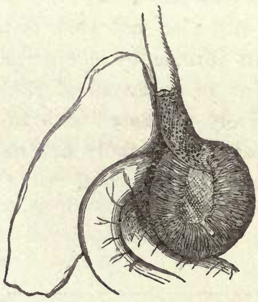
P. Z. S. 1880, p. 144.

As was first pointed out by Lund, half a century ago, a singular exception to this rule obtains in the Tanagers of the genus *Euphonia* *.

From his description (quoted below) and figures, it is quite evident that Lund considered that there was, in these birds, an intermediate zone devoid of glands or muscles, between the proventriculus and the

P. Z. S. 1880, p. 144.

Fig. 1.



Stomach of *Tachyphonus melaleucus*, natural size, undisturbed, and viewed from behind. The liver, œsophagus, and small intestine are also partially represented.

P. Z. S. 1880, p. 144.

commencement of the small intestine, and that a small lateral diverticulum springing from this zone was also present, representing the true, though rudimentary, gizzard. Lund found, as he believed, this state of things in three species of *Euphonia*, whilst the normal type of stomach existed

* In a pamphlet entitled "De genere *Euphones*, præsertim de singulari canalis intestinalis structura in hocce avium genere, autore Dr. Peter Wilhelm Lund," published at Copenhagen in 1829 (31 pages and 1 plate).

This pamphlet being rather scarce, I here give Lund's own words:—

"§ 13 (p. 12). Ubi incipit intestinum tenue, ibi conspicitur in externa superficie angustæ illius zonæ, quæ locum ventriculi occupare videtur, minima quædam protuberantia, cui intus respondet levis quædam impressio. Opaca est parvula hæc protuberantia; quare in parietibus fibras musculosas contineat non dubito; hoc vero, propter minimam ejus molem, decidere vix valebis . . . . . Ad eam sententiam maxime inclinare animam, ut statuam verum esse hoc ventriculi analogon, haud diffiteor.

"§ 14. Hæc si vera judicetur cogitandi ratio, referas licet structuram hujus avis ad formam avium generalem; ita enim habebimus, uti solet, musculosum nostrum organon e latere intestini exortum, interque proventriculum et intestinum tenue positum; neque a forma generali avium aberrat hæc structura, nisi in eo, quod ad minimum quoddam rudimentum reductus est ventriculus: contra, si zonam illam, de qua mentionem fecimus, angustam pellucidamque, quæ inter proventriculum et intestinum tenue invenitur, analogon esse ventriculi statuamus, constantes duo maximeque essentiales ventriculi avium characteres subruentur, in musculosa structura ortuque laterali positi."

in sixteen other species of Tanagers which he examined. Lund's description has frequently been copied since in various text-books, and his figures at least three times reproduced *.

Mr. Sclater having called my attention to this subject, I have been able, thanks to the resources of the Prosector's department and to the material afforded by Mr. Salvin, to re-examine this question. I have been able repeatedly to dissect specimens of various species of *Euphonia* both preserved in spirit and quite fresh. I can fully confirm Lund's description in all points, except as regards the presence of a small lateral diverticulum from the alimentary canal, of which I have never been able to find the slightest trace, though I have always carefully looked for it.

Fig. 2 will show the structure of this part of the alimentary canal, with the parts as little disturbed as possible, but with the stomach &c. cut open from behind, in a perfectly fresh specimen of *Euphonia violacea*. As will be seen, between the glandular proventriculus and the villi-covered duodenum a narrow zone is interposed, with its walls in no degree thickened, but thin and membranous, and of rather greater calibre than the adjacent parts, there being no pyloric constriction. Moreover there is none of that approximation of the cardiac and pyloric ends of the stomach that obtains in most other birds. There is no trace of P. Z. S. 1880, p. 145.

Fig. 2.

Stomach of *Euphonia violacea.*

A portion of the alimentary canal of *Euphonia violacea*, twice the natural size, cut open and seen from behind, to show the proventriculus (*p*), the narrow zone representing the gizzard (*z*), and the commencement of the small intestine (*sm.i*). The liver and spleen are also seen, as is the end of the œsophagus, which is opened up.

* Carus and Otto, Tab. Anat. Comp. Illustr. 1835, pt. iv. tab. vi. figs. 4, 5; Wagner, Icones Zool. iii. t. xi. figs. 3, 4; Bruhl, Zoot. aller Thierkl. Lief. iii. pl. ix. fig. 13 *a*.

any external diverticulum to be seen; and I therefore can only conclude that Lund must have been misled, he, owing to the bad condition of his specimens (a very probable contingency when dissections are made in tropical climates), having mistaken a bit of fat or connective tissue for a diverticulum of the ventriculus, which last there can be no doubt that this non-glandular zone really represents, the muscular walls and hard epithelium of the true Passerine gizzard being almost entirely undeveloped *.

I have also been able to ascertain that the nearly allied genus *Chlorophonia* (at least in *C. viridis*) is characterized by the same non-development of a gizzard. On the other hand, all Tanagers yet examined belonging to other than these two genera have stomachs constructed on the normal type. Thus in a specimen of *Tachyphonus melaleucus* (see fig. 1, p. 134) the characteristic gizzard with the two central tendons is present and well developed, the muscular walls being nearly $\frac{1}{4}$ inch thick, and the epithelium lining it hard and horny. As might have been expected, considerable variations in the comparative development of these parts occur in different genera. Thus in the thick-billed *Pitylus* the
P. Z. S. 1880, p. 146.
whole organ is much more strongly developed than in the more slender-billed genera *Tanagra*, *Calliste*, &c. Why the genera *Euphonia* and *Chlorophonia* alone, as far as it is yet known, of birds should present this structure is an as yet unsolved problem; I believe they differ in no appreciable degree from other Tanagers in food † or habits. I may also remark that in such genera as *Cœreba* and *Æthopyga*, feeding chiefly on minute insects and juices of flowers, there is a well-marked gizzard, with muscular walls and hardened epithelium.

Subjoined is a list of all those species of Tanagers, 27 in number belonging to 11 genera, in which the condition of the stomach is as yet known. This includes the species mentioned by Lund (L.), as well as those examined by the late Prof. Garrod (A. H. G.) and myself, and the nomenclature is that of the 'Nomenclator,' Mr. Sclater having kindly reduced Lund's names to the terms of that list for me.

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* In confirmation of the above-mentioned view being correct, I may notice that neither Owen (Anat. Vert. ii. p. 106) nor Gadow (Jen. Zeitschr. B. xiii. p. 168, 1879), when mentioning the stomach of *Euphonia*, describe any lateral diverticulum. Prof. Garrod, in his MS., notes of *Euphonia violacea*, with characteristic terseness, "No stomach specialized, the intestines apparently continuing from the œsophagus."

† Several of the wild specimens of *Euphonia* that I have dissected have had in their intestines a large number of small round reddish seeds, which are probably, Mr. Salvin tells me, those of a climbing species of *Ficus* common in the Central-American forests.

Tanagers with a normal stomach.

Calliste tricolor (L. & W. A. F.).
—— *festiva* (L. & A. H. G.).
—— *cyaneiventris* (L.).
—— *thoracica* (L.).
—— *melanonota* (L.).
—— *nigriviridis* (W. A. F.).
Tanagra episcopus (L.).
—— *ornata* (L.).
—— *abbas* (W. A. F.).
—— *sayaca* (W. A. F. & A. H. G.).
—— *palmarum* (L. & A. H. G.).
Rhamphocœlus brasilius (L.).
—— *jacapa* (W. A. F.).
Pyranga erythromelæna (W. A. F.).
Trichothraupis quadricolor (L.).
Tachyphonus melaleucus (W. A. F.).
—— *cristatus* (L.).
—— *coronatus* (L.).
Saltator magnus (L.).
Cissopis leveriana (W. A. F.).
Pitylus fuliginosus (W. A. F.).

Two other species not named by Lund.

Tanagers with the stomach abnormal.

Chlorophonia viridis (W. A. F.).
Euphonia chlorotica (L.).
—— *trinitatis* (W. A. F.).
—— *violacea* (L., A. H. G., & W. A. F.).
—— *rufiventris* (L.).
—— *pectoralis* (W. A. F.).

Pipridea melanonota is mentioned by Lund (under the name *Tanagra vittata*) as one of the species with a normal stomach. On the other hand, according to M. Taczanowski (P. Z. S. 1879, p. 226), Stolzmann found in this bird "la poche stomacale rudimentaire," and consequently considers that it is nearly allied to the *Euphoniæ*. It is to be hoped that we shall know ere long which of these statements is correct. It would be also highly desirable to ascertain the structure of the stomach in the other genera placed near to *Euphonia*, particularly that of the genus *Procnias*. I propose on some future occasion to publish a supplementary list describing the condition of the stomach in any other forms that I may have an opportunity of examining.

P. Z. S. 1880, p. 147.

P. Z. S. 1880, p. 380.

25. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—Part II. ON THE SYRINX AND OTHER POINTS IN THE ANATOMY OF THE *EURYLÆMIDÆ*.*

The true position of the Broadbills or Eurylæmidæ in the series of birds, and particularly the question as to their passerine or non-passerine affinities, has long been in question amongst systematic ornithologists†. That more intimate knowledge of their structure from which alone any true answer to this question could be given, has been likewise gradually accumulating for many years.

P. Z. S. 1880, p. 381.

Nitzsch, in his great work on Pterylography, published posthumously in 1840, showed that the species examined by him possessed a characteristically Passerine pterylosis‡. Johannes Müller, in 1846, in his classical memoir on the vocal organs of Passeres§, remarked that in *Corydon sumatranus*, the only species of this group examined by him, there were "no muscular fibres on the larynx." Blanchard, in 1859||, showed that *Eurylæmus javanicus* agreed in its sternal characters with other Passeres, and particularly compared it with the Swallows in this respect.

Mr. Sclater¶, in 1872, figured the sternum of *Cymbirhynchus macrorhynchus* (under the name of *Eurylæmus javanicus*; *cf.* Lord Walden, *l. c.* p. 370), and stated that in his opinion these birds were truly Passerine.

Prof. Garrod**, in 1877, was enabled, by an examination of dry skins

* Proc. Zool. Soc. 1880, pp. 380–386. Read May 4, 1880.

† For a succinct résumé of the opinions of ornithologists on this point, see Mr. Sclater's paper in the 'Ibis,' quoted below.

‡ Ray Soc. ed., pp. 76, 77. These were *Corydon sumatranus, Calyptomena viridis, Eurylæmus javanicus* and *E. ochromelas*, and *Cymbirhynchus macrorhynchus*. In the three last named Nitzsch describes *nine* of the remiges as situated "on the hand;" in all the specimens of this group I have examined, I find there are *ten* primaries (*cf.* also Wallace, Ibis, 1874, p. 406, and Sundevall, Tentamen, p. 61). An examination of the pterylosis in my spirit-specimens has also convinced me of the partial inaccuracy of Nitzsch's figure of that of *Cymbirhynchus* (pl. iii. fig. 15). The lumbar saddle is here represented as too angular, and the inclosed space, as well as the antero-lateral tracts bounding it, too broad. The postero-lateral tracts also are represented as consisting of but a single row of feathers. In reality, in this species there is a large ephippial space, of an elongated oval shape, the whole shape of the saddle being more like that represented by Nitzsch in *Cephalopterus* (*l. c.* fig. 10). The tracts behind are *two* feathers broad. In *Calpytomena*, judging from skins, there is an acutely-angled rhombic saddle, whilst in *Eurylæmus* the condition is intermediate.

I may add that in *E. ochromelas* and *Cymbirhynchus* the neck-feathering of the lower surface is uninterrupted till behind the middle, and that the throat is entirely feather-clad, with no naked symphysial space.

§ Garrod's edition, p. 27.

|| Ann. Sci. Nat. (4) Zool. vol. xi. p. 92.

¶ Ibis, 1872, p. 177, &c.

** P. Z. S. 1877, p. 447.

of *Cymbirhynchus*, *Calyptomena*, and *Eurylæmus ochromelas*, to show that these species differed singularly from all other Passeres yet examined in that in them the tendon of the *flexor longus hallucis* sends a strong vinculum to the tendon of the *flexor digitorum profundus*, as in nearly all other non-passerine birds in which a hallux is developed. He also showed at the same time that in these species the palate was truly Passerine, and proposed to divide the order Passeres "into two sections to start with, those with the hallux not free (the Eurylæmidæ), and those with the hallux independently movable." The following year he was able to add to this account some facts in the anatomy of two other species, *Psarisomus dalhousiæ* and *Serilophus rubropygius*. These facts included the typical Passerine arrangement of the tendon of the *tensor patagii brevis* (P. Z. S. 1876, p. 508), the presence of the left carotid only, the normal disposition of the vessels of the thigh, the presence of the femoro-caudal, semitendinosus and accessory semitendinosus, and the absence of the ambiens and accessory femoro-caudal muscles. He also called attention to the unforked condition of the sternum in *Psarisomus*, this feature resembling that figured previously by Mr. Sclater in *Cymbirhynchus*. P. Z. S. 1880, p. 382.

Having lately, through the kindness of Mr. Edward Gerrard, jun., become the possessor of a specimen each of *Cymbirhynchus macrorhynchus* and *Eurylæmus ochromelas* from Sarawak, excellently preserved in spirits, I am in the position to supplement the above-mentioned facts in our knowledge of the anatomy of the *Eurylæmidæ* by describing the syrinx and alimentary canal, previously hardly known at all in this group, in these two species, as well as of confirming or modifying previously published statements.

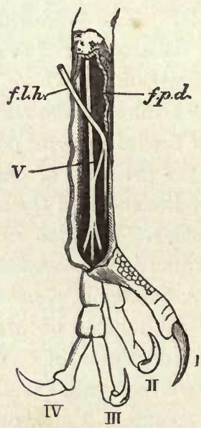
As regards osteology, the only point I wish to record is the unforked condition of the *manubrium sterni* in both species. In this respect they resemble the condition present in *Psarisomus*, as already noticed by Prof. Garrod. As this feature appears equally in Mr. Sclater's figure of *Cymbirhynchus* above alluded to, as well as in a specimen of the sternum of that bird in the College of Surgeons, and in Mr. Eyton's figure of *Corydon sumatranus* (Osteol. Av. pl. 8. fig. 5), it seems probable that it is a regular character of this family of Passeres, though in other families of that group it seems to be an individual or specific characteristic.

Both the species under discussion agree entirely with *Psarisomus* and *Serilophus* in the points already noted by Prof. Garrod. I may add that the *pectoralis primus* is large, as is also the *pectoralis secundus*, this muscle extending to the end of the sternum, or thereabouts. As in other Passeres, the *biceps*-slip to the patagium and the *expansor secundariorum* are absent. The *semimembranosus* is slender, but muscular. The *gluteus primus* is large, covering the *biceps*; and the *obturator internus* is elongatedly oval. As will be seen in fig. 1 (p. 140), in *Cymbirhynchus* the vinculum in the deep plantar tendons is strong, and has the character of a firm round tendon, P. Z. S. 1880, p. 383.

instead of being composed of more or less transversely-directed fibres running between the two tendons, as in many birds where this structure obtains. In *Eurylæmus ochromelas* it is apparently double, there being a second additional slip given off lower down from the hallux-tendon, which joins the tendon of the digital flexor at the point where the latter, splitting up into three, receives the main vinculum.

P. Z. S. 1880, p. 382.

Fig. 1.



Left foot of *Cymbirhynchus macrorhynchus*, viewed from behind, to show the deep plantar tendons, and the vinculum (*v.*), which the *flexor longus hallucis* (*f. l. h.*) sends to the tendon of the *flexor profundus digitorum.* The skin has been turned aside, and the superficial flexors removed; the *flexor longus hallucis* has been cut short above and displaced.

P. Z. S. 1880, p. 383.

As regards the alimentary canal of these birds, there is nothing unusual in its conformation. The tongue is elongatedly cordate, and slightly bifid at the tip. Both it and the palate generally are smooth; along its posterior sides it is provided, as is frequently the case, with about eighteen small, backwardly directed, spiny processes, that at the angle being much larger than the others. There is no crop developed; and the *proventriculus* is zonary: in *Cymbirhynchus* it is $\frac{3}{8}$, in *E. ochromelas* $\frac{1}{4}$ inch in vertical depth. The stomach has the character of a not very muscular gizzard, and is lined with hardened brown epithelium; the left lobe of the liver is the smallest (considerably). The cæca are present, as might have been predicted from the *nude* oil-gland*, and are truly Passerine in nature, being mere nipples $\frac{1}{8}$, or, in the smaller species, $\frac{1}{10}$ inch long. The following are the intestinal measurements:—

Cymbirhynchus.	Small intestine $7\frac{3}{4}$ in.,	large intestine $1\frac{1}{4}$,	total	9 in.
E. ochromelas.	,, $5\frac{3}{4}$,,	,, $\frac{3}{4}$,	,,	$6\frac{1}{2}$ in.

* *Cf.* Garrod, P. Z. S. 1874, p. 119.

The nature of the *syrinx* was the most interesting question to be examined in these specimens, Müller's short allusion to that of *Corydon*, quoted above, being all that was known as regards its structure.

In *Eurylæmus ochromelas* the syrinx is less specialized, as regards its cartilaginous constituents, than in *Cymbirhynchus*, and will therefore here be described first.

The tracheal rings have their usual complete form, being notched before and behind to varying extents, and separated only by narrow intervals. The strong *sterno-tracheales*, the only extrinsic syringeal muscles, are inserted on the last ring but five. Only the last two tracheal rings are modified. The penultimate ring is narrowed and slightly produced downwards in front; the last is also narrow, and closely apposed to the penultimate, the membranous interval between the two being very much reduced, except in the middle line in front, where it is well developed, the last ring being here notched above. Behind, the ultimate and penultimate rings are united by a vertically disposed median bar. The last ring forms a three-way piece, there being a forwardly-directed narrow *pessulus* developed from its hinder margin below. The *pessulus* is apparently membranous, in this specimen at least, except at its base. The first bronchial semirings are still narrower than the last tracheal one and strongly arched, being concave downwards. They are separated by a very slight interval indeed from the last tracheal ring (three-way piece), and are nearly in contact with each other in front in the middle line; behind they are inturned and somewhat thickened. To the *middle of each ring*, or a little posteriorly to this point, is attached the lateral tracheal muscle, which is extremely slender and hardly visible when dry. The

P. Z. S. 1880, p. 384.

Fig. 2.

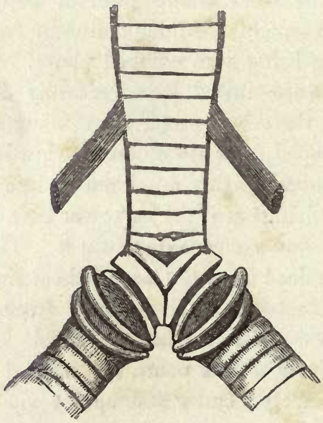
Syrinx of *Eurylæmus ochromelas*, × 5, viewed from in front. *p*, the "pseudo-ring."

second bronchial semirings are shorter than either the first or third; they are slightly deeper than the first pair, but are narrowed behind. Being only slightly concave downwards, a considerable membrane-covered fenestra is left between them and the first pair. What at first looks like a bronchial semiring is interposed between what are here described as the first and second of that category. This pseudo-ring is most evident in front (*vide* fig. 2), but is also visible when dry behind; it is apparently due to the accumulation of tissue inside, forming the outer boundary of each glottis. The third and fourth rings are slightly concave upwards: they are deeper, especially behind, thinning away towards the front, than those that preceded them. The fifth and other succeeding rings are typical, unmodified bronchial rings, which more and more encroach upon the *membrana tympaniformis*, and eventually almost overlap behind. The second and succeeding semirings are more or less incompletely ossified at their ends.

In *Cymbirhynchus macrorhynchus* (figs. 3–5), the syrinx is constructed

P. Z. S. 1880, p. 385.

Fig. 3.



Syrinx of *Cymbirhynchus*, viewed from in front, × 5.

Fig. 4.

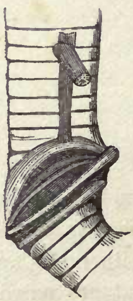


Fig. 5.

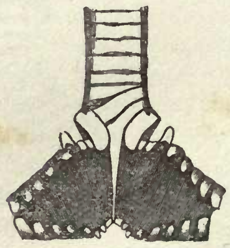


Fig. 4. The same, × 5, from the side, to show the insertion of the intrinsic syringeal muscle into the *middle* of the first bronchial semiring. The *sternotrachealis* is cut short.

Fig. 5. The same, × 5, from behind, to show the pessulus.

on essentially the same plan, with some modifications. The trachea, below the insertion of the extrinsic muscles (on the last ring but six), appears to be somewhat laterally compressed and diminished in size. In the specimen before me the last few tracheal rings are somewhat irregular in their disposition, which may or may not be due to individual variation. The antepenultimate ring is apparently incomplete on the right side, or is at least exceedingly reduced (*vide* fig. 5). The penultimate ring is narrowed, and is closely apposed to the terminal ring throughout except in front, where there is a well-marked subtriangular fenestra. The last tracheal ring is produced downwards in front, but is apparently incomplete on the left side in front; so that there the penultimate ring is next to the first semiring, in consequence of this disposition. The *pessulus* is a well-marked, forwardly-directed linear process, formed only by the right half of the last tracheal ring, which is thus, like the antepenultimate, incomplete for a part of its course. The first bronchial semirings are much thickened and strongly arched; they are nearly in contact in front in the middle line, and are separated by but a narrow space from the last tracheal ring; behind they become incurved and thickened. The second bronchial semiring is the slenderest of all; it is shorter than the first or third, and slightly concave downwards. There is the same pseudo-ring formed, apparently by accumulation of tissue inside, between it and the first semiring as already described in *Eurylæmus*, but it is not so apparent here. The third semiring is much longer, being the longest of all the semirings, and in consequence projecting at both extremities. It is nearly straight, narrow, but not so narrow as the second ring, dilated behind and tapering slightly towards the front. The first, second, and third semirings of each side are nearly in contact with each other before and behind. The fourth ring has much the same shape as the third, but is slightly shorter, and more concave upwards than that one. The intervals between the second and third and third and fourth rings are somewhat deeper than are the rings themselves. The fifth and succeeding rings take on the usual form of bronchial semirings, gradually becoming more complete. As in *Eurylæmus*, the single intrinsic tracheal muscle, which is very slender, is inserted slightly behind the middle of the first bronchial semiring.

P. Z. S. 1880, p. 384.

P. Z. S. 1880, p. 385.

P. Z. S. 1880, p. 386.

The Eurylæmidæ are therefore, as is evident from this description, Mesomyodian*, in that respect agreeing with most of the other "Formicarioid" Passeres of Wallace (Ibis, 1874, p. 406). It is probable that the existence of an intrinsic muscle in the syrinx of *Corydon sumatranus* escaped the notice of Johannes Müller—always supposing that in that species the same essential form of syrinx occurs as in those above described—owing to its slenderness. They are *not* Tracheophone; and

* Garrod, P. Z. S. 1876, p. 517.

in that they possess the sciatic, instead of the femoral artery*, they differ from the Pipridæ and Cotingidæ, with which they have so often been associated. From these, too, they differ, as they do from the Tyrannidæ, Pittidæ, and *Rupicola*, in the details of their syrinx as well as in the simple manubrium sterni and other points. As has already been stated, they differ from all the other Passeres in the retention of a vinculum in the deep flexor tendons of the foot. To the general bearing of these facts on the classification of the Passeres, I hope to return on some future occasion.

P. Z. S. 1880, p. 387.

26. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—PART III. ON SOME POINTS IN THE STRUCTURE OF *PHILEPITTA*, AND ITS POSITION AMONGST THE PASSERES.†

THE doubt which has hitherto prevailed amongst ornithologists as to the true affinities of the very singular Malagash bird for which Geoffroy founded his genus *Philepitta* ‡, makes a knowledge of its anatomy, and particularly of its osteology and syrinx, a desideratum. Its original describer considered this genus most nearly related to *Philedon*. Bonaparte, in his 'Conspectus' §, referred *Philepitta* with some doubt to the Starlings (Sturnidæ), placing it near *Dilophus*. The late Mr. Gray, in his Hand-list ‖, made it a genus of Pittidæ, *Pitta* being the only other genus of that family recognized by him.

Mr. Sharpe in 1870 ¶ suggested that it ought to be regarded as an aberrant genus of the Paradiseidæ, forming a subfamily which he proposed to call Philepittinæ.

That neither this position nor those assigned to it by Geoffroy or by Bonaparte can be accepted is evident from the fact that, as shown by Sundevall **, *Philepitta* possesses a long 10th ("first" ††) primary, at the same time that the tarsus is *not* bilaminate. The Swedish naturalist last mentioned made his subfamily Paictinæ (he having rechristened *Philepitta Paictes*) the first in the fifth cohort, "*Taxaspideæ*," of his "*Oscines Scutelliplantares*," the others being the Thamnophilinæ, Myrmornithinæ, Hypsibæmoninæ, and Scytalopodinæ, in which last *Menura* was also

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* *Cf.* Garrod, P. Z. S. 1876, p. 516.

† Proc. Zool. Soc. 1880, pp. 387–391. Read May 4, 1880.

‡ Mag. Zool., Ois. pl. 3 (1839).

§ *Op. cit.* p. 422.

‖ *Op. cit.* i. p. 297, gen. no. 1094.

¶ P. Z. S. 1870, p. 397.

** Tentamen, p. 63.

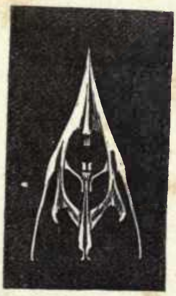
†† See P. Z. S. 1879, p. 256, note.

included—a striking illustration of the unsatisfactory results that a classification founded on external characters only always leads to.

More recently, M. Alphonse Milne-Edwards has figured the two known species of *Philepitta*, as well as the tongue and osteology of *P. castanea*, in Grandidier's magnificent work on Madagascar *. In this work (the plates only of the part in question having been issued) he places it next to the Nectariniidæ, apparently on account of the eye-wattle of the male and the bifid tongue approximating it to such a form of that group as *Neodrepanis*. Having written to M. Milne-Edwards to ask if he had examined the syrinx or other soft parts of the bird under discussion, he was kind enough to reply by sending me the viscera, including the trachea &c., of a specimen (in all probability *P. castanea*), and by generously granting me permission to make any use of them I liked. He also informs me that in the text to the plates he has fully described the osteology.

As regards this part of the structure of *Philepitta*, I only wish to remark on and give a figure of the palate, extracted from a skin of *P. castanea* by Prof. Garrod, M. Milne-Edwards's figure of this (pl. 112. fig. 2 *a*) being rather indistinct in some important points. As will at once be seen, the vomer is truly Passerine, being split behind and trun- P. Z. S. 1880, p. 388.

Fig. 1.



Palate of *Philepitta castanea* (nat. size).

cated in front; to its outer and anterior angles are articulated two small nodules of bone, probably corresponding to the "septo-maxillaries" of Prof. Parker. The maxillo-palatines are slender, long, recurved apically, and pointed backwards; the transpalatines are distinct and slightly curved inwardly, and the palatines tend to diverge behind. In *Pitta* (*cyanura*) the vomer is proportionally broader, the maxillo-palatines are much shorter and broader and more transversely directed, and the pala-

* Hist. Phys. Nat. et Polit. de Madagascar, tome iii. Oiseaux, Atlas ii. 1re partie, pls. 109–112.

tines are nearly parallel to each other throughout *. In the Eurylæmidæ † the maxillo-palatines, though slender, are nearly transverse to the axis of the skull, and the "transpalatines" tend to become obsolete.

Judging from M. Milne-Edwards's figure (*l. c.* pl. 112. fig. 3), the manubrium sterni is but slightly bifid, therein approaching that of the Eurylæmidæ.

As regards other points, in its pterylosis *Philepitta*, which was one of the few important forms unexamined by Nitzsch, is perfectly Passerine. There is a longish oval ephippial saddle, with a large space, much as in some of the Eurylæmidæ (*vide suprà*, p. 138); in *Pitta*, according to Nitzsch, the saddle is undivided. But *Philepitta* differs from the Eurylæmidæ, and agrees with all other Passeres, in the absence of any vinculum in the deep plantar tendons, as was ascertained by Prof. Garrod from the examination of a skin, and recorded by him in MS.

P. Z. S. 1880, p. 389. As regards the alimentary canal, there is nothing peculiar. The tongue, in the specimen forwarded from Paris, was removed; but, as we know from M. Milne-Edwards's figure, it is triangular and bifid at the end. There is no crop developed; and the zonary proventriculus is half an inch deep. The stomach is a strong gizzard, rather elongated in shape, with thick and considerably plicated epithelium. The liver is unequilobed, the left lobe being half the size of the right; it has a gall-bladder. The total length of the intestines is seven inches, of which the last half-inch is large intestine. The cæca are truly passerine, being mere nipples, and rather widely separated.

The syrinx of *Philepitta* being hitherto entirely unknown, I herewith give a description and figures of it.

Fig. 2.

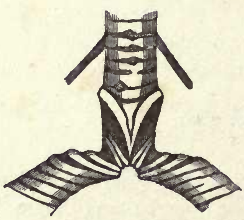


Fig. 3

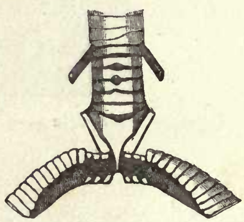


Fig. 4.

Fig. 2. Syrinx of *Philepitta*, from before. Fig. 3. The same, from behind. Fig. 4. The same, from the right side. (These figures are magnified about 4 times.)

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* *Cf.* Prof. Parker's fig. of *Pitta melanocephala*, Trans. Zool. Soc. ix. pl. lvi. figs. 6, 7. In this species the "transpalatine" processes are far less developed than in *P. cyanura*.

† Figures of the palates of *Eurylæmus ochromelas* and *Calyptomena viridis* are given in Prof. Garrod's paper, P. Z. S. 1877, p. 449.

The trachea is slightly laterally compressed below; the rings, which are complete, are somewhat irregular in shape, owing to the greater or less development of the notchings on their borders. In front, of the last few rings preceding the terminal one, two or more are joined together by vertically directed bars, which makes it difficult to count their number with exactitude. Behind, however, they are all free. The terminal tracheal ring is narrow laterally, and closely opposed to the first bronchial semirings; in front and behind it is produced downwards triangularly, and behind bears a well-developed forwardly directed narrow pessulus. As seen from behind, therefore, the terminal tracheal ring has somewhat the shape of an arrow-head. The narrow sterno-tracheales are inserted on about the last ring but six. The first bronchial semirings are thickened, and very much arched, being concave downwards. As seen from the side (fig. 4) they are more strongly convex anteriorly than posteriorly. The second and third semirings are very slender indeed, closely approximate, much shorter and much less concave downward, so that a large membranous fenestra is left between them and the first semirings. The fourth and fifth semirings are also slender, but less so than the last two: they are slightly concave *upwards*, so that a second, though shallower, fenestra is formed between them and the second and third pairs. The fifth semirings are slightly dilated at their extremities, where they are in close proximity, before and behind, with the first four pairs. The sixth and succeeding bronchial rings take on the ordinary character, being deeper than those that precede them, and gradually becoming more complete, till the fifteenth pair are nearly perfect. On one side, the left, in this specimen, the eighth and ninth semirings are partially fused externally.

P. Z. S. 1880, p. 390.

The lateral muscles of the trachea, after the insertion of the sterno-tracheales, become excessively thin, so that it is difficult to make out accurately their exact extent. They apparently fan out, so as to be nearly in contact with each other before and behind, and are inserted on to the first bronchial semirings for the greater part (as far as I can make out) of their *lateral* surface, the *tips*, however, being quite free from muscular fibres.

Philepitta is therefore perfectly Mesomyodian, as Prof. Garrod predicted would probably be the case *.

There are thus three families of Mesomyodian Passeres in the Old World—the Pittidæ, the Philepittidæ, and the Eurylæmidæ. All agree in the possession of a broncho-tracheal syrinx, in that respect agreeing with the Cotingidæ (including *Rupicola*), Pipridæ, and Tyrannidæ of the New World, and differing from the Tracheophone families, which are all, as is well known, American. *Philepitta* differs in the details of its

* Voice-organs of Passeres, p. 68.

syrinx from all the other "Haploophone" Passeres. In *Pitta* (*cf.* P. Z. S. 1876, pl. 53. figs. 1–6) the bronchial semirings are much less modified, being nearly entirely simple semirings; the lateral muscle, too, is slender and not spread out as in *Philepitta*. This fact, taken with others, as the scutellation of the tarsi, osteology, &c., justifies, in my mind, the establishment, as has been done by Sundevall under the name Paictidæ, of a separate family for the bird under consideration *. The Eurylæmidæ differ in their retention of a plantar vinculum (*cf.* Garrod, P. Z. S. 1877, and *suprà*, p. 139), as well as in the structure of their feet and other points. In the form of their syrinx, however, they approach *Philepitta* perhaps more nearly than any form yet described, though in them too the lateral muscle remains slender and unexpanded. The peculiarities of the Eurylæmidæ, and especially their oft-spoken-of retention of the plantar vinculum, are sufficient, I think, to justify their forming a main division of Passeres by themselves, as suggested by Prof. Garrod †, which may be termed Desmodactyli in distinction from the other or Eleutherodactyli. Prof. Garrod's arrangement of Passeres ‡ may therefore be modified as follows:—

P. Z. S. 1880, p. 391.

		New World.	Old World.
PASSERES.	i. DESMODACTYLI. (The plantar vinculum retained; manubrium sterni not forked.)		*Eurylæmidæ.*
	ii. ELEUTHERODACTYLI. (The plantar vinculum lost; manubrium generally strongly forked.)		
	A. **Mesomyodi.**		
	Heteromeri.	*Pipridæ.* *Cotingidæ.*	
	Homœomeri §.		
	Haploophonæ.	*Tyrannidæ.* *Rupicola.*	*Philepittidæ.* *Pittidæ.*
	Tracheophonæ.	*Dendrocolaptidæ.* *Furnariidæ.* *Pteroptochidæ.*	
	B. **Acromyodi.**		Abnormales. *Atrichiidæ.* *Menuridæ.*
			Normales.

* The general myology and vascular system of *Philepitta* are still, it must be remembered, unknown, but are in all probability perfectly Passerine.

† Voice-organs of Passeres, p. 73, and P. Z. S. 1877, p. 449.

‡ P. Z. S. 1876, p. 518.

§ I place *Philepitta* only provisionally amongst the Homœomeri, presuming that, as in all Passeres but the Pipridæ and Cotingidæ (minus *Rupicola*), the artery of the leg is sciatic.

Till more material has been examined, it is impossible to say whether or not some of the points in the above classification fairly express the affinities of the various groups treated of. This appears to me particularly the case as regards the primary division of the Mesomyodi into Hetero- and Homœomeri, depending as it does on the presence of the femoral or the sciatic artery respectively.

The pseudo-schizorhinal character of the skull also in some of the Tracheophonæ* may necessitate an ultimate arrangement of that group different from that here adopted (taken from Messrs. Sclater and Salvin's 'Nomenclator').

As regards the Passeres whose anatomy still remains unknown, the forms that most require examination are *Phytotoma* † and *Oxyrhamphus* of the New, and *Orthonyx* and *Melampitta* of the Old World. The last may be, as suggested by Mr. Gould ‡, a link between *Pitta* and *Philepitta*; Count Salvadori §, on the other hand, is inclined to regard it as a Timeliine and therefore a normal (Oscinine) Acromyodian form. It is also highly desirable to obtain some knowledge of the soft parts of some of the larger forms usually placed amongst the Cotingidæ, especially *Ptilochloris* and *Phœnicocercus* (placed by Sundevall with *Rupicola*), as well as of *Gymnoderus*, *Querula*, *Cephalopterus*, &c.

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27. ON THE ANATOMY OF *LEPTOSOMA DISCOLOR*.‖

P. Z. S. 1880, p. 465.

It is to the liberality of my friend Prof. A. Newton that I am indebted for the opportunity of dissecting a female example of this bird, the most peculiar, perhaps, with the exception of *Mesites*, of all the anomalous forms that Madagascar produces. Till the past year or two our knowledge of the structure of *Leptosoma* was almost confined to its skin and certain parts of its skeleton.

Mr. Sclater, in this Society's 'Proceedings' (1865, pp. 682–689; also in Nitzsch's 'Pterylography,' Ray Soc. ed. App. ii. p. 158), has already given us an account of the different views that have at various times been held by ornithologists as to the position of this peculiar form; and he was also the first to point out the existence in it of powder-down patches, as well as other of its peculiarities. Since then I am unaware

P. S. Z. 1880, p. 466.

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* *Cf.* Garrod, P. Z. S. 1877, p. 452, &c.

† Very imperfectly described by Eyton and Eydoux and Souleyet, *cf.* Joh. Müller, Stimmorgane, &c., p. 8.

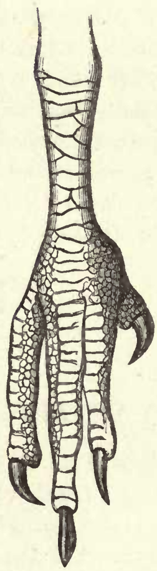
‡ B. New Guinea, pt. ii. (1876).

§ Ann. Mus. Civ. Gen. x. p. 147.

‖ Proc. Zool. Soc. 1880, pp. 464–475. Read June 15, 1880.

of any thing more having been done to elucidate its structure till 1878. In M. Grandidier's magnificent work on Madagascar*, in the plates of the Atlas devoted to the birds, M. A. Milne-Edwards has figured the entire skeleton, together with separate views of the bones, as well as the tongue and alimentary canal, and has likewise given pictures of the bird when plucked, showing the external nares, the position and shape of the powder-down patches, and its naked oil-gland. In reply to my inquiries on the subject, M. Milne-Edwards kindly replied that he intended to describe in full the osteology of *Leptosoma*, together with that of *Atelornis*, *Brachypteracias*, &c., of which figures are given also in the

Fig. 1.



Right foot of *Leptosoma* (nat. size), seen from before, to show the disposition of the toes. (The fourth toe is slightly removed outwards, to better show its position.)

above-named work, in the text, but that, as regards other points, only an explanation of the plates was to be given. I have therefore thought it would be of interest to bring before the Society some additional notes on its pterylosis and soft parts, derived from my examination of Prof. Newton's specimen.

Before proceeding further, I should like to call attention to the structure of the feet in *Leptosoma*, which has already been accurately described by Mr. Sclater (*l. c.* p. 688). They are in no way "zygodactyle," in the sense in which that term is applied to the feet of such birds as the

* Hist. Phys. Nat. et Pol. Madag., Zool., Ois. pls. 85–88.

Cuckoos, Parrots, or Toucans. In this spirit-preserved specimen it is easily demonstrable that the fourth digit cannot naturally be placed in a really reversed position, like that of the above-named birds. While the second and third toes look directly backwards, the hallux looks inwards and forwards, and the fourth toe *inwards* and slightly *backwards* at its apex, there being, as it were, a slight twist in its axis*. However much the fourth toe is bent backwards (and this is only done by the exercise of some little force), its plantar surface always looks more or less inwards. The presently-to-be-described arrangement of the deep plantar tendons also confirms the view here taken as to *Leptosoma* not being a true zygodactyle bird.

P. Z. S. 1880, p. 467.

Pterylosis.—As regards *Leptosoma*, Nitzsch only noted the presence of an aftershaft and 12 rectrices, he only having been able to examine a stuffed specimen. Mr. Sclater, in his above-mentioned paper, besides describing the two characteristic lumbar powder-down patches of this bird, briefly alludes to the pterylosis, which "appears nearly similar to that assigned by Nitzsch to *Coracias* and *Eurystomus*." These features are diagrammatically represented in a woodcut (fig. 5, *l. c.*).

The following is a more detailed description:—

The inferior tract divides about 1 inch behind the junction of the rami of mandible—the (badly) so-called "chin-angle"—from which it starts as a narrow, single tract†. Between this tract and the mandibular rami, extending as far as the angle of the jaw, a narrow naked space is left; at this point the inferior tract becomes continuous with the feathering of the head above, so that here the neck, except for the narrow median ventral *apterium*, is continuously feathered. This continuous feathering extends downwards to about ⅜ inch above the shoulder, when, the inferior and dorsal tracts diverging, the lateral neck-space is formed. The inferior tracts diverge gradually as they approach the breast, and then run parallel to each other over the pectoral muscles and abdomen to the sides of the vent, leaving a rather wide bare carinal space, with a few scattered down-feathers. As the inferior tract emerges on the breast, it gives off a branch to the anterior margin of the *patagium*; and this at first is dilated somewhat, so that the space between it and the main tract is feathered. The broad humeral tract is also connected with the inferior tract where the latter gives off this patagial branch. In the lower part of the neck the inferior tract is about 8 feathers broad, on the breast

* This disposition of the fourth toe makes *Leptosoma*, at first sight, look as if it had three toes anteriorly directed, and no doubt accounts for Mr. Sharpe entirely omitting any notice of its peculiar feet in his paper on the Coraciidæ (*cf.* Ibis, 1871, pp. 187, 285).

† In *Coracias garrula* the naked median space left between the halves of the inferior tract extends quite up to the symphysis, so that the inferior tract is double from the commencement.

about 6, and on the abdomen only 2. About the middle of the sternum the outer pectoral tract, which is about 4 feathers wide and slightly stronger than the main tract, is given off; it is not very divergent, but is dilated terminally, and develops a recurrent hook, which, however, is not very distinct. There is a circlet of feathers round the vent, and a short tract of feathers behind it, on each side of the fleshy part of the tail, continuing the direction of, though quite separate from, the main inferior tract of its side.

P. Z. S. 1880, p. 468.

The feathering of the head is continuous, and from it the anterior moiety of the dorsal tract runs, being anteriorly continuous at the sides, as already noted, with the inferior tracts, along the dorsal median line of the neck, as a rather broad, thickly feathered band, which forms a strong interscapular fork, just as in *Coracias* and the Parrots, the ends of the fork lying about $\frac{1}{4}$ inch anterior to the posterior extremities of the two scapulæ. The posterior moiety has also a forked form, the two arms enclosing a fairly broad naked median space, and only uniting about 1 inch in front of the oil-gland, the united tract so formed ceasing altogether about $\frac{1}{4}$ inch in front of that organ. This posterior fork is very narrow anteriorly, not more than two feathers wide; indeed, for the first two or three rows each arm consists of only one feather in each row, and the two arms run in between the forks of the anterior moiety, just as in the Parrots, *Coracias*, and some other birds. Posteriorly the fork widens, and becomes connected closely with the scattered contour-feathers which are found outside it, over the space between the dorsal tract proper and the lumbar powder-down patches, so that on the rump the dorsal tract appears to consist of five or six rows of feathers on each side of the median line. There is a very strongly feathered and broad band of feathers over the knee, being the anterior end of the lumbar tract of its side; this tract is quite distinct from all others but the crural, which are much weaker and clothe the leg as far as the "ankle." The powder-down patches, one on each side, lie between the posterior portion of the dorsal tract and the lumbar tracts. They form elongated patches, extending forwards over the femur as far as the *sartorius* muscle, and backwards to within $\frac{1}{4}$ inch of the vent; their dorsal border is parallel to the dorsal tract, the ventral to the lumbar ones. On the inside of the skin they are conspicuous as dark grey patches, formed by the closely aggregated insertion of the feathers of which they are composed, these lying at a less angle with the skin than the contour-feathers. Nitzsch* has described the pterylosis in *Coracias garrula* and *C. indica*, with figures of that of the former, and in *Eurystomus gularis*. I have examined the first-named species in the flesh, and also a skin of *Atelornis crossleyi*. In all essential respects, as will be seen by a comparison of

* Pterylogr. (Ray Soc. ed. p. 89).

the above description with Nitzsch's figures of *Coracias garrula*, *Leptosoma* is essentially Coraciine, though it differs from all others of that group in its possession of powder-down patches*.

In the Cuculidæ the dorsal tract, though it divides between the shoulders, is perfectly continuous throughout, enclosing an elongated oval space (*vide* Nitzsch's figures of *Cuculus canorus* and *Centropus rufipennis*, *l. c.* pl. iv. figs. 12 & 14). In the Cuculidæ too, as is well known, the aftershaft is absent and there are but 10 rectrices. I may remark that in the possession of an *inter*scapular dorsal fork the Coraciidæ and *Leptosoma* form an exception to Prof. Garrod's generalization † that when "the dorsal tract develops a fork *between* the shoulder-blades a bird is homalogonatous." P.Z.S. 1880, p. 469.

Visceral Anatomy.—The mucous membrane of the palate and mouth is smooth throughout, except along the margins of the nasal aperture, where it develops three or four small blunt retroverted tubercle-like papillæ on each side, and also external to this on each side along a line parallel to the axis of the palatine bones, where there is a similar short row of small papillæ.

The tongue is tapering and elongated in shape; its length is $1\frac{1}{4}$ inch. The basal part, which alone is fleshy, and supported by the hyoid bones, is of a triangularly sagittate shape, about $\frac{1}{2}$ inch long, and provided at its postero-external agles with a few minute, blunt, retroverted papillæ; it is prolonged forwards into a horny lamina, which is strongly concave above and forms the greater part of the tongue; at its apex the part, which is of a slightly tapering shape, is apparently entire ‡. This tongue closely resembles that of *Coracias*, and differs from that of such of the Cuculidæ as I have examined in wanting the well-developed retroverted spines that are always present on the posterior part of the lateral margins in those birds §.

The œsophagus is capacious at first, but rapidly narrows; it develops no crop. The proventriculus is zonary, being $\frac{1}{2}$ inch deep. The stomach is globose and not strongly muscular: there is a distinct pyloric bulb in-

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* I may here mention that *Atelornis crossleyi* differs as regards its pterylosis but slightly from the Coraciine type. It has the same interrupted dorsal tract, each half having a furcate form; but here the interscapular fork is very short and narrow, and does *not* enclose the anterior part of the posterior fork, which has a long stem or "handle." There are the same strong lumbar tracts. Below, the outer pectoral tract, given off on the middle of the breast, is only indicated by an enlargement of the main tract, and is not at all free. There are no traces of powder-down patches.

† P. Z. S. 1878, p. 931.

‡ The tongue of *Leptosoma* has been figured by Mr. Sclater (*l. c.* p. 688), and also by M. A. Milne-Edwards (*l. s. c.* pl. 88. fig. 1).

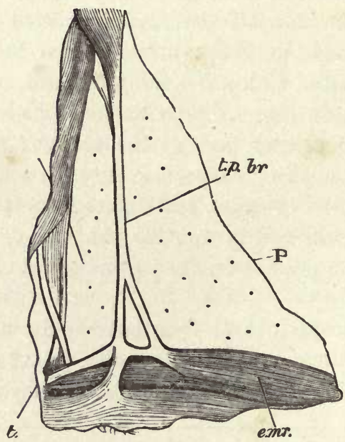
§ *Vide* also the figures of the tongues of *Coua gigas* (pl. 63. fig. 1) and *C. olivaceiceps* (pl. 64. figs. 1, 2) in Grandidier's work.

dicated externally at the commencement of the duodenum. Internally it is lined with rather soft epithelium, which is concentrically striated. In the present example the stomach contained hairs, apparently of lepidopterous larvæ, and the horny jaws and other hard parts of insects: many of the smaller hairs had become impacted in the soft lining of the stomach, so that this at first sight appeared to be villous. The same appearance has often been described in our common Cuckoo *.

P. Z. S. 1880, p. 470. The intestines in all measure 12½ inches, of which 2¾ are "large;" they are not markedly capacious. The cæca † are long and cylindrical in shape, largest apically, and slightly tapering towards their bases; they measure respectively 2¼ and 2¾ inches. The liver has the left lobe much the smallest; there is a distinct gall-bladder.

There is thus nothing striking or characteristic about the alimentary canal. In the possession of large cylindrical cæca, *Leptosoma* agrees with both Coraciidæ (including *Brachypteracias* and *Geobiastes*) and Cuculidæ, as also in most of the other points noted. In the Cuckoos, however, the gall-bladder is *said* to be absent as a rule ‡.

Fig. 2.



Wing-muscles of *Leptosoma*.

Termination of the *tensor patagii brevis* (*t.p.br.*) in *Leptosoma*. *e.m.r.*, the fleshy belly of the superficial layer of the *extensor metacarpi radialis longior* muscle; *t*, the tubercle on the humerus, whence it arises; above it the humerus. P, the *patagium*, its dorsal layer having been removed to show the muscles, &c.

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* *Cf.* Hunter's Essays and Observations, ii. p. 285 &c.

† Figured, with other parts of the intestinal canal, by M. Milne-Edwards, *l. c.* pl. 88.

‡ Owen, Anat. Vert. ii. p. 177. Gadow also states its absence in *Cuculus*. Hunter, on the other hand, found it, though "very small," in *C. canorus* (*l. s. c.* p. 285). According to the plates in Grandidier's work, *Coua gigas has* a gall-bladder (pl. 63); so has *Geobiastes squamigera* (pl. 99. fig. 2).

Myology, &c.—The first pectoral is big; the second extends at least halfway down the sternum; the third is not represented. There is no *biceps*-slip to the patagium, as is the case in all "Anomalogonatæ" except the Caprimulgidæ. In none of these points does *Leptosoma* differ from the Coraciidæ or Cuculidæ. The *expansor secundariorum* is present and well developed; its proximal end is T-shaped ("*ciconiiform*," Garrod), the sternal part of the tendon being attached to that bone at the junction of the costal process with the body near the coracoid groove; it therefore resembles the same muscle in the Coraciidæ. In no other birds amongst the Anomalogonatæ is this muscle present. In the Cuculidæ this muscle is present, but its terminal tendon is *not* T-shaped, the sternal moiety being undeveloped. P. Z. S. 1880, p. 471.

The arrangement of the termination of the *tensor patagii brevis* is represented in the accompanying figure (fig. 2, p. 154).

The main tendon (*t.p.br.*) runs on to the ulnar side of the arm, and there becomes fused with the fascia covering the muscles. Before doing so, however, it crosses the superficial tendon of origin of the *extensor metacarpi radialis longior* (*e.m.r.*), which springs from the humeral tubercle, and becomes firmly blended with it.

It likewise sends off, distally, a special slip of tendon which joins the same tendon of that muscle more externally (wristward). This is much the same arrangement as in the Coraciidæ, as described and figured by Prof. Garrod (P. Z. S. 1876, p. 511, pl. 49. fig. 1), except that in those birds the tendon of the *tensor patagii brevis* is split into two quite separate halves; if these were united together, an arrangement would be arrived at practically identical with that of *Leptosoma*. In the Cuculidæ the condition of things is quite different, as in them the "undivided tendon runs on to the ulnar superficial fascia without auy complication" (*l. c.* p. 512).

Of the leg-muscles, the *gluteus primus* is present, though small, only slightly overlapping the *biceps*, and with its fleshy part not reaching the innominate, to which it is attached only by fascia. The *ambiens* is absent; the *femoro-caudal* is very large, but lacks the accessory head, as in all Anomalogonatæ. Both the *semitendinosus* and its accessory are well developed, as is the *semimembranosus*. The *biceps cruris*, as usual, passes through a tendinous loop. The *obturator externus* is well developed, and the *obturator internus* is of a very elongated oval shape. The formula of *Leptosoma* is therefore — . A . X . Y, exactly the same as that of the Coraciidæ and the greater number of Anomalogonatous birds. In the Cuculidæ the ambiens is *always* present and well developed, and the *accessory femoro-caudal* usually so *, giving a formula of + . A . B . X . Y.

* It is absent only in *Cuculus*, *Chrysococcyx*, and *Cacomantis*. [Garrod's MSS.]

Leptosoma is therefore clearly *not* Cuculine. In the Cuculidæ, too, the *obturator internus* is triangular in shape, as in the Gallinæ and their allies; in *Leptosoma*, as already stated, as in *Coracias*, it is oval.

The anomalous arrangement of the toes in *Leptosoma* made me very anxious to observe the disposition of its deep plantar tendons, these, in all "zygodactyle" Anomalogonatous birds, being arranged in a manner quite unique amongst birds and entirely different from that which obtains in the even-toed *Homalogonatous* birds (*i. e.* the Psittaci, Cuculidæ, and Musophagidæ) *.

But in *Leptosoma neither* of these conditions occurs; on the contrary, the disposition of its plantar tendons is exactly that found in many birds P. Z. S. 1880, p. 472. with feet of the ordinary structure. This condition is diagrammatically represented in fig. 3; as will there be seen, the tendon of the *flexor longus hallucis* (*f.l.h.*) joins the tendon of the *flexor profundus digitorum* (*f.p.d.*) *on the outer side*, some little way above the phalanges, and completely *blends* with it. From the single compound tendon so formed the small slip to the hallux is given off, on the *inner* side, just before the common tendon splits up for distribution to the three other digits. This is exactly the same condition as that found by Prof. Garrod in *Coracias garrula*, and by myself in *Atelornis crossleyi* (in a skin).

It differs completely from that found in the Psittacidæ, Cuculidæ, and Musophagidæ on the one hand, and that of the Galbulidæ, Bucconidæ,

Fig. 3.

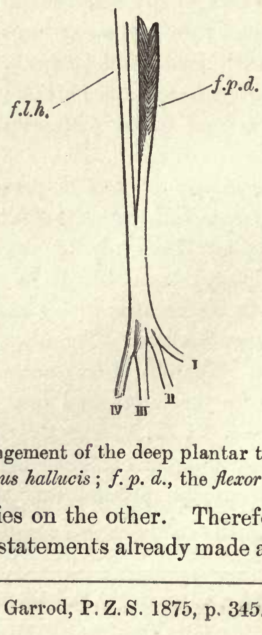

Diagram of the arrangement of the deep plantar tendons in *Leptosoma*.
f. l. h., the *flexor longus hallucis*; *f. p. d.*, the *flexor profundus digitorum*.

and Picidæ and their allies on the other. Therefore this fact, when taken in conjunction with the statements already made as to the natural position

* *Vide* Garrod, P. Z. S. 1875, p. 345.

of the fourth digit in *Leptosoma*, shows that there are no real grounds for calling *Leptosoma* a " zygodactyle " bird *.

As regards other points, it may be mentioned that the vessels and nerves of the thigh are normal; that is to say, the sciatic nerve and artery and the femoral vein are all present in their normal position.

There are *two* carotid arteries present, both of them being unusually small, the left particularly so. They run up in the usual converging way, springing from the vertebral arteries into the hypapophysial canal of the neck, and there become so closely applied to each other that it is impossible to dissect them away as can usually be done in birds. As far as I can make out, they do not, however, fuse, but are continued up to the head and there diverge. In *Opisthocomus* † Prof. Garrod found a somewhat similar condition, though he says nothing about the vessels being minute. In *Leptosoma* they have the appearance of white fibrous cords, and they may *possibly* be, like the carotids of *Bucorvus* ‡, no longer functional as blood-channels. But satisfactorily to decide this, as well as the ultimate termination of these carotids, fresh or injected specimens will be necessary.

P. Z. S. 1880, p. 473.

In both the Cuculidæ and Coraciidæ there are two equisized carotids, which are as free as usual.

As regards the vocal organs, there are present but one pair of extrinsic muscles, which diverge to be attached to the " costal processes " of the sternum. The syrinx possesses a single pair of intrinsic muscles, as

Fig. 4.

Fig. 5.

Fig. 4. The syrinx of *Leptosoma* seen from in front, the muscles of the *left* side having been removed.

Fig. 5. The same, from behind. (Both are twice the natural size.)

usual. This organ having been previously unknown in *Leptosoma*, I here take the opportunity of describing and figuring it.

The tracheal rings, which, as usual, interlock with each other for the

* In *Podargus cuvieri*, where the outer toe is reversed in perching, and in *Colius*, where the toes are directed at various times in very different ways, the "same blended" distribution of the deep plantar tendons obtains.

† P. Z. S. 1879, p. 112.

‡ *Vide* Mr. Ottley's paper on this bird, P. Z. S. 1879, pp. 461–467.

greater length of the trachea, are well ossified, and only separated by narrow intervals. They gradually narrow as they approach the thorax, the last two being the narrowest of all. The penultimate tracheal ring is produced downwards in a triangular way behind, as is the terminal one in front; behind, this last ring bears the anteriorly directed narrow pessulus, which intervenes behind between the inturned ends of the first pair of bronchial semirings, but in front does *not* appear, stopping short before it reaches the anterior surface of the bifurcating trachea.

Like the tracheal rings, the first three bronchial semirings are well ossified, and separated from each other only by very narrow interannular intervals. They are nearly straight, with only a very slight concavity upwards, and increase in depth as they descend. In front the semirings
P. Z. S. 1880, p. 474 of opposite sides are separated from each other by a small notch; behind they are less and less complete as they go downwards. The first semirings are posteriorly closely applied to, though separate from, the pessulus, and are apparently continued on, as cartilaginous rings, posteriorly, so as to form complete or nearly rings. The posterior ends of the second and third semirings where they appear behind are widely separated from their fellows of the other side. The fourth and succeeding bronchial rings are all cartilaginous. Of these the fourth is the largest, being nearly straight, and slightly more prominent than the others. To its middle, rather towards its posterior margin, is attached the (single) intrinsic syringeal muscle. The rings succeeding the fourth ring rapidly become more and more complete, at the same time that the bronchus becomes less capacious, the whole tube tapering away from this ring as it approaches the lung. The fifth and sixth semirings are more slender than those that succeed them, and are slightly concave upwards. The remaining ones are straighter and deeper. Except between the fourth and fifth, and fifth and sixth semirings, the interannular intervals are exceedingly narrow.

This syrinx does not show much similarity of form to that of *Coracias garrula*, the only one of the family of Coraciidæ that I have been able to examine as regards this point. At the same time it does not much resemble that of any Cuckoo I am acquainted with.

Reviewing the facts already stated, it is clear that the affinities of *Leptosoma* to the Cuculidæ are very remote, whilst, on the contrary, its relations to the Coraciidæ are quite the reverse. The subjoined tabular statement (p. 159) of the principal points in the structure of the three just named groups will perhaps render this additionally clear.

In common with both Cuculidæ and Coraciidæ, *Leptosoma* possesses a nude oil-gland and long cæca, two carotids, and the femoro-caudal, semitendinosus, and accessory semitendinosus muscles. Wherever there is any difference, *Leptosoma* resembles the Coraciidæ; and the same story is told by the pterylosis and *tensor-patagii* arrangement.

	Tail-feathers.	Aftersh.	Oil-gland tuft.	Ambiens.	Fem.-caud.	Acc. f.-c.	Semitend.	Acc. semit.	Exp. secund.	Obt. int.	Carotids.	Cæca.
Cuculidæ ...	10	−	−	+	+	+	+	+	peculiar	triangular	2	+
Leptosoma...	12	+	−	−	+	−	+	+	ciconiine	oval	2	+
Coraciidæ ...	12	+	−	−	+	−	+	+	ciconiine	oval	2	+

Nevertheless, both in the syrinx and in these last two points, as well as in some others, especially osteological ones *, *Leptosoma* is not quite typically Coraciine, and it may therefore be retained, as was proposed by Mr. Sclater, as the type of a peculiar family, Leptosomidæ. This should be placed in the series of Passeriform Anomalogonatous birds as defined by Prof. Garrod†, next to the Coraciidæ, with which its relations are most intimate. Indeed it is possible that, when the anatomy of the allied genera, *Brachypteracias*, *Geobiastes*, and *Atelornis*‡ becomes fully known, the truth of Mr. Sharpe's proposition §, that *Leptosoma* should be relegated to the position merely of a subfamily of the Coraciidæ, may be established. P. Z. S. 1880, p. 475.

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28. ON TWO RARE PLOCEINE BIRDS NOW OR LATELY LIVING IN THE SOCIETY'S MENAGERIE.|| P. Z. S. 1880, p. 475.

(Plate VII.)

1. Vidua splendens. (Plate VII. fig. 1.)

Vidua splendens, Reichen. Orn. Centralbl. 1879, p. 114.

On the 17th of July, 1878, Mr. Archibald Brown presented to the Society, with some other birds, a specimen of a small Weaver-bird, which being then "out of colour," was entered on the list of additions as *Vidua principalis*, the common and well-known "Pin-tailed Whydah bird." Last summer this bird had assumed an entirely blue-black plumage, like that of *Hypochera nitens*, also a common cage-bird. But I was struck by the appearance of the beak and feet, these being of a bright coral-red colour, whereas in *H. nitens* they are only pale flesh-coloured. The

* *Vide* Grandidier's work, Atlas, Ois. pls. 85, 86.

† P. Z. S. 1874, p. 119, and *l. c.* 1878, p. 99.

‡ The osteology of these genera, with some other points, is figured in Grandidier's work on pls. 97–99, 101, 102, 103*a*.

§ Ibis, 1871, p. 187.

|| Proc. Zool. Soc. 1880, pp. 475–477 Pl. XLVII. Read June 15, 1880.

tail-feathers, too, were slightly tipped with white, and the two central ones became gradually slightly more lengthened than the others, and so projected beyond them. The accompanying figure (Plate VII. fig. 1) shows the appearance of this bird at that time, as sketched from life by Mr. Smit. Unfortunately it died on the 29th of March in the present year, being then in very poor plumage, as it was moulting; on dissection it proved to be a male. Thinking I had here a new species of *Hypochera* to deal with, I took the skin with me, on a late visit to Berlin, to show to Drs. Hartlaub, Cabanis, and Reichenow. The latter gentleman speedily recognized this bird as the young male of a species he had lately described from E. Africa as *Vidua splendens* (Orn. Centralbl. 1879, p. 114). Of this only a single specimen was collected at Kibaradja, E. Africa, by Dr. Fischer, and is now in the Berlin Museum. A sketch from this bird is reproduced in the distant figure of the accompanying Plate; as will be seen from it, the male bird, when fully adult, possesses enormously elon-

P. Z. S. 1880, p. 476.

gated rectrices, the two of each side fitting into each other, so that at first sight there only appear to be *two* on each side. The excess of these four central tail-feathers over the other rectrices is, in this specimen, nearly 6 inches: in the young male that lived in our Gardens, there are only two lengthened feathers, which project only to the extent of $\frac{1}{5}$ inch. If our bird had lived, the other two tail-feathers would, no doubt, have been duly developed, the birds in other respects being nearly similar. In our specimen all the rectrices, including the two central ones, are slightly tipped with white; the eyes were very dark red-brown. *Vidua splendens* is perhaps most like *Vidua hypocherina* of Verreaux*; from that species it can be at once distinguished by the absence of the white, elongated rump-feathers. *Vidua* (*Hypochera*) *nitens* is also entirely blue-black, but has *no* lengthened rectrices, and, moreover, has the feet and beak flesh-colour; in *V. principalis* the beak is also bright red, but the feet are fleshy, besides many other differences. The discovery of this bird renders, in my opinion, the retention of the genus *Hypochera*, founded by Bonaparte † in 1850, for *Fringilla nitens* unnecessary—the males of *V. splendens* and *V. principalis*, as well as probably *V. hypocherina* ‡ when in winter plumage, as well as the females and young males at all times, being indistinguishable by any characters, structural or otherwise, from that section of the group including *V. nitens* and *V. nigerrima* (*Hypochera nigerrima*, Sharpe, P. Z. S. 1871, p. 133), in which the male has, in nuptial plumage, no elongated rectrices.

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* *Vidua hypocherina*, J. and E. Verreaux, Rev. et Mag. Zool. 1856, p. 260, t. 16.

† C. R. xxxi. p. 434.

‡ *Vidua superciliosa* (Vieill. Gal. Ois. pl. 61) I only know by the plate and descriptions; it is said to have only *two* elongated rectrices; as there are said to be ten of the ordinary length, this statement is therefore probably correct.


J. Smit

J. Smit lith. Hannart imp.

1. VIDUA SPLENDENS.
2. PYTELIA WIENERI.

Our specimen was said to be from the "east coast of Africa," a fact rendered probable by the arrival along with it of specimens of *Euplectes nigriventris* *, a truly eastern species.

2. Pytelia wieneri. (Plate VII. fig. 2.)

Pytelia wieneri, Finsch, Gef. Welt, Aug. 9, 1877.

Pytelia cinereigula, Cab. Orn. Centralb. Dec. 1, 1877, et Journ. für Orn. 1878, p. 101.

In the 'Gefiederte Welt' (6th Jahrg. no. 32, p. 317) for Aug. 9th, 1877, Dr. Finsch described as new, under the above title, a species of *Pytelia*, of which Mr. A. F. Wiener, F.Z.S., had purchased four living specimens in London, supposed to be from "Australia." On June 18th, 1879, Mr. Wiener presented one of these specimens to the Society, which is still (May 31) living in the Parrot-house in good health. From it the accompanying drawing has been taken (Plate VII. fig. 2).

In the 'Ornithologisches Centralblatt' for Dec. 1, 1877 (p. 182), Dr. Cabanis described a *Pytelia* † *cinereigula*, of which there had been two P. Z. S. 1880,
specimens lately received at the Berlin Museum from East Africa. One p. 477.
of these had been collected at Zanzibar by Dr. Fischer, the second at Mombassa by Drs. Hildebrandt and von Kalkreuth. During my late visit to Berlin I at once recognized in this species Finsch's *Pytelia wieneri*; and by the kindness of Drs. Cabanis and Reichenow I was allowed to bring back with me to London a third skin of the same bird, still more lately received, and collected in Angola, at Malange. A comparison of this with our living bird has quite confirmed the opinion I had already arrived at, so that Cabanis's name must yield to Finsch's ‡. The Australian habitat is, of course, a mistake, *Pytelia* being an entirely African form. Of the red-beaked section of *Pytelia*, to which it belongs, *P. wieneri* can only be confused with *P. melba* and its ally (or geographical form) *P. citerior*. The differences between these and the bird under consideration have already been pointed out by Drs. Finsch and Cabanis in their descriptions; suffice it to say that *P. wieneri* is at once, *inter alia*, distinguished from these by its very different markings below, and also by the red of the chin and throat being separated from the greenish-yellow of the lower parts by the interposition of a grey band. In our living bird the beak is bright red and the feet pink; the irides are dark red.

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* Cassin, J. Ac. Phil. 1849, p. 242, pl. xxxi. fig. 1. Erroneously entered in the register (P. Z. S. 1878, p. 1008) as *E. oryx*. *Cf.* List Vert. 1st supplem. 1879, p. 65.

† This description is reproduced in the Journ. für Orn. 1878, p. 101. I may here remark that, in my opinion, *Pytelia*, though perhaps a "nonsense name," is sufficiently "like Latin" to be retained, and not replaced by "*Zonogastris*," or altered into "*Pytilia*," as proposed by Dr. Cabanis (*l. c.* p. 100).

‡ I also found a single specimen of this bird, with no precise locality, in the Museum at Hamburg.

P. Z. S. 1880, p. 477.

29. NOTE ON A SPECIMEN OF DENHAM'S BUSTARD (*EUPODOTIS DENHAMI*).*

The interest attached to the existence, or otherwise, of special mechanisms connected with the habit of "showing off" in the males of the Otididæ, together with the fact of the subject of the present note being of a species rarely seen in captivity, so that some time may elapse before a further opportunity of examination offers itself, must be my excuse for this short and imperfect notice.

On March 20, 1872, two specimens of *Eupodotis denhami*, from W. Africa, I believe, the first and only ones of this species possessed by the Society, were presented by Governor Ussher and C. D. O'Connor, Esq. Of these one lived in good health in the Gardens for many years, dying on May 12 last, after having been attacked by a companion hen of *Otis tarda* that was in the same enclosure with it. Having never observed any signs of "showing off" in this bird, I had always considered it to be a female. This surmise, however, proved incorrect, for on dissection it turned out to be a male.

P. Z. S. 1880, p. 478.

On examining the mouth there was no trace of any sublingual or gular pouch; on the contrary, the *frænum linguæ* was well developed in its ordinary position. But the *œsophagus*, for the greater part of its course in the neck, though stopping short considerably of its entrance into the thoracic cavity, was much dilated, so that by blowing it up with a blowpipe a large distention of the neck took place, confined, however, to the upper two thirds, or thereabouts, of the neck—the œsophagus, which, as usual in the Otididæ, develops no crop, being in the rest of its course, till it entered the stomach, of very much smaller calibre.

On inquiring of Mr. Bartlett and the keeper, J. Church, whether they had ever witnessed any display on the part of this bird, they both told me that during the last two summers (1878, 1879) it had "shown off." But this display did not take place in the same way as in *E. australis*, as depicted and described by Dr. Murie (P. Z. S. 1868, pp. 474, 475, pl. xxxvi.); for there was none of that *downward* distention of the *œsophagus*, and consequent trailing of it on the ground, that is so marked a feature in the showing-off of that species; on the contrary, the distention of the œsophagus during display in *E. denhami* is *lateral*, the neck being immensely puffed out on both sides in a globular way, and so resembling when seen from in front, to use Mr. Bartlett's words, "a lady's muff." In *E. australis*, it must be remembered, there is a similar dilatation of the œsophagus, extending, however, in that species, over a larger extent of its course, so that "before dissection, by filling its cavity with air, the

* Proc. Zool. Soc. 1880, pp. 477, 478. Read June 15, 1880.

lower portion of the dilated œsophagus protruded downwards considerably in front of the *symphysis furculæ*, and formed the depending portion of the sac which was so conspicuous in the living animal" (Garrod, P. Z. S. 1874, p. 473).

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30. REMARKS ON DR. GADOW'S PAPERS ON THE DIGESTIVE SYSTEM OF BIRDS.* Ibis, 1880, p. 234.

Dr. Hans Gadow, who is already known as a worker at the anatomy of birds from his papers in the 'Journal für Ornithologie,' has lately published in the 'Jenaische Zeitschrift' an elaborate article on the anatomy of the digestive organs of birds †. This paper, in two parts, extends over more than 140 pages, and is illustrated with nine plates.

In the first part Dr. Gadow gives a descriptive account (without histological details) of the alimentary canal and its appendages—tongue, liver, pancreas, cæca, &c., as well as of the kidneys, which he strangely includes with these organs—in the various orders of birds, in large part based upon his own investigations. I cannot always agree with Dr. Gadow in his grouping of the various forms together, as, *e. g.*, including such different forms as Auks, Penguins, and Grebes in the same order, "Pygopodes."

For this part of his work Dr. Gadow seems to have examined a large number of birds; but it is to be regretted that he has apparently had no opportunity of investigating some of the most interesting forms, such as the Tinamidæ and Turnicidæ. Had Dr. Gadow been acquainted with the structure of the former group, he would not, I think, have insisted Ibis, 1880, p. 235. so strongly on the absolute isolation of the "Ratitæ" from all other living birds ‡.

Dr. Gadow justly regrets the small amount of attention that has been paid of late years to the anatomy of birds, and particularly, as he says, to the digestive system. But he seems to be unacquainted with the work done lately in this country by Prof. Garrod, as in the list of papers quoted by him but two of that anatomist's are mentioned. Hence no account is given of some of the most peculiar variations that are

* Ibis, 1880, pp. 234–237.

† "Versuch einer vergleichenden Anatomie des Verdauungssystemes der Vögel," I. Theil, Jen. Zeitschr. f. Wissenschaft., Band xiii. Heft 1, pp. 92–171 (1879); II. Theil, *tom. cit.* Heft 3, p. 339 &c. (1879).

‡ "Dass aber . . . . Uebergänge der 4 noch lebenden Ratitenfamilien unter einander und *auch zu den Carinaten gänzlich fehlen*," tom. cit. p. 107.

known to occur in the alimentary canal of birds, of, for instance, the peculiar proventriculus and cæca of *Chauna* (though Dr. Crisp's paper on this bird is quoted), and of the extraordinary stomachs of the species of *Plotus*. No allusion is made to the tongue of *Nestor*; and the old statements as to the universal absence of a gall-bladder, or, at all events, its only exceptional presence as an individual variety, in the Parrots and Pigeons, are repeated.

In the second part Dr. Gadow commences with the different forms of the same organs throughout the series of birds. In a tabular statement of the correlation of the nature of the cæca to the nature of the food, *Phœnicopterus* is included as one of the "Fleisch u. Fische" eaters. But, according to Mr. Salvin and other authorities, the major part of the food of these birds consists of the vegetable matter that grows at the bottom of the lagoons which they frequent (*vide* Dresser, B. of Eur. pts. 75, 76). The length and width of the alimentary canal, the relative size of its various parts, the influence of the food on the canal as a whole, and the variations in its length in birds of the same species, both young and old, are then discussed. The concluding part of the paper is devoted to a description of the disposition of the convolutions of the intestines; and this is decidedly the most novel part of Dr. Gadow's work, previous accounts of this subject being very meagre.

Ibis, 1880, p. 236. Excluding the Ratitæ, Dr. Gadow distinguishes three chief types of intestinal arrangement. These he calls *Orthocœla*, *Plagiocœla* (or *Plagiobrochi*), and *Cyclocœla*.

In the first group (*Orthocœla*), in which he includes the Pygopodes, Steganopodes, Anseres, Tubinares, Erodii, Alectorides, and Rallidæ, the chief folds, which are from five to eight in number, are straight and parallel to one another and to the long axis of the body.

In the *Plagiocœla*, which includes only the Rasores, the two middle of the four chief folds form more or less horseshoe-shaped loops at their extremities, and the general direction of the intestines always forms, more or less, an angle with the long axis of the body.

In the *Cyclocœla* one or more of the chief folds are spirally coiled round their ends. This division includes some of the Grallæ, the Pelargi, Laridæ, Psittaci, Raptores, Columbæ, the Coccygomorphæ and Pici in part, the Cypselomorphæ, and the Passeres.

It is further subdivided into the *Telogyri*, in which only the terminal part of the fold is coiled, and the *Hologyri*, in which the whole fold is so disposed, these latter, again, being further divided into *Progyri*, *Mesogyri*, *Amphigyri*, and *Polygyri*.

But, judging from the forms associated together under some of these heads, the groups so named are eminently artificial. Thus, the Raptores are divided amongst the first three, and under the *Mesogyri* are included forms as various as *Astur*, *Melierax*, *Halcyon*, and *Phœnicopterus*.

The paper concludes with the inevitable phylogenetic table, showing Dr. Gadow's ideas of the lines of descent amongst birds. He holds that all the highest forms of each subdivision belong to the *Hologyri* or *Mesogyri*, the more primitive ones being *Orthocœla* or *Plagiocœla*.

The figures in the plates are chiefly devoted to showing, in a more or less diagrammatic way, the various types of intestinal convolution described in the text, and will be found very useful in elucidating Dr. Gadow's views.

In conclusion, it seems to me that, as it is a well-known fact that individuals of the same species vary, sometimes very greatly, in the length of their intestines, the stowing away of a greater or less amount of gut in a given space, the abdominal cavity, becomes simply a mechanical problem, and therefore that there is less help in forming a sound view of the mutual affinities of birds to be derived from the facts in this direction described by Dr. Gadow than from many other points, more complicated, and therefore less easily altered, in the structure of birds. Ibis, 1880, p. 237.

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31. THREE WEEKS' BUTTERFLY-COLLECTING IN THE ALPS.*

Ent. M. M. xvi. p. 256 (1880).

THE following is an account of a short trip in the Alps of Dauphiné and Piedmont made last summer by myself, in company with Messrs. Salvin and Godman, and Capt. Elwes. Our object was quite as much to enjoy a change and breathe fresh air, as to catch butterflies, though we devoted most of our time to the latter pursuit. We left London on June 22nd, and reached it again on the 11th of July, so that we were only about three weeks, and as we got over a good deal of ground in that time, rarely staying more than one night in a place, a large part of our trip was spent in travelling. Our route was as follows: from Chambery we drove, by St. Laurent du Pont, a village close to the famous monastery of La Grand Chartreuse, to Voiron, and thence by rail to Grenoble. From there we proceeded to Bourg d'Oisans, and next day over the Col du Lautaret—a driving pass about 6800 ft. high—to Briancon. Mr. McLachlan † had made known to us before starting his

* Ent. Month. Mag. xvi. pp. 256–259 (1880).

† "I visited this part of the Alps of Dauphiné as far as the Col du Lautaret, in the beginning of July, 1876, in company with M. Constant (then of Autun, now of Cannes), who joined me at Grenoble, and a botanist from the neighbourhood of Bordeaux. This

experiences some years ago of this part of the Dauphiné Alps; but unfortunately we were too early for Lepidoptera, the snow lying still thickly about the top of the pass above La Grave, where, indeed, we narrowly escaped being carried away by a small avalanche—a catastrophe that happened to a small cart that had preceded us by about an hour. At Briancon, although over 4000 ft. above the sea, we got for a while into a more southern fauna, as evidenced by the occurrence of such forms as *Melitæa dejone*, and the beautiful yellow "orange-tip" *Anthocharis euphenoides*. The Mediterranean fauna would, therefore, seem to extend up the valley of the Durance quite into the Alpine district. From Briancon we drove by Mount Genèvre, a pass of about 6000 ft., over the frontier to Oulx, a small village (at an elevation of 3500 ft.) on the Mount Cenis

Ent. M. M. xvi. p. 257 (1880).

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district had long been known to members of the Alpine Club, and possessed the peculiar attraction of a mountain (La Meije, over 13,000 ft.) that had, up to that time, baffled all attempts to scale it (it has since been several times successfully ascended), in addition to many other inducements for mountaineers of the more amateur class; it was also well known to botanists as a paradise for rare alpine plants, and it supplies (through its adventurous and migratory inhabitants) many of the horticultural establishments of Europe (and even of America) with them, either in the form of seeds or roots. French entomologists had also visited it; but it had rarely seen an English net; yet there are probably few districts in Europe so favourable for a Lepidopterist; it is *not* favourable for a Neuropterist, owing to most of the streams having their source in glaciers. It has the advantage of a magnificent military road, a wonderful piece of civil-engineering. British tourist-entomologists should decidedly make its intimate acquaintance. It is easy of access. From Grenoble to the summit of the Col du Lautaret is about 50 English miles by diligence and mail. Grenoble can be reached from London in about 27 hours (on my return I left that city at 3.15 P.M., and was at home in my study before 7 P.M. next day). The end of June is too early, even in an ordinary season, and in such a season as 1879 was a month too early. I would recommend entomological tourists (not pressed for time, nor wanting to go over too much ground) to stay first at Bourg d'Oisans, where there is a comfortable inn, kept by an obliging old Frenchman, M. Martin ("Hôtel de Milan"). Afterwards they should push on to the Col du Lautaret, where there appears to be good accommodation at the Hospice on the summit (subsidized by government, as a refuge for wayfarers in the long winter months). My head-quarters were at Bourg d'Oisans and La Grave, the latter at the foot of La Meije. But I think (for an entomologist) the Hospice is preferable to La Grave. This latter is a miserable village with a poor inn, offering no special inducements, excepting to Alpine climbers: the sleeping-quarters were over the stable (which is, perhaps, cleared out once a year), the food was indifferent, the charges not moderate; and, moreover, newly-arrived strangers are liable to an indisposition (already alluded to several times in the records of mountaineering), that may place them (as it did me and one of my companions) *hors de combat*, and take several days to shake off. (The water, and the sudden change of temperature from the *excessively* hot experiences of Bourg d'Oisans were both blamed for this; but there has been no report from an official sanitary inspector!). Any British entomologist who is not specially connected with water insects should visit this district; and even the exception I have made would, perhaps, not hold good in the autumn months, when the glaciers have discharged their annual surplus."—R. McLachlan.

railway, between Bardonèche and Susa, and after a day there, proceeded to Turin. Spending the Sunday there, we, after a good baking, were glad to get away early next morning, and travel by rail to Arona, and then up the lake by steamer to Baveno. Baveno being hot and crowded, we left next day, and drove up the Val Anzasca to Ponte Grande, a charming village about 2500 ft. above the sea, with a lovely view of Monte Rosa. Finding good quarters here, we stayed several days (from July 1–5). The Val Anzasca is a good example of an Italian alpine valley, and proved likewise very productive in insects, though the weather was not as fine as it might have been. We only had one really fine day, July 3rd, and on that Mr. Salvin and I working down the valley towards Vogogna, saw or caught fifty-two species of butterflies, not a bad day's work for one morning between 8 A.M and 2 P.M. In this valley below Ponte Grande alpine and southern species were curiously interblended, as evidenced in such forms as *Neptis* and *Libythea* occurring with *Parnassius* and other mountain insects. From Ponte Grande we went further up the valley to Macugnaga, and after spending a day there, over the Monte Moro pass (about 9000 ft.), and down the Saas Thal to Saas, and eventually Visp. After this, except for an hour or two near Bienne, on our way home, we had no occasion to use our nets.

The total number of species of Rhopalocera seen or caught by us during the trip was 103, and, had the weather been finer, this number would, doubtless, have been increased. We altogether missed numbers of common Alpine species, as owing to the unusual amount of snow that had fallen during the winter, the season was extremely backward, so that had we started a fortnight later, our "bag" would, no doubt, have been correspondingly increased. A list of some of the more uncommon species we obtained is appended.

Papilio podalirius: Chambery, Col du Lautaret, Briancon, &c.

Parnassius apollo: Val Anzasca, Col du Lautaret, &c. *P. mnemosyne*: Val Anzasca, above Ponte, Macugnaga.

Pieris napi, var. *bryoniæ*: several near Macugnaga.

Anthocharis belia, var. *simplonia*: rather common towards, and on, the top of the Col du Lautaret. *A. euphenoides*: this truly Mediterranean species occurred, but not commonly, at Briancon; one specimen was seen at an elevation of about 5000 ft., on the road towards Mont Genèvre. All seen were males.

Leucophasia duponcheli: Oulx (?) and Briancon. At the time we did not distinguish this from the common species, so only got two or three specimens. According to M. Bellier de la Chavignerie (Ann. Soc. Ent. France, 1869, p. 514), this species is, in France, almost confined to the lower parts of the Basses Alpes, and the neighbourhood of Digne, and Aix in Provence. Ent. M. M. xvi. p. 258 (1880).

Colias edusa, var. *helice*: Oulx, Chambery, &c.

Thecla ilicis: round bushes in the Val Anzasca. This and *T. rubi* were the only "hairstreaks" met with.

Polyommatus virgaureæ: Val Anzasca, not numerous. *P. hippothoë*, var. *eurybia*: upper parts of Val Anzasca, and near Macugnaga. *P. alciphron*, var. *gordius*: this beautiful "copper" was abundant in the Val Anzasca, flying about, and settling on, the flowers by the sides of the road. The males were by far the most numerous; a few were also caught at Baveno and near Briancon. *P. dorilis*: near Chambery, Briancon, Val Anzasca, &c.; the males commoner. The alpine form (*subalpina*, Speyer) occurred at Macugnaga.

Lycæna argyrotoxus (=*ægon*): St. Laurent du Pont, &c., common. *L. argus*: very common in the Val Anzasca; also on the Col du Lautaret, at Oulx, and Baveno; most of our specimens are referable to the form *ægidion* (Meissner). *L. orion*: not uncommon, flying over the road, particularly where muddy, in the lower parts of the Val Anzasca, but local, and generally worn. *L. baton*: one at Bourg d'Oisans, and a few at Briancon and Macugnaga. *L. eros*: Oulx, and more commonly in the Saas Thal, above Stalden. *L. icarus*, ab. *icarinus*: Oulx. *L. eumedon*: Oulx, and Saas Thal, above Stalden; nowhere common. *L. escheri*: Chambery, near Bourg d'Oisans, Oulx, and Stalden, singly. *L. hylas*; common at Oulx, Saas Thal. *L. sebrus*: Col du Lautaret, Oulx, males only; we probably passed this species over as the next in many cases. *L. semiargus*: common at Briancon, Oulx, &c. *L. cyllarus*: rather common on the Col du Lautaret, and about Briancon, Baveno, and Val Anzasca. *L. alcon*: Oulx, a few. *L. arion*: Col du Lautaret, Oulx, Saas Thal, &c.

Nemeobius lucina: Chambery, Val Anzasca, &c.

Libythea celtis: I saw, and caught, a single specimen of this S. European species in the Val Anzasca, below Ponte Grande. This was the only one seen.

Apatura ilia, var. *clytie*: a single specimen of this species was seen, but not secured, on the roadside near Baveno.

Limenitis populi: a fine female near Ponte Grande; we saw another higher up the valley, but failed to catch it. *L. camilla*: I caught a single specimen at Oulx, the only one we saw.

Ent. M.M. xvi. p. 259 (1880). *Neptis lucilla*: we got two or three specimens, only in the Val Anzasca, of this species. This must be nearly its most western habitat.

Melitæa phœbe: Briancon, &c., very common in the Val Anzasca. *M. didyma*: Chambery and Val Anzasca. *M. dictynna*: Briancon, Macugnaga. *M. dejone*: a few specimens at Briancon; this species is, according to Dr. Staudinger, confined to Spain and the South of France. *M. athalia*: abundant nearly everywhere in suitable localities; in swarms in the Val Anzasca, with *M. phœbe* and others. *M. parthenie*: St. Laurent du Pont.

Argynnis amathusia: common at Oulx, near Macugnaga. *A. thore*: Godman caught a single specimen of this rather scarce species in the Val Anzasca, above Ponte Grande. *A. lathonia*: common in the Val Anzasca; this species seems fond of settling on the dusty roads, and has a peculiar jerking flight, unlike the other species of *Argynnis*. *A niobe*: a single specimen of the typical silvery-spotted form at Briancon; curiously enough, we saw nothing of *eris*, which is usually the commoner of the two.

Erebia melampus: Val Anzasca and Saas Thal. *E. epiphron*, var. *cassiope*: Saas. *E. ceto*: Col du Lautaret, Val Anzasca, and more commonly near Macugnaga. *E. medusa*, Val Anzasca, Macugnaga, &c. *E. stygne*: Col du Lautaret, Briancon. *E. evias*: on the Col du Lautaret near La Grave, but mostly worn; also near Macugnaga. *E. euryale*: Val Anzasca.

Œneis aello: not very uncommon near Macugnaga, and also caught in the Saas Thal, between Stalden and Saas.

Satyrus alcyone: Val Anzasca and Saas Thal, common near Stalden. *S. semele*, near Stalden. *S. actœa*, var. *cordula*: a few near Stalden.

Pararge mœra: common everywhere in the alpine valleys. *P. hiera*: Oulx, Val Anzasca, nowhere abundant. *P. achine* (=*dejanira*): two specimens in a wood near Bienne.

Cœnonympha arcania, var. *darwiniana*: Chambery, Baveno, and common in the Val Anzasca. The alpine form *satyrion* occurred sparingly in the Saas Thal.

Spilothyrus althææ: we got two specimens of this rather scarce species in the Val Anzasca. *S. lavateræ*: this skipper was not uncommon one one hot day flying over the road in the Val Anzasca, but it was very lively and difficult to catch; we subsequently saw it again in the Saas Thal, above Stalden.

Syricthus carthami: Briancon, Oulx, and Saas Thal. *S. sao*: near Chambery, Briancon, Oulx. *S. alveus*: Saas Thal and Oulx.

Hesperia thaumas: Ponte Grande, Saas Thal. *H. lineola*: Saas Thal and Val Anzasca.

Carterocephalus palæmon (=*paniscus*): a single specimen caught by Salvin near Chambery.

February 23rd, 1880.

Rep. B. Assoc. 1881, p. 718.

32. ON A LITTLE-KNOWN CRANIAL DIFFERENCE BETWEEN THE CATARRHINE AND PLATYRRHINE MONKEYS.*

Besides the well-known difference in the dentition, and in the form of the external auditory *meatus*, in the monkeys of the old and new worlds, there is a difference in the formation of the bony walls of the temporal fossa which in nearly every case suffices to distinguish at once the skull of a member of one of these groups from that of one of the other. As independently discovered by the author (P. Z. S. 1880, p. 639) and Dr. Gustav Joseph ('Morphologisches Jahrbuch,' i. pp. 453–465), in the Platyrrhine monkeys the parietal bone is prolonged forwards to meet the malar, there being a well-marked suture usually between the two, the frontal being in consequence altogether excluded, superficially at least, from articulating with the squamosal and alisphenoid. In the Catarrhine monkeys, on the other hand, as also in man, the parietal does not reach the malar, there being an isthmus between the two bones formed by the articulation of the frontal with the alisphenoid.

T. Z. S. 1881, xi. p. 107.

33. ON THE MALE GENERATIVE ORGANS OF THE SUMATRAN RHINOCEROS (*CERATORHINUS SUMATRENSIS*.†

On two occasions the late Prof. Garrod had opportunities of dissecting the Sumatran two-horned Rhinoceros; and his notes on their anatomy will be found duly recorded in the Society's publications ‡. Both his specimens were females.

On March 20, 1879, the Society received on approval a fully adult male of this animal, being, I believe, the first individual of that sex

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* Rep. Brit. Assoc. 1881, p. 718.

† Trans. Zool. Soc. vol. xi. pt. iv. pp. 107–109, Pl. XX. (1881). Read March 16th, 1880.

Prof. Garrod had the drawings which accompany this paper made by Mr. Smit from the animal whilst still fresh, with the object of laying some notes on the subject before the Society. Unfortunately I have been unable to find any such amongst his numerous MS. papers. He also requested me to make notes and measurements of the male organs for him with the like object; and from these sources I have drawn up the present paper. The glans penis is now preserved in the College of Surgeons.

‡ Proc. Zool. Soc. 1873, p. 92, and Trans. Zool. Soc. x. p. 411 (1878).

brought alive to Europe. Unfortunately it died on the 5th of April following, the post-mortem examination showing evidence of dropsy, as well as tubercle in the lungs and spleen. The skin and skeleton of this specimen are now in the British Museum.

Prof. Owen, in his account of the anatomy of *Rhinoceros indicus* (Trans. Zool. Soc. iv. pp. 31–58), has described and figured the male organs of that species; and the present account will fill up the corresponding blank that has as yet existed as regards these parts in *Ceratorhinus sumatranus*.

As was to be expected, the two genera closely conform with each other in all main points, with some considerable differences in matters of detail.

As in *R. indicus*, there was no scrotum; each testis measured 4½ inches long by 2 broad at the widest part. The epididymis was of the same length as the testis.

The vasa deferentia were 29½ inches long by ⅛ inch broad; unlike these ducts in the Indian species, they were not dilated terminally. The vesiculæ seminales resembled in shape those described by Owen: they were 7½ inches long, and 1 inch across at the broadest part. The right vesicula had two, the left four, narrow ducts, 1½–2 inches long, which joined the vasa deferentia just before these entered the urethra. The verumontanum is short and rounded, ½ inch long and 1 inch broad. The openings of the ejaculatory ducts were very minute; a larger pore, which was the only representative of a vesicula prostatica, lay close above.

The prostate was of a roughly triangular shape, 2 inches long by 5 inches across, and had the same structure as in *R. indicus*, the glands opening by numerous pores on each side of the verumontanum in a well-marked sinus prostaticus. T. Z. S. 1881, xi. p. 108.

Cowper's glands were large (3½ inches by 2) and oval; their ducts opened by pores 1½ inch in front of those of the ejaculatory ducts.

The urethra measured in all, in the unerected state, about 23½ inches, of which ½ inch was "prostatic," 3 inches "membranous," and the rest "spongy."

The glans penis is a long and tapering cylinder, provided at the end with a second, somewhat mushroom- or trumpet-shaped expansion, nearly in the centre of which is the opening of the urethra. It thus conforms closely with the same organ in *R. indicus*. But, as will be seen from the drawings, it is provided, in addition, with two large oblong-oval lobes, of the same colour and substance as the rest of the glans, which are free for the greater part of their length, and only attached to the rest of the glans at their bases. These lobes lie on the sides of the dorsum of the penis, and are closely approximated at their bases, as represented in fig. 2. In fig. 1 they are spread out artificially, so as to show better their extent and attached bases. The total length of the glans, to the reflection of the prepuce, was 7 inches, the trumpet-like terminal part being 1 inch long, and 1 inch transversely. The lobes of the glans measured $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ inch across.

In *R. indicus*, according to Prof. Owen (*l. c.* p. 51), " on each side of the base of the glans, and rather towards its under part, there is a longitudinal thick oblong ridge or lobe, $3\frac{1}{2}$ inches in length, and 8 lines in basal thickness; the thick rounded free border of each lobe inclines downwards." Prof. Owen's figure is reproduced in outline, of the original size, in fig. 3, to show the differences thus indicated. By the kindness of Prof. Flower I have been enabled to examine the penis of an Indian Rhinoceros preserved in the stores of the College of Surgeons, and which is probably the same specimen as that dissected and described by Prof. Owen, with whose description and figures it closely corresponds. The lobes, however, seem to me to be (as also indicated in his figures) rather on the upper than on the under part of the penis, as they lie, in fact, on each side of the dorsum a little removed from the middle line, as also is the case in *Ceratorhinus.* They are about $1\frac{1}{4}$ inch in height at the centre, diminishing towards each end till they become undistinguishable from the rest of the glans. *Ceratorhinus* therefore differs from restricted *Rhinoceros* in the greater size and development of the lobes, which have now ceased to be mere elevations or ridges attached throughout their length to the body of the glans, but have become freely projecting lobes attached only by their bases *. In *R. indicus*, too, the terminal part of
T. Z. S. 1881, xi. p. 109. the glans is more slender, being longer in proportion to its depth, and its apical expansion narrower across in proportion to its height ($\frac{7}{8}$ inch to $1\frac{1}{2}$), with its margins, moreover, somewhat crinkled.

It is, in conclusion interesting to observe that the distinctness of the two genera *Rhinoceros* and *Ceratorhinus*, as shown by other characters—external, cranial, and visceral—is confirmed by these differences in the sexual organs.

* I may mention that Prof. Flower also found for me in the stores of the College of Surgeons a detached glans penis of a Rhinoceros exactly like that now described. Its history is somewhat uncertain; but it was probably sent over, along with other viscera of animals, by Sir Stamford Raffles when Governor of Java. There can be no doubt that it belongs to a species of *Ceratorhinus.*

34. ON SOME POINTS IN THE ANATOMY OF THE KOALA (*PHASCOLARCTOS CINEREUS*).*

P. Z. S. 1881, p. 180.

On April 28th of last year (1880), as already recorded in the Society's Proceedings †, the Society purchased for its collection the first living Koala (*Phascolarctos cinereus*) ever brought to Europe. The animal, a young female, continued to do well and thrive after its arrival at the Gardens, and on a diet of *Eucalyptus*-leaves, which were substituted after a while for the dried ones on which it had been kept alive during the voyage and the first part of its stay in this country, became daily in better condition and more active. Being a pet animal, accustomed to being caressed, it was thought better not to put it in a cage; so a room for its use was fitted up in the Superintendent's office. Here, under the charge of a special attendant, it slept, perched upon the branches of a tree erected for its use, by day, whilst at night it wandered about the room. Very unfortunately, on the night of the 14th of June it was accidentally killed, whilst thus roaming about at night, by getting caught between the top and bottom of a fixed washing-stand, which had been allowed to remain in the room. It had apparently climbed up this and brought down on its neck the heavy lid. Nobody being near, and in spite of evidently determined struggles on its own part, it failed to relieve itself, and so was found dead in the morning from asphyxia.

P. Z. S. 1881, p. 181.

The death of this animal, so unfortunate for visitors to the Society's Gardens, has given me the opportunity of putting on record some additional facts concerning the anatomy of the soft parts of this species. Mr. W. Martin, in this Society's 'Proceedings' for 1836 ‡, has described already some of the most striking features of the animal's organization; and in Prof. Owen's 'Anatomy of Vertebrates' (vol. iii.) a few additional facts concerning it are also recorded. More recently Mr. A. H. Young has described and figured the male reproductive organs (Journn. Anat. Phys. xiii. pp. 305–317, pl. xviii.). All these anatomists, however, had only spirit-preserved specimens to work on; a few additional observations from the fresh specimen may therefore be worth putting on record, and the liver, brain, and female reproductive organs described in particular, these important parts of the system having been only imperfectly, or not at all, described by my predecessors in this field.

The following dimensions were taken on the body of the animal:—

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* Proc. Zool. Soc. 1881, pp. 180–195. Read Jan. 18, 1881.

† P. Z. S. 1880, p. 355; where a woodcut of it, from the pencil of Mr. Wood, is given.

‡ P. Z. S. 1836, pp. 109–113.

	inches.	millim.
Total length, from tip of nose to end of body	17·0	432
Length of eye	1·0	25
„ ear (greatest)	2·15	55
„ head	4·0	100
„ nude muzzle	1·4	35
„ chin	2·65	67
Breadth across muzzle	1·0	25
„ of mouth	1·3	33
Distance between cloaca and mammæ	1·25	32

The tail is a mere stump above the cloaca, which latter is well defined by a well-marked circular marginal fold of the integuments. The hallux has no trace of a nail. The skin is generally flesh-coloured; but the soles of the manus and pes, together with the naked "muffle," are black. The skin of the large and hairy ears is flesh-coloured. There is a narrow naked ring round the eyes; and the irides are brown. The pupil is a vertical oval. The nostrils are transversely oblique, the nasal septum measuring 3½ millims. The upper lip is split; but the split does not quite, when the surrounding parts are expanded, reach the nostrils. The skin is sparsely covered with hairs between the rami of the mandible; for nearly two inches behind it the skin is absolutely naked; and on the P. Z. S. 1881, p. 182. sides (running up towards the angle of the mouth) it is nearly so, a patch of black hairs being developed just behind the mouth on the lower and outer surface of this bare space.

The marsupial pouch in this young specimen is very imperfectly developed. It appears as a small, oval, nearly naked space, measuring about 0·8 inch both across and antero-posteriorly, with a well-marked bounding-fold of integument on each side; inside which is a smaller, secondary one. The hairs of the surrounding parts more or less radiate from this nude space, which lies between the epipubes (or so-called "marsupial bones"). The skin covering it is pinkish. The teats are two* in number, 15 millims. apart, and are situated at the posterior and inner angles of the bounding-folds; they are covered by fur. The lips of the pouch, it may be noted, look as much downwards as forwards.

In an adult ♀ Koala, 20½ inches long, preserved in spirit, the pouch is much better developed—its antero-posterior extent being about 1·85 inch, whilst the breadth of the aperture is 1·4 inch. It admits (my) three median fingers, and extends widely outwards into the groins, as far as the skin-fold between the knee and trunk. The teats, two in number, are situated behind, on a level with the posterior margin of the pouch's

* Prof. Owen (Anat. Vert. iii. p. 769) describes *Phascolarctos* as having four ["two on each side"] mammary glands.

mouth. The skin lining the pouch, except just around the ventral opening of the pouch, is smooth throughout.

The mucous membrane of the cheeks is smooth throughout; the skin is attached to the gum opposite the first palatal ridge, and again opposite the posterior border of the first premolar. Between these two attachments there is formed a sort of cheek-pouch, defined by a distinct sphincter, and capable of receiving the end of the little finger. This pouch extends upwards on the side of the skull, occupying the somewhat oval space that exists, in the macerated skull, in front of the zygoma; it is lined by smooth, white, mucous membrane*.

The palate presents 9 irregular raised ridges, best marked anteriorly. There is no uvula, and the narrow fauces are smooth. The tongue quite fills up the space between the gums. It is parallel-sided and elongated, but rounded off and thinner in front. It has a single, small, circumvallate papilla behind; the fungiform papillæ are distributed chiefly along the sides of the upper surface.

The salivary glands are well developed. The sublingual (which is not mentioned by Martin in his description) is a long, narrow, and thin gland, somewhat foliaceous at the extremity, and about 2·7 inches in extent, lying deeply along the inner margin of the lower jaw. The long duct of the submaxillary gland pierces it. I could find no subzygomatic gland, as described by him (*l. c.* p. 112).

On opening the abdominal cavity the stomach is visible in the epigastric and left hypochondriac regions, the pylorus being directed towards the right side; and it is there in contact with the gall-bladder. The liver does not appear. The commencement of the transverse colon is visible, running downwards towards the left, below, but parallel with, the greater curvature of the stomach. The great omentum is atttached to the transverse colon in the right hypochondrium, and does not cover the mass of the viscera. The greater part of the rest of the abdominal cavity is occupied by the great, longitudinally plicated, folds of the cæcum and cæcum-like ascending colon, a few folds of the small intestine appearing between the transverse colon and a great fold, apparently the cæcum, which runs transversely across the middle of the abdominal cavity. On turning back these great superficial folds the end of the cæcum is seen passing downwards to the left of the rectum, behind the uteri and bladder, to terminate, deep in the pelvic cavity, close to the cloaca! The descending colon, which is narrow and of the ordinary appearance, is very long, and is arranged on a broad mesocolon to the right of the vertebral column, forming here a series of loose loops, which, however, are not closely coiled together on each other as in Ruminants. The

P. Z. S. 1881, p. 183.

* These pouches are also, I find, described by Owen (Anat. Vert. iii. p. 385). They also exist, though less well defined by a sphincter, in the Wombat; but I cannot find them in the other Phalangers I have examined.

right kidney lies superficially to the liver. The duodenal loop passes downwards and to the right, and overlies the right kidney, but passes under the ascending colon just here.

The stomach is cylindrical and sac-like. Its length, moderately distended, is about $3\frac{1}{4}$ inches; its greatest depth, opposite the pyloric constriction, $1\frac{1}{2}$ inch. There is a well-marked cardiac fundus to the left of the œsophagus, and the pyloric part is slightly bent on the cardiac part; this latter is marked off internally by a distinct fold of the mucous membrane, which is smooth and pale, with some slight traces of rugæ in the cardiac fundus.

The most marked peculiarity of the Koala's stomach is its possession, as is well known, of a special gland-patch, similar to that found in the Beaver* and Wombat†. This gland-patch forms a slight elevation externally on the lesser curvature of the stomach, just on the pyloric side of the entrance of the œsophagus. It is somewhat saddle-shaped, with a transverse extent of 1·4 inch. Internally it forms an eminence about the size of a florin, which includes the entrance of the œsophagus. The mucous membrane on the gland-patch, around the entrance of the œsophagus, is red and vascular; elsewhere in the stomach, as already stated, it is quite pale. The openings of the gland-patch are about 30 in number, of varying sizes, and irregularly arranged over the eminence. Some of the openings of the gland are complicated, several smaller openings debouching into a larger one; and the area occupied by the openings is not symmetrical. The general appearance of this patch is well represented by Sir Everard Home's figure (*l. c.*) of that of the Wombat. In this latter animal the general structure and form of the
P. Z. S. 1881, p. 184. stomach are also very like that here described; but it is more globular, and therefore less cylindrical in shape, the cardiac and pyloric openings being more approximated.

The small intestine is villous, but otherwise smooth. It is not sacculated, and when spread out, after being cut, is 0·5 inch across. At its commencement it is dilated for about two inches; there are no Peyer's patches; its length is 115 inches. The large intestine is very peculiar: for the first $28\frac{1}{2}$ inches or so of its length, which forms the ascending colon, it is very capacious, and internally longitudinally corrugated, like the cæcum, which externally it much resembles, the rugæ of the interior appearing through the walls of the intestine, and giving it a longitudinally striated appearance. These folds of the mucous membrane, which might be called longitudinal *valvulæ conniventes,* where best developed are about ·2 inch in depth; they are arranged longitudinally and are roughly parallel, though somewhat irregular in extent; they are

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* *Cf.* Owen, Anat. Vert. iii. p. 422.

† Home, Phil. Trans. 1808, p. 307, pl. ix.

separated from each other by intervals of about the same extent (0·2 inch). At the commencement of the colon, which here, when cut open and spread out, is 3·75 inches broad, and of the cæcum, there are about a dozen of these folds very well marked. These continue throughout the ascending, cæcum-like, colon; but where it narrows to form the transverse and descending parts they converge, and become more or less blended with each other, forming linear elevations. They are continued downwards as far as the rectum, but are reduced by that time to five*. In the cæcum, which is also very capacious, the same arrangement of folds obtains till within 18 inches of its apex, when they gradually disappear, the rest of the organ being thence onwards quite smooth internally. The cæcum, the curious position of the *caput* of which has already been described, measures 46·75 inches in length (nearly three times the length of the animal's body!); the large intestine 93·25 inches. In an adult female ($20\frac{1}{2}$ inches long), preserved in spirit, the following were the intestinal measurements:—

	inches.
Small intestine	111·15
Large "	160·8
Cæcum	66·0

Owen (Anat. Vert. iii. p. 420) gives 92, 125, and 77 inches respectively. On each side at the junction of the ileum and colon is a small patch of three glands.

The liver of the Koala is of very remarkable form. It is represented, drawn to scale of $\frac{3}{5}$ the natural size, in the accompanying figures (1 and 2, pp. 178, 179). All four principal lobes are well developed; but those on the right are far larger than those on the left, the left central being considerably the smallest of these. The umbilical fissure is distinct, extending about halfway across the liver. The right central lobe, which is broad transversely, and forms the largest lobe, is divided very deeply by the large cystic fissure, which extends on the thoracic surface nearly as far back as the umbilical one, and allows the very large and elongated gall-bladder to appear above. Both right and left lateral fissures are also

P. Z. S. 1881, p. 185.

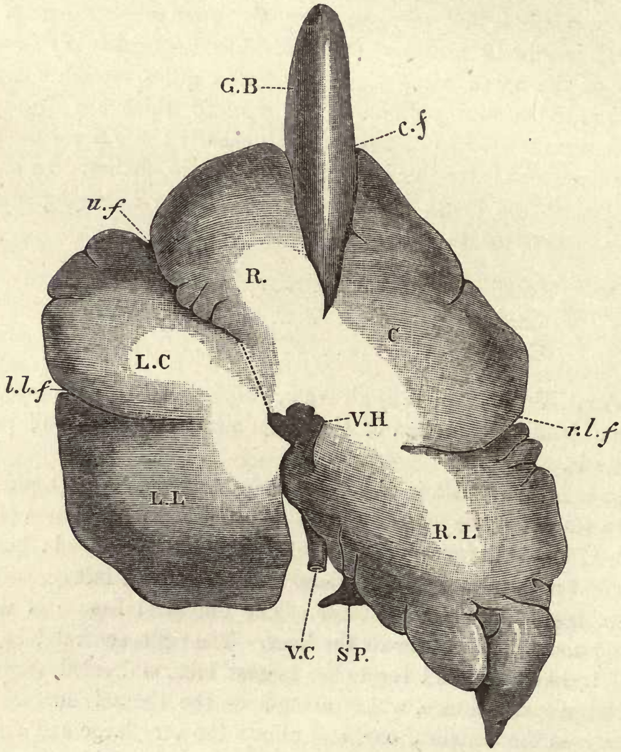
* Mr. Martin describes (*l. c.* p. 111) both colon and cæcum as sacculated "by a slight longitudinal (mesenteric) band of muscular fibres," with indications of a similar opposite band. I could find no traces of any such sacculation in the fresh Koala examined by me; nor are they mentioned by Prof. Owen (Anat. Vert. iii. p. 418) It is also to be noticed that Martin does not in any way allude to the existence of the very remarkable folds of the interior of the cæcum and colon.

In *Phalangista* and *Phascolomys* an examination of fresh specimens has completely failed to exhibit any traces in either cæcum or colon of the longitudinal folds here described. In the latter genus the colon is capacious at its commencement, and sacculated transversely, in a way that does not obtain in either *Phalangista* or *Phascolarctos*.

(in this specimen) well developed. The right lateral lobe is large and somewhat oval in shape, but pointed below. The caudate is not present as a free structure, but it is represented by a somewhat squared, diagonally ridged elevation, lying to the right of the inferior *cava*, and

P. Z. S. 1881, p. 186.

Fig. 1.

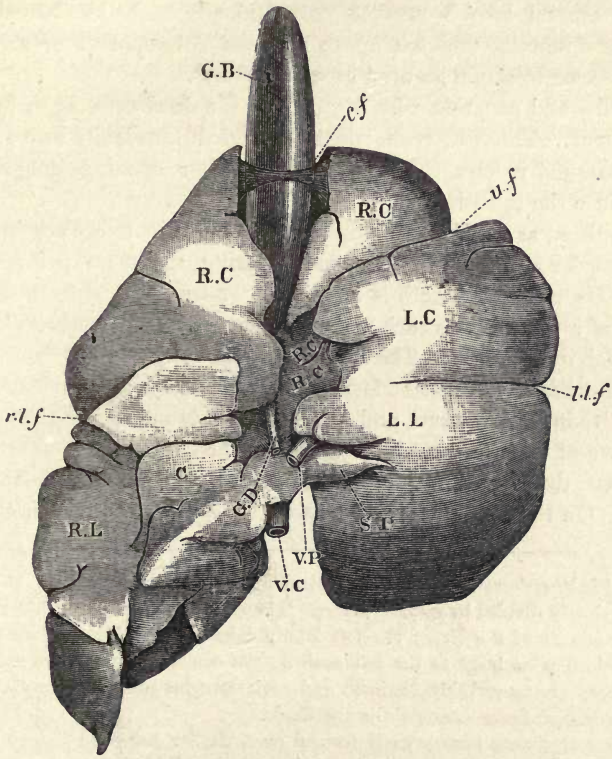


Liver of Koala, from above; three fifths the natural size.

P. Z. S. 1881, p. 185. broadly attached to the substance of the right lateral lobe. The lower border of this elevation is slightly excavated to receive the corresponding kidney. The Spigelian is represented by a smaller thickening, ending in a pointed and free apex, and lying to the left of the *vena cava*; it is united over this by hepatic tissue to the caudate. This liver is further remarkable for the great tendency it has to subdivision, numerous fissures, of varying sizes and depths, being developed along the margin of the chief lobes. Their position and relative size will be better understood from the figures than from any verbal description. They are more conspicuous on the visceral than the thoracic surface. The right half of the right central lobe has one such notch on its right external border; the other half 3, on the right internal border; the left central has 4, the

Fig. 2.

P. Z. S. 1881, p. 187.



The same, from below.

R.C. Right central lobe; *L.C.* left central lobe; *R.L.* right lateral lobe; *L.L.* left lateral lobe; *C.* caudate lobe; *SP.* Spigelian lobe; *G.B.* gall-bladder; *G.D.* bile-duct; *r.l.f.* right lateral fissure; *l.l.f.* left lateral fissure; *u.f.* umbilical fissure; *c.f.* cystic fissure; *V.C. vena cava inferior*; *V.P. vena portæ*; *V.H.* hepatic vein.

left lateral 3, whilst the right lateral is still more cut up by about 10. Finally, the caudate has 3 of these supplementary fissures. P. Z. S. 1881, p. 185.

The gall-bladder is remarkably long, projecting far beyond the anterior margin of the liver, and, as already described, appearing superficially.

It is $2\frac{3}{4}$ inches long from its apex to the commencement of its duct opposite the anterior margin of the left central lobe. The free part is connected by a peritoneal investment to the sides of the cystic fissure.

In a second liver of *Phascolarctos* examined (which, however, having been extracted from a spirit-preserved animal, an adult ♀, is not so well preserved as might be wished) the same general features obtain. The left lateral fissure, however, is less distinct, as is the caudate; and the left central lobe is smaller proportionally to the left lateral. The Spigelian wants the pointed apex; and the development of secondary fissures seems to attain an even greater extent*.

P. Z. S. 1881, p. 186. The bile- and pancreatic ducts open into the duodenum $2\frac{1}{2}$ inches from the pylorus. The pancreatic duct is dilated terminally into a vesicle, which does not receive the bile-duct, the latter opening alongside the former into the intestine.

P. Z. S. 1881, p. 187. The spleen, as usual in Marsupials, is somewhat triradiate in shape, being broader and forked at one end, tapering and more pointed at the other. Its greatest length is $2\frac{1}{4}$ inches. There is a lymphatic gland, the size of a pea, outside each marsupial bone, and a pair of similar ones, superficial, on the neck. The axillary glands are large.

The heart is of the usual Marsupial type. The right auriculo-ventricular valve in membranous, and nearly complete all round the aperture, P. Z. S. 1881, p. 188. being largest on the right side. It is attached to two, or, in one of my specimens, three *columnæ carneæ*, which also decrease in size from right to left. On the side corresponding with the septum the valve is attached,

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* In *Phalangista vulpina* the right central lobe is also, as in the Koala, the biggest, and very deeply divided by a cystic fissure. The gall-bladder, however, does not nearly reach the margin of the liver; the left lateral lobe is much bigger than the right lateral, which is as large as the left central; the caudate is quite free and narrow. All the lobes are remarkably distinct; and their margins are quite simple, with no trace of any such fissures as obtain in the Koala.

The liver of *Cuscus maculatus* is formed on a similar principle, though the right central lobe is not bigger than the left lateral, and the gall-bladder reaches to the liver-margin. All the lobes are simple. The caudate and Spigelian, though small, are quite distinct. The livers of *Belideus sciureus* and *B. breviceps*, *Acrobata pygmæa*, and *Dromicia* (*nana* ?), though differing among themselves considerably in the relative degree of development of their constituent lobes, all agree in having a distinct and free caudate lobe, as well as a Spigelian, and in no system of secondary sulci attaining any degree of development.

In *Phascolomys wombat* the left lateral lobe is the largest; the right central is also large; but the left central is very small, as is the right lateral fissure. The umbilical fissure is distinct, as is the cystic fissure, which allows the gall-bladder, which reaches to the anterior margin of the liver, to appear superficially. There are no distinct caudate or Spigelian lobes, though the former is indicated. There is a tendency particularly on the left lateral and right central lobes, to develop accessory sulci. As in the Koala, too, the small right lateral lobe is pointed below.

not to a *columna carnea*, but by *chordæ tendineæ* inserted on the septal wall. There is apparently only a single opening for the coronary veins, just at the entrance of the *inferior cava* into the auricle.

The aorta gives off, in the specimen which died in the Society's Gardens, three vessels from a common trunk, and then the left subclavian, as in *Phalangista* and most other Marsupials *. In another specimen, however, the arrangement is as in Man and as in *Phascolomys*, the left carotid arising independently from the aortic arch. Of the two *venæ azygos*, each opening into the superior cava of its side, the *left* is much the larger, the right being formed mainly by vessels derived from only the first few intercostal spaces, whilst below these the veins of the right side pass over, behind the aorta, into the *left azygos*. This is an arrangement I have found in several Marsupials examined, including *Phascolomys, Belideus*, *Cuscus*, and *Phalangista*, though *not* in *Petrogale* or *Hypsiprymnus*. In *Phascolomys* there exists a commissural branch between the first intercostal vein on the right side going to the left, and the last going to the right, *vena azygos*. In the Hedgehog, and some other animals according to Prof. Owen (Anat. Vert. iii. p. 553), the right is also smaller than the left *azygos*, though usually the reverse condition holds; and in the highest forms, where there is only *one vena azygos*, it is the *right* that persists.

The external and internal iliac arteries come off separately from the aorta, there being no common iliac arteries. This disposition is, I believe, nearly universal † in the Marsupials, but is by no means confined to them, as I have found it in *Tamandua*, *Tapirus*, and *Hyomoschus*, and Prof. Watson records it in *Hyæna crocuta* (P. Z. S. 1879, p. 89).

The lungs are simple in form. The right side has three, the left two lobes; the lower lobes of each side being about equal in size, and much larger than the others—half as big again as the upper, or two upper, lobes. There is no azygos lobe at all.

The female generative organs of *Phascolarctos* have not been, so far as I have been able to ascertain, hitherto described, though Mr. A. H. Young has lately given us an excellent account, with figures, of the corresponding

* P.S. Feb. 11, 1881. In a fresh specimen of *Belideus breviceps*, which I have just dissected, I find only *one* trunk arising from the aortic arch; this splits up into 3 branches—a left innominate, dividing into the subclavian and carotid branches for that side, a right carotid, and a right subclavian. Moreover, as in no other Marsupial known to me, there is only one anterior cava, the right and left innominate veins joining to form a large trunk, some ½ inch long, which opens into the auricle.

† In a *Cuscus maculatus* that I dissected I found the abdominal aorta splitting up into four trunks, the right and left external, and the right internal iliacs, whilst from the remaining or median (caudal) one, the *left* internal iliac was given off some way below the level of the other.

system in the male. In their essential points they differ in no important respect from those of the Wombat *.

P. Z. S. 1881, p. 189. The ovaries are rounded ovals in shape, considerably depressed, and measuring about ·45 inch along their greatest extent. They are cut up by three or four sinuous fissures ; each of these lobes is further subdivided into ovisacs, which are of large size for a Mammal, though nothing like so big as the large ones figured by Prof. Owen in *Phascolomys*. The ovaries are enveloped to some extent by the fimbriated ends of the Fallopian tubes, and are enclosed, in common with these, in pouches of delicate peritoneum. The fimbriated ends of the oviducts are attached narrowly to the posterior part of the ovary; they extend hence for about 0·5 inch to the *ostium abdominale*.

The Fallopian tubes are a little bent, and are of small calibre, passing gradually into the larger, somewhat fusiform uteri, which, as usual in the Marsupials, are quite separate from each other; muscular, thick-walled, and nearly straight, these open on a prominent, somewhat compressed nipple-like eminence, forming the *os tincæ*, by a small pore. The total length of the Fallopian tubes and uteri is about 1·3 inch from the *ostium* at the commencement of the former. The vaginæ are also two in number, each being bent outwards in a simple curve, and not communicating with its fellow at any point. The lower part of each vagina is thick-walled, with but a small central cavity which opens into the urino-genital sinus by a small pore, 0·2 inch above the opening of the vesical urethra. Above they are thin-walled; and from the internal side is developed a blind *cul-de-sac*, also thin-walled, communicating only with the vagina of its own side and the corresponding uterus, there being a median septum between the two *culs-de-sac*. No opening from the latter into the urino-genital sinus exists in either specimen I have examined. From the *os tincæ* there is prolonged downwards on each side a slightly elevated fold of the mucous membrane, which separates off the vagina proper from the more medianly placed *cul-de-sac*.

Both vaginæ and *culs-de-sac* are lined by smooth mucous membrane, with slight longitudinal rugæ. The two uteri, as well as the vaginæ and their *appendices*, are united together by peritoneum. The two ureters penetrate this to open into the neck of the bladder, beyond the termination of the vaginal *culs-de-sac*. The length of the vaginæ is about 0·65 inch, measured in a straight line ; that of the *culs-de-sac* about 0·45 inch.

The urino-genital sinus is a tube, with moderately thick walls and longitudinally plicated mucous membrane, of 1·3 inch in length. It communicates below by a considerable aperture with the rectum, and the

* For description of these see Owen, P. Z. S. 1836, p. 52, and Anat. Vert. iii. p. 680 *et seq.*

cloaca so formed is surrounded by a common fold of muscles and integument. A small, flattened, linguiform clitoris, not free at its apex, with two grooves above and about 0·2 inch long, is developed on the anterior wall of the cloaca, beginning at the level where the rectum and urinogenital canal meet.

A second specimen examined—an adult female that has been preserved in spirit, and which, judging from the condition of its mammæ, has been a mother—shows exactly the same relations of these parts as that here described, the only differences being in the sizes of some of the parts, due, no doubt, to age. The clitoris, however, is free at the apex and slightly bilobed *. P. Z. S. 1881, p. 190.

The brain of the Koala is represented of the natural size in the accompanying figures (figs. 3–6, p. 185), of which that representing its superior aspect was taken from the brain before being removed from the cranial cavity, and therefore unaltered by displacement or hardening in spirit. The other three figures are drawn from the brain after hardening in alcohol for some months.

The cerebral hemispheres are remarkable for their simple surface, which is broken up by no convolutions. Broadest behind, they taper forwardly, and so are somewhat pyriform in outline when viewed from above. They leave the *corpora quadrigemina* largely exposed behind; and in consequence the cerebellum is left entirely uncovered: indeed, when the parts are undisturbed (fig. 3) it is not even in contact with the cerebral hemispheres. The greatest length of the cerebral hemispheres is about 1·2 inch; their greatest depth about 0·7 inch. Viewed from the side, their superior contour is seen to be but little arched behind, whilst anteriorly it slopes downwards away rather suddenly towards the olfactory

* In *Phascolomys wombat*, in a two-thirds grown female, I can detect no differences of importance whatever from the type here described. The Fallopian tubes are apparently longer, and their fimbriated extremities better developed. The form of the ovaries, and the disposition of the uteri, vaginæ, and urino-genital sinus seem to be nearly precisely similar in the two genera.

In *Phalangista vulpina*, on the other hand, considerable differences occur. The Fallopian tubes are shorter in proportion to the uteri, and are more convoluted. The uteri are more distinct from the Fallopian tubes, are more capacious, and strongly curved outwards. Each *os tincæ* projects as a prominent and quite free papilla into a common vaginal chamber, formed by the coalescence and fusion of the two *diverticula* present in *Phascolomys* and *Phascolarctos*. This chamber is capacious, and has only a very slight indication of a median septum left.

In *Belideus sciureus* the Fallopian tubes and uteri resemble those of *Phalangista*. The vaginæ, however, are much longer and curved on themselves, much as in the Kangaroos. There are apparently two small *culs-de-sac*; but the specimen examined does not allow me to say whether or no they unite. In *Petaurus* (=*Belideus*?), according to Owen (Anat. Vert. iii. p. 682), where the vaginæ are also long and curved, the *culs-de-sac* remain separate.

lobes. These last are not large, and but little exposed; in fact, in the undisturbed state, they are covered, when viewed from above, by the hemispheres. The temporal lobe is small. Superiorly the hemispheres, save for a few slight vascular impressions, are altogether smooth; laterally, a well-defined sulcus, running from the temporal lobe forwards, and curved, first upwards and then downwards, is visible. Anteriorly, this separates off the olfactory tract from the side walls of the hemispheres. A slight indentation, about halfway along its course, at the top of its upward convexity, may represent a rudimentary Sylvian fissure. Just behind this is a second similar, though smaller, impression. The olfactory ganglion is large, as is the tract. Internally, the characteristic features of the Marsupial brain * are distinct, the corpus callosum being small and indistinct, and the anterior commissure very large. The
P. Z. S. 1881, p. 192. hippocampal sulcus is distinct and deep, strongly curved, and continued forwards over the corpus callosum onto the internal face of the hemispheres to a point about 0·15 inch in front of the anterior commissure. Behind is another rather deep, *f*-shaped sulcus, which appears at both ends on the prominent rounded margin of hemispheres. The *corpus fimbriatum* and *fascia dentata* are both distinct. The middle (grey) commissure is very large. Of the *corpora quadrigemina*, the *nates* are longer (from before backwards) than the *testes*. The posterior limb of the crucial impression is not as distinct as the fore one.

In the cerebellum the vermis is well-developed, as are the lateral lobes and the *flocculi*, which have the form of projecting, rounded lobes. The *pons Varolii* is narrow, the anterior pyramids well defined, and the *corpora trapezoidea* distinct.

As compared with *Phascolomys*, the principal points of difference in the brain are the more richly convoluted hemispheres—a distinct *calloso-marginal* sulcus being present, as well as others on the external surface —and the non-projecting *flocculi*, of the latter. *Phalangista* has nearly as simple a brain as the Koala; but the *flocculi* project more.

A consideration of some of the facts on the visceral anatomy of the Koala here stated appears to me to throw considerable light on the classification of the Marsupials. Naturalists generally have placed the Koala in, or close to, the Phalangistidæ; whilst the Wombats have been retained as a separate family or section, of equal value with the former group, the Kangaroos being often, indeed, interposed between the two †. Writing as long ago as 1846, Mr. G. R. Waterhouse, in his 'Natural History of the Mammalia' (vol. i.), though in that work keeping the Phascolomyidæ separate from the Phalangistidæ, evidently

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* *Vide* Flower, Phil. Trans. 1865, p. 647.

† *Cf.* Owen, "Classification of the Marsupialia," P. Z. S. 1839, p. 19; Sclater, Rev. List of Vertebrata, 7th edition, 1879.

P. Z. S. 1881, p. 191.

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 6.

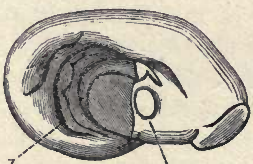

Fig. 3. Right half of Koala's brain, from above, of the natural size; drawn before removal from the skull.

Fig. 4. The same, from below.

Fig. 5. The same, from the side.

Fig. 6. Left cerebral hemisphere, from the inside, the optic thalamus being cut short. *a.c.* anterior commissure; *h.* hippocampal sulcus.

did so with some hesitation. He says (*l. c.* p. 16):—"Upon a careful examination of the Wombat, I find so many points in common with the *Phalangista* group, that it is so intimately connected with the Koala (which is more clearly an aberrant Phalanger), as indicated by the structure of the stomach and the deficiency in the number of the false molars, and the total absence of tail, that I am inclined to regard the genus *Phascolomys* as presenting an aberrant form only of the Phalangistidæ. That the thumb should be reduced to a small size in this animal, which differs from others of its (supposed) family in living upon the ground, I am prepared for, since in the Dasyuridæ the same thing takes place under similar circumstances. I am also prepared to find in an herbivorous group like the Phalangistidæ a difference in the structure of the molar teeth, in having them rooted in one case and rootless in another, for such happens in other herbivorous groups of the Mammalia." Again, in a note on p. 257:—"With regard to the position of the Wombat and the Koala (*Phascolarctos*) in a natural position, I may observe, in the first place, the Wombat (*cæteris paribus*) shows some affinity to the Phalangistidæ in the possession of a thumb, which, though short, is very broad and sufficiently distinct. Then, beyond this, we have to add that P. Z. S. 1881, p. 193. the limbs are equal, the tibia and fibula are widely separated, excepting, of course, at the extremities; and the stomach is simple*, as in the Phalanger group. On the other hand, we perceive in the Koala an animal possessing all the essential characters of *Phalangista*, but in which the stomach is provided with a peculiar glandular apparatus, and the tail is wanting, as in the Wombat. The two animals agree, moreover, very closely in the structure of the humerus; they agree in the non-possession of a patella, in the absence of a *ligamentum teres* †, and in the outermost of the articular surfaces of the upper extremity of the tibia being continuous with the articular surface of the fibula. The skull of the Koala, as compared with that of a typical *Phalangista*, differs in having the posterior palatine openings confined to the palatine bone, which is also the case in the Wombat; the lower jaw differs in the greater extent of the symphysis menti; and, lastly, an approximation to that Rodent-like type of dentition which is exhibited by the Wombat is perceptible in the Koala, in the smaller development of the posterior incisors and canines of the upper jaw, and the total absence of any of those premolars which, in the typical Phalangers, intervene between the

* I suppose by this is meant as opposed to the sacculated stomach of the Kangaroos.

† As regards these last two characters, it must be observed that the first is a character practically common to all Marsupials, excepting the Peramelidæ (*cf.* Flower, 'Osteology of Mammalia,' 2nd ed. p. 306). As regards the alleged absence of a *ligamentum teres*, I find it perfectly well developed in fresh specimens of both Koala and Wombat; on the femur the depression for it, though not distinct, is traceable.

canine and the five molars of the upper jaw, and the incisor and the corresponding teeth in the lower jaw." Dr. Murie, from his examination of the osteology of the Wombats (P. Z. S. 1867, p. 815), appears also to incline to Mr. Waterhouse's view.

In the course of this paper I have already noted several other points of resemblance between the Koala and Wombat, in the presence in both of more or less distinct cheek-pouches, in the absence of a distinct caudate lobe to the liver and the tendency of its lobes to develop additional superficial sulci, and, finally, in the structure of the female reproductive organs. In the Wombat, too, the first traces of the *syndactyle* condition of the pes appears, both externally and also in the structure of the bones. But, to my mind, the most convincing token of their affinity is their possession of the peculiar gastric gland * already referred to and described. In no other Marsupial is there any trace of such a structure visible, whilst in the two forms under consideration its identity is almost precise. That such a unique structure should have been independently developed in two forms unrelated to each other appears to me to be in the highest degree improbable.

The main points of divergence from the Phalangers presented by the Wombat are the peculiarities of its dentition, and its extraordinary cæcum (see the description and figure by Prof. Flower, Med. Times and Gazette, Dec. 14, 1872, p. 642). In its teeth being all rootless, as well as in the equality in the number of its incisors, *Phascolomys* differs from all other Marsupials. But it is highly probable that this peculiar Rodent-like dentition has been brought about in accordance with its mode of life, and that therefore these features, being adaptive, have in reality less importance in classification than has been assigned to them. Moreover, in a very young Wombat's skull preserved in the Hunterian Museum (1795 D), in which the first three molar teeth only in each jaw have cut the gum and are quite unworn, each lobe of the teeth has two quite distinct, though small cusps; hence the second and third teeth on each side have four distinct cusps, and the anterior two, as in the Phalangers generally. The cæcum is no doubt peculiar, and quite unique amongst Mammalia, any resemblance to the "*appendix vermiformis*" of the highest Primates being fanciful. If in these points sufficient reason is considered present for elevating the Wombats to the position of a primary group of the Marsupials—whether such group be called a tribe or a family is no matter—it should not be forgotten that in some features *Phascolarctos*, too, is nearly as peculiar as *Phascolomys* itself. These are mainly:—the peculiar alisphenoidal bulla of the skull; the extraordinary complicated liver, with the elongated gall-bladder; the immensely deve-

P. Z. S. 1881, p. 194.

* It would be interesting to investigate the histological structure of this gland, with the object of determining whether or not the resemblance is more than external.

loped cæcum and cæcum-like ascending colon, with their longitudinal folds of mucous membrane; and the absence of an azygos lobe to the lungs, the Wombats agreeing with the Phalangers in possessing one. Hence it appears to me to be a more natural course to keep these three groups together as subdivisions of a larger one, though whether that one be called a family, or made into a larger section, will depend on the value attached to those ideas by different naturalists. Adopting the former as most convenient, they might be defined briefly as follows :—

PHALANGISTIDÆ.

Diprotodont Marsupialia, with clavicles, and not more than six incisors above. The hallux present; the 2nd and 3rd digits of the pes smaller than the others, and more or less united together by integument. Stomach not sacculated. Cæcum present. Glans penis more or less bilobed; vaginæ provided with median *culs-de-sac* which may unite.

1. PHALANGISTINÆ.

Teeth rooted; superior incisors 3 . 3; at least one small additional premolar on each side above. Tail well developed. No cheek-pouches. Stomach and ascending colon simple. Cæcum long, simple. Liver not complicated by secondary sulci, and with distinct caudate and Spigelian lobes. Lungs with an azygos lobe. Vaginal *culs-de-sac* coalesced (at least in *Phalangista*).

Phalangista, *Cuscus*, *Belideus* *, *Acrobata* *, *Dromicia* *.

P. Z. S. 1881, p. 195.

2. PHASCOLARCTINÆ.

Teeth rooted; superior incisors 3 . 3; additional premolars absent. Tail rudimentary. Distinct cheek-pouches. Stomach with a cardiac gland. Cæcum very long; commencing colon cæcum-like, both being dilated and provided with numerous longitudinal folds of mucous membrane. Liver very much complicated by secondary sulci; caudate lobe not free; gall-bladder immensely elongated. Lungs with no azygos lobe. Vaginal *culs-de-sac* free.

Phascolarctos.

3. PHASCOLOMYINÆ.

All teeth rootless; superior incisors 1 . 1; no additional premolars. Tail and cheek-pouches rudimentary. Stomach as in *Phascolarctinæ*. Cæcum short, peculiar. Commencing colon transversely sacculated. Liver somewhat complicated by secondary sulci; no distinct caudate lobe. Lungs with an azygos lobe. Vaginal *culs-de-sac* free.

Phascolomys.

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* For an opportunity of dissecting examples of these genera I am indebted to the liberality of our President.

35. ON THE CONTRIBUTIONS TO THE ANATOMY AND CLASSIFICATION OF BIRDS MADE BY THE LATE PROF. GARROD, F.R.S.*

Ibis, 1881, p. 1.

It having been suggested to me by one of the Editors of this Journal that a concise *résumé* of the ornithological papers of my late friend and predecessor, Prof. A. H. Garrod, F.R.S., would not only form an appropriate memoir of him, but would also be useful to those ornithologists who are interested in the anatomy of birds and the questions of classification that depend on it, I have endeavoured in the present paper to give a short sketch of the contributions Prof. Garrod made to our knowledge of, and of his views on these points.

In the seven years (1872–1879) during which Prof. Garrod held the post of Prosector to the Zoological Society, no less than thirty-eight papers from his pen (all, with one exception†, published in the Zoological Society's 'Proceedings') appeared, dealing with various points in the anatomy or physiology of birds. Of these a complete list will be found in the January number of this Journal for last year‡. All of these, except two§, are morphological in nature; but many of the characters of birds from the physiological side were fully expounded in his series of Fullerian Lectures at the Royal Institution and elsewhere. At the time of his death, Prof. Garrod was also engaged on an article on the mechanism of flight; for his wonderful mechanical skill enabled him to explain and demonstrate this and other physiological problems in a method but rarely to be met with amongst biologists generally. But this, unfortunately, he left in an unfinished condition.

Ibis, 1881, p. 2.

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* Ibis, 1881, pp. 1–32.

† "Note on some of the Cranial Peculiarities of the Woodpeckers," Ibis, 1872, p. 357.

‡ In addition to his published papers on birds, Prof. Garrod was engaged, as probably many of the readers of 'The Ibis' are aware, on a general account of the Anatomy of Birds, to be published in three fasciculi. As originally planned, the first fasciculus of this work was to contain a complete account of the anatomy (not including the histology) of the common Fowl, as a type of all birds; the second was to be occupied with a comparative account of the "soft parts" in the different groups; whilst the third was, I believe, to have been devoted to osteology and a consideration of the results arrived at as regards classification. Of these three fasciculi, the first was nearly completed at the time of his death, and the second left about half done, nearly all the groups of the "Homalogonatous" birds being treated of in it, together with some of the remaining ones. The MS. of both of these portions has been, fortunately for our science, preserved; and it is my hope some day to complete the work for publication in a form worthy of its original author.

§ "On the Mechanism of the Gizzard in Birds," P. Z. S. 1872, pp. 525–529; "On a Point in the Mechanism of the Bird's Wing," P. Z. S. 1875, pp. 82–84.

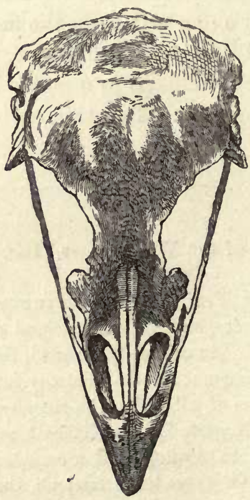
In the present article I propose first to consider those points in the anatomy of birds first brought into notice, or worked out in large groups, by Garrod, and secondly to consider the light thrown by these facts on the correct collocation of various genera, or larger groups, as well as on the arrangement of these latter into groups of a still higher power. But I shall avoid, as far as possible, any comparisons with previously proposed classifications, as it is not my wish to enter, in this place, into discussions of that kind. Under each of these headings I shall endeavour, as far as is consistent with clearness and conciseness, to preserve a chronological order.

Ibis, 1881, p. 3.

I. *On the Conformation of the Nasal Bones**.

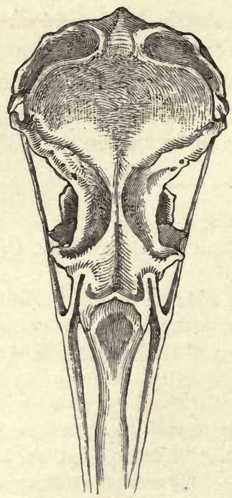
"In most birds the anterior margin of the nasal bone is concave, with the two cornua directed forwards," these processes being "continuous behind with the body of the bone and with one another, there being no interruption of any kind between them. Such a condition is found in *Otis* and the Gallinæ proper; and birds possessing the bone so constructed may be termed *holorhinal*: in them a transverse straight line, drawn on the skull from the most backward point of the external nasal aperture of one side to that of the other, always passes in front of the

Fig. 1.



Skull of *Gallus domesticus* (from P. Z. S. 1873, p. 35, fig. 9).

Fig. 2.



Skull of *Larus argentatus* (from P. Z. S. 1873, p. 34, fig. 2).

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* "On the Value in Classification of a Peculiarity in the Anterior Margin of the Nasal Bones in certain Birds," P. Z. S. 1873, pp. 33–38.

posterior terminations of the nasal processes of the præmaxillæ." This simply concave nature of the posterior margin of the osseous external nares, as well as the relations of the extremities of the nasal bones to those of the nasal processes of the præmaxillæ, is shown in the subjoined figure of the Fowl's skull (see fig. 1).

In a large number of birds, however, the condition of things is different, as will be evident from an inspection of a similar view of a Gull's skull (*Larus argentatus*). Ibis, 1881, p. 4.

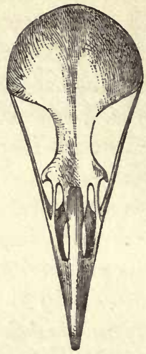
Here (see fig. 2) the posterior margin of the osseous nares has a distinctly slit-like or triangular form, instead of being simply concave; hence the birds presenting this peculiarity, which varies to some extent in the degree of its development in different forms, may be called "*schizorhinal.*" In most of these *schizorhinal* forms the line joining the posterior extremities of the nostrils passes *behind*, instead of in front of, the ends of the nasal processes of the præmaxillæ. When the beak becomes shortened and broad at the base, however, as, *e. g.*, in the Pteroclidæ, this feature nearly disappears. Birds belonging to the *schizorhinal* group are nearly all, with the exception of *Platalea* and *Ibis*, "*schizognathous*," as regards their palate. The "Schizorhinæ" comprise the following minor groups:—Columbidæ, Pteroclidæ, Turnicidæ, Parridæ, Limicolæ (except *Œdicnemus*, which is holorhinal, therein agreeing with the Bustards), Laridæ, Gruidæ, Eurypygidæ, Rhinochetidæ*, Plataleidæ (the *Hemiglottides* of Nitzsch), and Alcidæ. *Aramus* also, as shown by Prof. Garrod's later investigations †, must be included here, being schizorhinal, like the Cranes. All these birds, it may be noticed, belong to the *Homalogonatous* series, possessing, at least normally, the *ambiens* muscle, presently to be referred to. In 1877 Prof. Garrod discovered that a similar conformation of the skull, as regards these bones, obtains in certain of the South-American "Formicarioid" Passeres—that is, in *Furnarius* and some of its allies ‡ (*Leptasthenura*, *Synallaxis*, *Sclerurus*, and *Phlœocryptes*), as may be seen in fig. 3, where that of *Furnarius rufus* is represented. Referring to this, he says, "It has been my habit to group all the birds possessing a schizorhinal skull in a single major division . . . but the independent development of an identical disposition in the small division of the Passerine birds above mentioned weakens the Ibis, 1881, p. 5.

* To these may be added, as I have Prof. Garrod's authority for doing, *Mesites*, as is shown by M. A. Milne-Edwards's investigations (*v.* Ann. Sc. Nat. ser. 6, vii. art. no. 6). The Rallidæ, with which that naturalist associates *Mesites*, are all *holorhinal*, at the same time that they lack the powder-down patches of *Mesites*, *Rhinochetus*, and *Eurypyga*.

† P. Z. S. 1876, p. 275.

‡ "Note on the Anatomy of Passerine Birds.—Part II.," P. Z. S. 1877, pp. 449-452.

Fig. 3.



Skull of *Furnarius rufus*, showing its schizorhinal character (from P. Z. S. 1877, p. 450, fig. 3).

importance of the character to a certain extent, although it is not at all necessary to assume that it overthrows its significance. Collateral evidence, from visceral and other details, compels me still to think that those schizorhinal birds which possess the ambiens muscle, or are, in other words, homalogonatous, must be retained in one great order, *Charadriiformes*, until some important structural differences are discovered which necessitate their being otherwise arranged. The schizorhinal disposition is most certainly one which is a secondary development upon the normal holorhinal one; and that it has been independently arrived at in two non-related orders of the class is proof that it results from most simple causes, because the *probability* that the same complex conformation should appear, *de novo*, varies inversely as the complexity; the greater the elaborateness the less the chance that it, in all its detail, comes into existence more than once."

Ibis, 1881, p. 6.

II. *The Carotid Arteries.*

The variations in the position of the carotid arteries in birds had been studied by Meckel, Bauer, Barkow, and others; but their opportunities of observation were limited, for the most part, to European species. Prof. Garrod, in his paper on the subject*, has recorded their condition in 400 species of birds, of 300 different genera; in his subsequent papers, or MS. notes, many additional species are included.

From a consideration of these, six different modifications in the disposition of these vessels may be traced:—

* "On the Carotid Arteries of Birds," P. Z. S. 1873, pp. 457–472.

(1) The two carotids, each springing, as usual, from the innominate artery of its side, after the latter has given off the pectoral and subclavian branches, run up in a converging manner into the neck, and then continue, closely parallel to but quite free from one another, up along the under surface of the neck, in a bony canal or passage formed by the hypapophyses of the cervical vertebræ, to near the head, where they again diverge and break up for the supply of that part. This may be considered the most typical and least modified form: it is present in a very large number of birds.

(2) Where, instead of both carotids being developed, only one, the left, is so, the right having disappeared. This is a condition constant in all Passeres, as well as in sundry other birds.

(3) Where the right artery is present in its normal position in the hypapophysial canal; but the left runs up the neck superficially in company with the left jugular vein and *vagus* (pneumogastric) nerve. This condition is present only in certain Parrots.

(4) Where the two arteries, instead of running parallel, *blend* together at the lower part of the neck, running up then as a *single* trunk in the normal position till its bifurcation near the head. This is an exceptional condition. The two trunks before blending may be equal in size (*Botaurus stellaris*), or either the right (*Phœnicopterus*) or the left (*Cacatua sulphurea*, according to Meckel*), may be the bigger.

To these four conditions, duly noticed in Prof. Garrod's paper above quoted, may be added two more:— Ibis, 1881, p. 7.

(5) When the *right* carotid only is present, as is the case †, as discovered by him, in the Bustards of the genus *Eupodotis*.

(6) In *Bucorvus abyssinicus*, as discovered by my friend Mr. W. Ottley, who, at Prof. Garrod's request, undertook a reexamination of the question, the two carotid arteries are reduced to fibrous imperforate cords, and their place is taken (functionally) by two vessels which are apparently enormously enlarged equivalents of the *comes nervi vagi* of other birds ‡.

From these facts it is evident that, taken *per se*, the disposition of the carotid arteries has not much significance amongst birds, there being many families in which, whilst the majority of the species have two, some have only one carotid. This, for instance, is the case with *Toccus* and *Buceros* amongst the Bucerotidæ, *Plotus* and *Phalacrocorax* amongst

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* Prof. Garrod was unable to confirm this statement in the only specimen dissected by him (P. Z. S. 1874, p. 588).

† P. Z. S. 1874, p. 473.

‡ "On a Peculiarity in the Carotid Arteries and other Points in the Anatomy of the Ground-Hornbill," P. Z. S. 1876, pp. 60, 61. Also "A Description of the Vessels of the Neck and Head in the Ground-Hornbill (*Bucorvus abyssinicus*), by W. Ottley, F.R.C.S.," P. Z. S. 1879, pp. 461–467.

the Steganopodes, *Cypselus* and *Cypseloides* in the Swifts, &c.: in all these cases the first-named genera have but *one*, the others two, carotids. In other cases, however, the characters of the carotids hold good through very large groups: thus no Passerine bird has ever yet been found with more than a left carotid, and no Pigeon, Duck, or Bird of Prey without two normally placed ones.

III. *The Disposition of the Vessels of the Thigh.*

In Man aud other Mammals, so far as I am aware, the main nerve of the leg is the sciatic; the main artery and vein are the *femoral*, running in the front of the leg. In Birds, as a rule, the main artery accompanies the *sciatic* nerve, running close above and parallel to it; the vein remains the femoral.

Ibis, 1881, p. 8. To these rules certain exceptions were first pointed out by Prof. Garrod. Thus, in *Centropus phasianus* *, though *not* in *Centropus rufipennis*, or any of the other Cuculidæ examined by him, as well as in all the species of Pipridæ and Cotingidæ, eight in number, dissected (except *Rupicola crocea*), the main artery of the leg accompanies the femoral vein: it is a *femoral* artery †.

Again, in *Dacelo gigantea* and *D. cervina* ‡, the femoral vein is replaced by one which lies between its normal position and the sciatic artery, crossing over, instead of under, the femoro-caudal muscle; and the same is the case, as recorded by him in an unpublished (and, unfortunately, unfinished) paper "On the Anatomy of *Pelecanoides*," in that singular form of Petrel. These two cases are, I believe, the only ones yet recorded of this unexpected arrangement.

IV. *The Muscles of the Thigh* §.

The myology of birds was always one of Prof. Garrod's favourite subjects; and of his various myological papers, the two enumerated below may fairly be considered the most important, as from the facts detailed therein he drew up, *in part*, the only detailed scheme of a classification of birds ever published by him.

In the region of the thigh of birds there are six muscles, which may or may not be present, though no known bird wants them all. These six

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* P. Z. S. 1873, p. 629, note.

† Since writing the above, I have found the same to be the case in my specimens of *Corythaix persa* (two), *C. porphyreolopha*, and *C. erythrolopha*, and in *Musophaga violacea*. In *Schizorhis africana* (two), however, the normal condition persists.

‡ P. Z. S. 1873, p. 629.

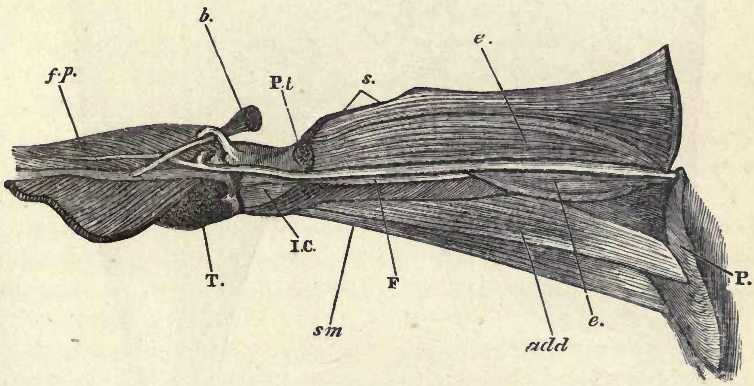
§ "On certain Muscles of the Thigh in Birds, and on their Value in Classification.—Part I.," P. Z. S. 1873, pp. 626–644; "Part II.," P. Z. S. 1874, pp. 111–123, pl. xvii.

muscles are the *ambiens*, the *gluteus primus*, the *semitendinosus*, the *accessory semitendinosus*, the *femoro-caudal*, and the *accessory femoro-caudal**.

These will here be all considered seriatim; they may all, it may be mentioned, be well seen in the common Fowl. Ibis, 1881, p. 9.

(1) The *ambiens*.—This muscle, unlike the others to be subsequently mentioned, lies on the lower or inner surface of the thigh. As generally developed, it is a more or less slender fusiform muscle, which, arising from the præpubic spine or process of the pelvis, close in front of the acetabulum, runs along the inner side of the thigh superficially, and then, turning slightly outwards, runs, as a thin tendon, in the fibrous tissues covering the knee-joint (in some cases perforating the *patella*) to the outer side of the leg, and terminates there by joining one of the tendons of the superficial flexor of the toes, the *flexor perforatus digitorum*. The course of this muscle will be made clear by the accompanying representation of

Fig. 4.



Thigh of Touraco (*Corythaix erythrolopha*) viewed from the inner side, to show the ambiens muscle, arising from the præpubic spine of the pelvis (P), and running along to blend with one of the tendons of origin of the flexor perforatus digitorum (*f. p.*). F, femur; *Pt*, patella; I.C, inner condyle of femur; T, tibia; *b*, biceps (cut short); *s*, sartorius (also cut); *e*, *e*, extensor femoris; *s m*, semimembranosus; *add*, adductores.

N.B. The surrounding parts have been somewhat distorted from their natural positions to show better the course of the ambiens.

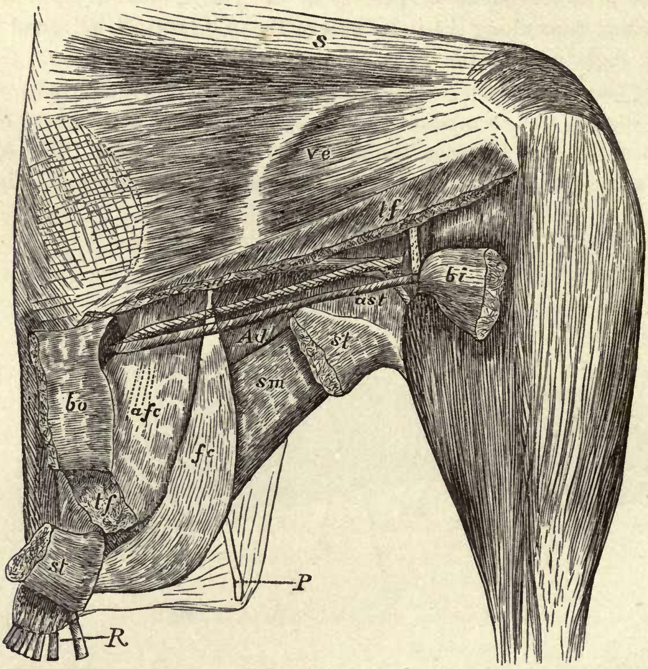
it, as seen in a Touraco (*Corythaix erythrolopha*). In one or two cases (e. g. *Œdicnemus*, *Stringops*) it tends to become obsolete after reaching the knee, becoming lost in the capsule of the knee-joint. In all Passerine birds, and some others, it is always absent. Ibis, 1881, p. 10.

* It is not my object in this paper to discuss the homology of the muscles here so named with those of other Vertebrata.

(2) The *gluteus primus.*—In Garrod's earlier papers this muscle is called the "*tensor fasciæ*;" and it is described under that name in the first of the two papers quoted.

Like the four next muscles, this lies on the upper (or outer) surface of the thigh, and with them may be seen in the annexed figure. It is entirely superficial, lying beneath the skin, and not requiring any dissection

Fig. 5.



Outer view of right thigh of *Gallus bankiva*, partially dissected (from P. Z. S. 1873, p. 627, fig. 1).

P, pubis; R, rectrices; *s*, sartorius; *v e*, vastus externus; *t f*, gluteus primus (cut) origin and insertion; *b o*, biceps origin; *b i*, biceps insertion; *f c*, femoro-caudal; *a f c*, accessory femoro-caudal; *s t*, semitendinosus; *ast*, accessory femoro-caudal; *Ad*, adductor.

or its display. More or less triangular in shape, it arises "from the
Ibis, 1881, p. 11. whole length of the postacetabular ridge," as the ridge separating the lateral from the dorsal surface of the postacetabular area of the pelvis may be called, "as well as from the posterior border of the ischium, as far forward as its junction with the pubis." Its fibres converge and become blended with those of the *extensor femoris*, forming with them a broad thin aponeurosis which covers the front of the knee and is inserted into the tibia-head—the patella, when present, being developed in it.

The degree of development of this muscle (whose cut surfaces are marked *tf* in fig. 5) varies much in different groups of birds, and in some may be entirely absent, *e. g.* the Bucerotidæ and Palamedeidæ. As a rule, it is not small. In the paper on *Chauna* * a table will be found stating the degree of development of this muscle in the greater number of families (*l. c.* p. 199).

(3) The *semitendinosus.*—Generally a broad flat ribbon-shaped muscle, bordering the contour (sometimes together with another muscle, the *semimembranosus*) of the fleshy part of the thigh behind. It arises from the transverse process of the first free coccygeal vertebra, and from the fibrous membrane between this and the ilium; it is inserted into the inner side of the head of the tibia (at least when the muscle next to be described is absent).

(4) In many birds "a rhomboidal sheet of muscle, arising from the anterior end of the *linea aspera*" (a muscular line on the under surface of the femmr) joins the last-named muscle "anteriorly by an oblique tendinous raphe, which continues down the back of the leg superficially." When present, most of the main *semitendinosus* joins this *accessory* head to be continued down the leg.

(5) The *femoro-caudal.*—This is a thin, narrow, elongated muscle, which is covered above by the *gluteus primus* (if present) and the *biceps cruris*, below by the *semitendinosus.* Arising from the last two coccygeal vertebræ, it is inserted into the *linea aspera* of the femur at about one third its length (in the Fowl) from the trochanter.

(6) In many birds the *femoro-caudal* is joined by an *accessorius*, which arises from the external surface of the pelvis behind the femur, and joins the main muscle, to be inserted with it into the femur, but nearer the head of that bone. Ibis, 1881, p. 12.

As already mentioned, some birds possess *all* these six muscles, but no bird is known which does not possess at least one. It is a convenient plan to designate the four last-named muscles by the letters X, Y, A, B. Thus a Fowl possessing all four would have a formula A.B.X.Y, the *femoro-caudal*, *accessory femoro-caudal*, *semitendinosus*, and *accessory semitendinosus* being all present. On the other hand, a Hawk or Owl, possessing only *one*, the *femoro-caudal*, would have as formula A.

Of these four muscles there are sixteen possible combinations; but of these only eight are actually found in birds †.

Furthermore, if we denote the presence or absence of the *ambiens* muscle by the signs + or —, we obviously get sixteen combinations again, though of these only fifteen have, as yet, been observed. For the sake of brevity it will be useful to remember the above four letters, to save the repetition of the full names. To the bearing of these muscles in the classification of birds, I intend to revert at a subsequent part of

* "On the Anatomy of *Chauna derbiana*," &c., P. Z. S. 1876, pp. 189-200.

† P. Z. S. 1874, p. 111.

this paper, only stating here that species of the same genus and nearly allied genera have, nearly in every case, *the same* myological *formula*, and that in *families* peculiarities involving more than *one* change are rare, further differences indicating a more remote relationship.

V. *The Distribution of the Deep Plantar Tendons**.

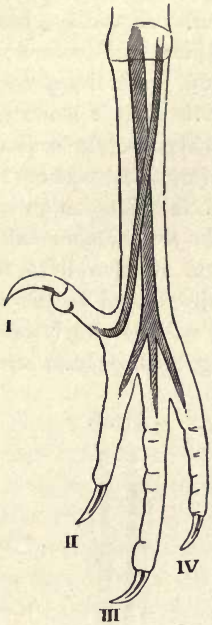
In all birds, whatever number of toes they have, there are two deep *flexor* muscles of the toes, the fleshy bellies of which are situated between the knee and the "ankle," whilst their tendons run along the posterior aspect of the tarso-metatarse. One, arising from behind the external condyle of the femur, is the *flexor longus hallucis*; the other, arising from the posterior aspect of the tibia and from the fibula, is the *flexor perforans digitorum*, so called because its terminal tendons per-
Ibis, 1881, p. 13. forate those of the more superficial *flexor perforatus* (the muscle, it will be remembered, joined by the tendon of the *ambiens*). Below the "ankle" the tendons of these muscles run along the tarso-metatarse; whatever their ultimate distribution, they may be easily identified in this region, the *flexor longus hallucis* being always external to, or superficial of, the *flexor perforans* (or both). In all the Passeres, as already noticed by Sundevall (except in the Eurylæmidæ, *vide infrà*), as well as in *Upupa epops* and perhaps one or two Ardeine birds, these two tendons are quite independent of each other, so that if the *flexor hallucis* be artificially pulled no flexion (closing) of the other digits takes place. This arrangement is represented in fig. 6. In all other birds, however, the two tendons, during some part of their course in the tarso-metatarse, are more or less intimately connected together by a fibrous band or *vin-*
Ibis, 1881, p. 14. *culum*, or may even completely blend. It is to a consideration of the varying arrangements produced that this paper of Prof. Garrod's is in the main dedicated; and some of the most important modifications may be noticed here.

In a large number of birds the type presented by the common Fowl obtains. Here the *flexor perforans* supplies digits II–IV, and the *flexor hallucis* only digit I (the hallux); this, as it crosses the tendon of the *flexor perforans*, sends down a strong fibrous *vinculum* (*vide* fig. 7, V). The proportions of the *vinculum* to the main tendon (that distributed to the *hallux*) vary greatly, as it may or may not be greater than the hallucial portion. In some Birds of Prey a *vinculum* may be combined with a special slip of tendon to digit II, or it may be nearly entirely distributed to that digit. In the Cathartidæ a quite different arrangement, next to be described, obtains. Here, and in many other birds, particularly amongst the *Anomalogonatæ*, the two tendons blend completely, and the

* "On the Disposition of the Deep Plantar Tendons in different Birds," P. Z. S. 1875, pp. 339–348.

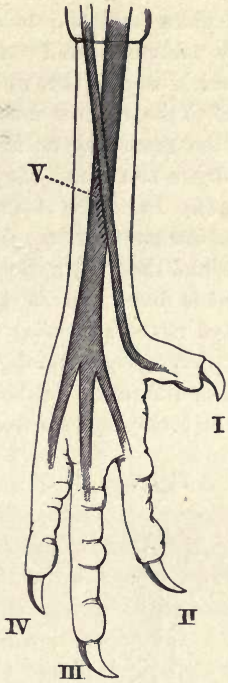
Ibis, 1881, p. 13.

Fig. 6.



A typical Passerine foot
(from P. Z. S. 1875, p. 347, fig. 9).

Fig. 7.



Foot of *Gallus bankiva*
(from P. Z. S. 1875, p. 341, fig. 1).
V, Vinculum.

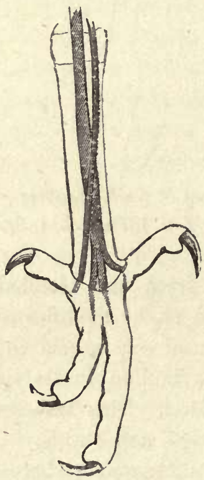
tendinous slip to the hallux comes off from the blended tendon, apparently springing from the *inner* side. A slight modification of this produces an arrangement by which the hallucial slip seems to come off from the inner side of the *flexor perforans* tendon in its *upper* part, before it has been joined by the *flexor hallucis.* This last-named condition obtains in such birds as *Momotus*, *Merops*, and *Dacelo*. Ibis, 1881, p. 14.

When the hallux is absent, as well as in *Struthio* (where only two digits are present), the two tendons fuse completely in the leg, and the compound tendon is distributed in the usual way to the three (or two) digits. In many birds with a hallux, when there is no long flexor to that digit, the slip to it is extremely small; and in some cases it is altogether absent.

In the Trogonidæ, as might have been expected from the well-known peculiarity of their feet, an equally peculiar arrangement of the plantar tendons obtains (*l. c.* p. 345, fig. 6).

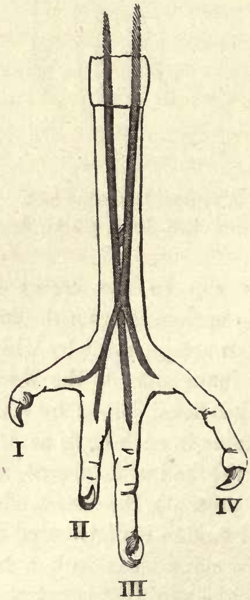
By far the most interesting feature, however, brought out by Prof. Garrod's investigations into this subject, is the discovery of the existence of two entirely different types of plantar arrangement in the so-called Ibis, 1881, p. 15. "zygodactyle" birds, as well as the fact that this diversity of type exactly coincides with the two groups of birds so marked out being respectively "*Homalo-*" and "*Anomalogonatous.*" Thus, in the Parrots, Cuckoos, and Musophagidæ, which are all *Homalogonatous*, *possessing* (at least typically) the *ambiens* muscle, the plantar tendons are distributed in exactly the same way as in the common Fowl, the *flexor perforans* supplying digits II–IV, and the *flexor hallucis* digit I alone (neglecting the *vinculum*). In *all* the *Anomalogonatous* zygodactyle birds (which *all lack* the *ambiens* and *accessory femoro-caudal* muscles), namely the Picidæ, Capitonidæ, and their allies, Bucconidæ and Galbulidæ, an entirely unique arrangement is found; for in those birds the *flexor longus hallucis* splits up into *three* parts, *supplying digits* II and IV as well as the *hallux*, whilst the *flexor perforans digitorum* is distributed to the *third digit alone.* These differences in the two types will be clearly seen by comparing fig. 8 (*Crotophaga sulcirostris*) and fig. 9 (*Megalæma asiatica*).

Fig. 8.



Foot of *Crotophaga sulcirostris.*

Fig. 9.



Foot of *Megalæma asiatica.*

(From P. Z. S. 1875, p. 346, figs. 7 & 8.)

Ibis, 1881, p. 16.

VI. *The Method of Insertion of the* Tensor patagii brevis *Muscle.*

In the patagial membrane of the wing in most birds there are two muscles present, the fleshy bellies of which arise chiefly from the scapular extremity of the furcula, whilst their tendons run between the two layers of membrane of which the *patagium* is composed. These muscles are the *tensor patagii longus* and the *tensor patagii brevis*. Arising in common, or in close proximity to each other, the tendon of the *tensor patagii longus* forms the more or less stiffened, though flexible, anterior border of the *patagium*; the tendon of the shorter of the two muscles runs more or less parallel with the humerus, ending near the elbow-joint. In different birds its insertion takes place in different ways, the tendon in some cases simply running straight on to the ulnar side, and there becoming blended with the general fascia of the part, whilst in others it becomes united, more or less intimately, with the tendinous origin, springing from a tubercle on the humerus, of a muscle lying on the radial side, the *extensor metacarpi radialis longior*. In some cases additional slips from the main tendon are given off, the arrangement sometimes thus getting very complicated (*e. g.*, in the Trogonidæ). As a rule, every natural family of birds has a characteristic arrangement of these tendons; so that their disposition often affords great help in classification. This is the case, for example, in the Passeres; throughout the whole of that immense group one arrangement, only slightly masked in one or two aberrant forms, which can be easily recognized and is most characteristic, obtains. The same is the case with the very closely allied groups of Picidæ, Ramphastidæ, Capitonidæ, and Indicatoridæ. These points were first worked out by Prof. Garrod in the first of his papers on Passerine birds*; and the arrangements in nearly all the families of his "Anomalogonatous birds" are there described and in several cases figured. In the Homalogonatæ, too, they offer nearly as well-marked peculiarities, though, unfortunately, his purpose of describing and figuring their arrangement in these birds was never carried out. In his MSS. and drawings, however, he has recorded their condition in very many groups. **Ibis, 1881, p. 17.**

VII. *Certain other Muscles.*

In his paper on *Chauna* (*suprà*, p. 197), Prof. Garrod, for the first time, called attention to the value in classification of certain other myological facts. These are :—

(1) The presence or absence of the "*expansor secundariorum*" muscle. This is a slender muscle which arises from the last few (generally two or three) secondary quills and has a peculiarly long and slender tendon, which, running superficially posterior to the humerus, together with the axillary vessels and nerves, is inserted into the thorax in different ways in different birds. One common arrangement is that found well developed in the Storks, and hence called "ciconiiform." Here the proximal part of the tendon is T-shaped, it splitting into two parts, one being

* P. Z. S. 1876, pp. 506–512, pls. xlviii.–li.

inserted into the coracoid near the junction of this bone with the sternum, the other into the scapula close to the coraco-scapular articulation. In other cases the tendon may end by joining the *coraco-brachialis brevis* muscle, so as to appear to be part of that muscle, as in the Fowl and most of the Gallinaceous birds; or the tendons of the two sides may join in the middle line, as in most of the Anseres; or other and more complicated arrangements, duly described in the paper above referred to, may obtain. The only Anomalogonatous birds in which this muscle is present are the Coraciidæ. A table (*l. c.* p. 199) records the nature of this muscle in the families of Homalogonatous birds. In many it is quite absent.

(2) The presence or absence of a *biceps* slip to the *patagium* of the wing.

In many birds there is given off from the anterior margin of the *biceps* muscle of the arm a distinct and most peculiar muscular slip, which joins the patagial membrane of the wing. Its presence or absence is a very constant character amongst closely allied birds.

(3) The area of origin of the *obturator internus* muscle.

Ibis, 1881, p. 18. This muscle, arising in the interior of the pelvis, is inserted proximad of the *obturator externus* on the head of the femur. In most birds its shape, as seen in the pelvis, is more or less oval; but in some, as in the Gallinæ and Rails, it is distinctly *triangular*. Both its character and the presence or absence of a *bicipital slip* are recorded in the majority of the Avian families, in the table already mentioned in the account of the *expansor secundariorum*.

Besides these, a few other myological peculiarities insisted on by Prof. Garrod in various papers may here be named, such as the presence of an additional secondary femoro-caudal muscle in *Apteryx*, and the presence in it, as well as in the other "Struthious" birds and the Crypturi, of a muscular slip to the accessory femoro-caudal above the exit of the sciatic nerve and artery *; the occasional complete absence of the *semimembranosus* in some of the Grebes †; and the double condition of the great pectoral muscle in the Storks, Steganopodes, Petrels, and their allies ‡.

VIII. *The Conformation of the Trachea and Syrinx.*

The curious contortions of the trachea, and other peculiarities of its structure, in various birds, such as the Cranes, Spoonbill, and Ducks, have long been known to ornithologists; and, as far as concerns this portion of the subject, Prof. Garrod's notes on these structures in various

* P. Z. S. 1873, pp. 643, 644, fig. 6.
† P. Z. S. 1873, pp. 629, 642.
‡ P. Z. S. 1874, p. 120, and 1876, p. 340.

forms * are simply confirmations of, or additions to, our previous knowledge of the subject. But, so far as I am aware, little or no attention had ever previously been paid to the details of modification in the cartilaginous or ossified tracheal and bronchial structures concerned in the formation of the hard framework of the lower larynx, or "syrinx." Garrod's investigations into this subject therefore mark a new line of departure; and it is exceedingly to be regretted that only one part of his notes on the subject were completed before his death, these forming his paper "On the Conformation of the Thoracic Extremity of the Trachea in the Class Aves.—Part I. The Gallinæ"†, the last contribution of his pen to ornithological science. There is every reason to believe that this line of research, when prosecuted further, will lead to most valuable results as a means of separating, on anatomical grounds, allied genera or families of birds‡. Of his investigations of the lower larynx of the Passeres I propose to speak later, under that head.

Ibis, 1881, p. 19.

In the remaining part of this paper I propose to consider the results arrived at, from the consideration of these and other anatomical features, by Prof. Garrod as to the relationships of various obscure forms of birds, and also to describe certain remarkable peculiarities of others as first discovered by him. In these remarks, as before, I shall, for convenience' sake, follow, as nearly as possible, a chronological order, reserving, however, till the last any general views on the classification of birds as a whole.

1. *Struthio* §.—In this paper, written in conjunction with Mr. Frank Darwin, the principal point of interest is the discovery, or, at all events, first notice, of a peculiar nodule of bone lying on the centre of the pubis, and, in some respects, similar to the "marsupial" bone of the Implacental Mammalia and its corresponding fibrous representative in certain Carnivora.

Ibis, 1881, p. 20.

* "On the Form of the Lower Larynx in certain Species of Ducks," P. Z. S. 1875, pp. 151–156 (the species described are *Sarcidiornis melanonota, Rhodonessa caryophyllacea*, and *Metopiana peposaca*); "On the Form of the Trachea in certain Species of Storks and Spoonbills," P. Z. S. 1875, pp. 297–301 (*Tantalus ibis* and *Platalea ajaja*); "On the Trachea of *Tantalus loculator* and of *Vanellus cayennensis*," P. Z. S. 1878, pp. 625–629.

† P. Z. S. 1879, pp. 354–380, figs. 1–35.

‡ A second part of Garrod's notes on the trachea, describing that of the Cuculidæ, I found in a nearly complete state amongst his MSS., as well as a very considerable mass of drawings and notes on this subject in other groups, it having been the special object of his study up to within a very few weeks of his death. Indeed, during all his last illness, when too weak to attend to larger and less convenient objects, he continued to work away with all his old enthusiasm and energy at the windpipes of birds, especially those from the extensive collection of Procellariidæ &c. made by H.M.S. 'Challenger.'

§ "Notes on an Ostrich lately living in the Society's Collection," P. Z. S. 1872, pp. 356–363.

2. *Heteralocha**.—In 1872 the true affinities of the Huia bird were quite uncertain, many authorities placing it amongst the Hoopoes (Upupidæ). From an examination of the specimen that lived in the Zoological Society's Garden's, Prof. Garrod was enabled to show that it was truly Passerine, and not only so, but in many respects so peculiarly *Sturnine*† as to entitle it to a place "at the head of the family."

3. *Steatornis*‡.—Besides the myology and visceral anatomy, the pterylosis, skull, and syrinx (which is "bronchial") are particularly described and figured. The result arrived at, as regards the systematic position of *Steatornis*, is that it must form a family by itself, with strong affinities to the Owls, Caprimulgidæ, and Coraciidæ and their allies.

4. *Columbæ*§.—In these papers the number of the rectrices (varying from twelve to twenty in different genera), together with the presence or absence of the oil-gland, of the cæca, and of the ambiens muscle, is recorded in a large number of forms, and, from the various combinations of characters so obtained, an attempt is made to divide up the group of Pigeons, in which are included the Pteroclidæ, in a more natural way than has hitherto been done. Attention is also called to the characteristic form of the humerus in these birds, as well as to the peculiar form of the gizzard in the genus *Ptilopus*, there being here *four* crushing-pads, instead of two as in all other birds, including even *Treron*.

Ibis, 1881, p. 21. In *Carpophaga latrans* the stomach is even more peculiar; for here the epithelial lining of the gizzard is developed into about two dozen horny conical processes, like the tubercles of a *Cidaris* or similar Sea-urchin. A similar condition has been described by MM. Verreaux and Des Murs in *C. goliath* of New Caledonia‖; but no other species of *Carpophaga* yet examined shows any trace of such a structure.

5. *Psittaci*¶.—In these papers, as in the last, the condition of certain structures is recorded in a large number of forms, and from the

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* "Notes on the Anatomy of the Huia Bird (*Heteralocha gouldi*)," P. Z. S. 1872, pp. 643–647.

† Mr. Sharpe must, we fear, have overlooked this paper of Prof. Garrod's, as he still retains *Heteralocha* amongst the Corvidæ (Cat. Birds, iii. p. 143), quite in opposition to the conclusions above stated.

‡ "On some Points in the Anatomy of *Steatornis*," P. Z. S. 1873, pp. 526–535.

§ "On some Points in the Anatomy of the *Columbæ*," P. Z. S. 1874, pp. 249–259; "Notes on two Pigeons, *Ianthœnas leucolæma* and *Erythrœnas pulcherrima*," P. Z. S. 1875, p. 367; "Note on the Gizzard and other Organs of *Carpophaga latrans*," P. Z. S. 1878, pp. 102–105.

‖ This has lately been described at greater length and figured by M. Viallanes (Ann. Sc. Nat. ser. 6, vii. art. no. 12).

¶ "On Points in the Anatomy of the Parrots which bear on the Classification of the Suborder," P. Z. S. 1874, pp. 586–598, pls. lxx., lxxi.; "Notes on the Anatomy of certain Parrots," P. Z. S. 1876, pp. 691, 692; "Note on the Absence or Presence of a Gall-bladder in the Family of Parrots," P. Z. S. 1877, p. 793.

combinations of characters so obtained a scheme of classification is sketched out, each group having assigned to it a formula stating its most essential characters. The presence or absence of the ambiens muscle, of a furcula, and of an oil-gland are the points here laid stress on, together with the condition of the carotid arteries. Of these there may be either two normally situated, or only one, the left (*Cacatua* and *Licmetis tenuirostris*), or two, the *left* of which, instead of running with its fellow in the hypapophysial canal, as already explained, runs *superficially* up the neck with the left *vagus* nerve and jugular vein. This last condition, which obtains *in no other birds*, is considered, as I think rightly, sufficiently important to divide off as a main group of Psittaci all those possessing it—a group including *all* the American Parrots, together with the Platycercidæ (including *Lathamus*), *Nestor*, *Dasyptilus*, and the African Parrots, other than *Agapornis* and *Palæornis*, of the Old-World forms. The further subdivision of these groups is effected in the way already indicated. In a supplementary note attention is called to the probably invariable presence of a gall-bladder in the *Cacatuinæ*, though this organ has not been found in any other Parrots. In a preceding paper* Prof. Garrod has described and figured the tongue of *Nestor*, which, as he shows, is peculiar, and *not* like that of the Lories, with which it has often been associated. Ibis, 1881, p. 22.

6. *Otididæ*†.—In *Eupodotis australis* there is *not*, as had been supposed, and even stated‡, by previous observers, a gular pouch, such as has been seen in *Otis tarda*. On the contrary, the *œsophagus* is highly *distensile*, and so produces the singular appearance of the males of this bird when excited during the breeding-season. In a young male specimen of *Otis tarda* examined, there is also no gular pouch present; but the *frænum linguæ* was double; and it is suggested that the pouch which *has* been found in the males of that species is due to a rupture and distention of the mucous membrane between this duplicate frænum, owing to the inflation of the air-passages during the period of display.

7. *Chauna*§.—The pterylosis, visceral anatomy, myology, and cranial and other characters of the Derbyan Screamer are here fully described. The very peculiar nature of the alimentary canal, in the glandular parts of the *proventriculus* forming, not a zone, but a patch, as well as in its possession of long *sacculated* cæca, without any spiral valve, which open into a special division of the intestine situated between the colon and

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* "Note on the Tongue of the Psittacine genus *Nestor*," P. Z. S. 1872, pp. 787–789.

† "On the 'Showing-off' of the Australian Bustard," P. Z. S. 1874, pp. 471–473; "Further Note on the Mechanism of the 'Show-off' in Bustards," P. Z. S. 1874, pp. 673, 674.

‡ Ibis, 1862, p. 114.

§ "On the Anatomy of *Chauna derbiana*, and on the Systematic Position of the Screamers (Palamedeidæ)," P. Z. S. 1876, pp. 182–200, pls. xii.–xv.

the ileum, is particularly worthy of notice, *Chauna** being absolutely unique amongst birds in this combination of characters. In its pterylosis and syrinx, too, it is very peculiar. As a result of his examination, Prof. Garrod concludes that the *Palamedeæ* cannot be placed amongst the Anseres, as had been done by Professors Parker and Huxley, but must form an independent group of birds, having probably "sprung from the primary avian stock as an independent offshoot at much the same time as did most of the other important families."

Ibis, 1881, p. 23.

8. *Aramus*†.—In the schizorhinal character of its skull, as well as in the presence of occipital foramina, *Aramus* resembles *Grus*, *Ibis*, *Platalea*, and the Limicolæ, and not the Rallidæ, with which it had generally been associated previously; and this collocation is quite confirmed by its myology and visceral anatomy.

9. *Plotus*‡.—In the first paper the anatomy of *P. anhinga* is described at considerable length—particular stress being laid on the curious arrangement of the cervical vertebræ which makes this bird literally *unable* to carry its neck straight, and the correspondingly modified muscular system. Other points described are the presence of but *one* carotid artery, and of but *one* cæcum—the latter a feature previously unknown in any Steganopodous bird, though constant in the Herons. The most interesting feature, however, of *Plotus anhinga* is its very extraordinary stomach, previously only partially described by Macgillivray. The *proventriculus*, instead of forming a zone or patch, is here developed into a special sac-like *diverticulum*, which projects from the gizzard externally in a way quite unlike that of any other bird. Moreover the pyloric compartment of the stomach, which is present in a less complete form in *Pelecanus*, the Herodiones, Falconidæ, &c., here develops a covering of hairs, "a peculiarity which, as far as I know, is found only in one other bird, namely *Cathartes aura*." This very extraordinary stomach is figured on plate xxviii., and is certainly, as far as yet known, unique amongst birds. In *Plotus levaillanti* the same features in its anatomy generally are present as in *P. anhinga*. But there are, as usual, two small cæca: and its stomach differs considerably; for here there is no proventricular gland-pouch, but this organ, as in some other birds, assumes the form of two separate patches. The second (pyloric) compartment of the stomach is also present, in a well-developed form, and is also hair-clad. But here another difference presents itself; for "the hairy epithelium surrounding the pyloric orifice . . . . is produced

Ibis, 1881, p. 24.

* The anatomy of the soft parts of *Palamedea* is still, I believe, almost unknown.

† "On the Anatomy of *Aramus scolopaceus*," P. Z. S. 1876, pp. 275–277.

‡ "Notes on the Anatomy of *Plotus anhinga*," P. Z. S. 1876, pp. 335–345, pls. xxvi.–xxviii.; "Note on Points in the Anatomy of Levaillant's Darter (*Plotus levaillanti*)," P. Z. S. 1878, pp. 679–681.

into a considerable conical hair-covered process, projecting into the second stomach, and evidently acting as a valve to close the pylorus when necessary." These differences in two species so closely allied in all other points show that, though in nine cases out of ten similarity of external characters predicates similarity of internal structure, nevertheless in the tenth the correspondence breaks down, and that, too, without any obvious differences in mode of life, food, &c. The parallel, pointed out by Prof. Garrod, presented by these two species of *Plotus* with the two living genera of Sirenia (*Manatus* and *Halicore*), as regards the modification of their gastric gland-structures, is particularly interesting.

10. *Coliidæ* *.—The skull of *Colius* is desmognathous, and has no vomer, as in *Alcedo*. The viscera and myology do not bear out the idea of any relationship to the Parrots or Musophagidæ; on the contrary, these birds are truly Anomalogonatous, and are most nearly related perhaps to the Alcedinidæ and Bucerotidæ. Nevertheless their combination of characters fully substantiates their claim to form a separate family, Coliidæ.

11. *Thinocoridæ* †.—These birds, in their schizorhinal skull, and in many other features, visceral and myological, resemble most some of the more aberrant forms of Limicoline birds, such as *Cursorius* and *Glareola*. Attention is also drawn in this paper to the very extensive variations in the form of the vomer in various Charadriiform birds, it being (so far from always "tapering to a point anteriorly," as it *should* [?] do in these "schizognathous" birds) in several forms extraordinarily *broad* or even widely *emarginate* anteriorly!

12. *Momotidæ* ‡.—The colic cæca being absent, at the same time that, except in *Momotus*, the oil-gland is tufted, the Momotidæ must be placed amongst the Piciform series of Anomalogonatæ, close to the Todidæ, and not with the Coraciidæ amongst the Passeriformes. The syrinx and some other points in their anatomy are also described. Ibis, 1881, p. 25.

13. *Megacephalon* §.—A short paper describing the pterylosis (hitherto almost unknown in the Megapodidæ), syrinx, and other points in this peculiar form, which is perfectly gallinaceous.

14. *Indicator* ‖.—In its pterylosis, visceral anatomy, myology, and osteology, *Indicator* closely approaches the Picidæ, Capitonidæ, and their allies, and is in no respect Cuculine. Its vomer is large and strongly bifurcate anteriorly, as in the Capitoninæ; of the latter some are

* "Notes on the Anatomy of the Colies," P. Z. S. 1876, pp. 416–420.

† "Notes on the Anatomy and Systematic Position of the Genera *Thinocorus* and *Attagis*," P. Z. S. 1877, pp. 413–418.

‡ "On the Systematic Position of the Momotidæ," P. Z. S. 1878, pp. 100–102.

§ "On the Anatomy of the Maleo," P. Z. S. 1878, pp. 629–631.

‖ "Notes on the Anatomy of *Indicator major*," P. Z. S. 1878, pp. 930–935.

desmognathous, others, as in *Indicator*, not. The truncated vomer of *Ramphastos* is also figured. In conclusion it is suggested that *Indicator* should form but a subfamily, to be comprised, together with the Ramphastinæ and Capitoninæ, in a larger group, the Capitonidæ.

15. *Opisthocomus**.—*Opisthocomus* is a true Homalogonatous bird, having both the *ambiens* and accessory femoro-caudal muscles; it cannot, therefore, have any thing to do with the Passeres. It is, perhaps, most nearly related to the Gallinæ, but, at the same time, can hardly be included with them; it is also not far from the Cuculidæ and Musophagidæ, helping thus to fill up the gap that now exists between these latter families and the Gallinaceous birds.

Ibis, 1881, p. 26. 16. *Passeres* †.—To define by anatomical characters supergeneric groups in the immense mass of Passerine birds was always a favourite object with Prof. Garrod; and the four papers quoted above ‡ are the published results of his efforts at a solution of the difficulties that have always attended the classification of this group. It was whilst working at Passerine birds that the classificatory value of the mode of termination of the tendon of the *tensor patagii brevis* muscle, already alluded to (*suprà*, p. 200), first attracted his attention. The presence also in certain Passerine birds, the Cotingidæ and Pipridæ, of a femoral instead of a sciatic artery has also been mentioned. A slight exception, too, to Sundevall's generalization about the independent muscular supply of the *hallux* in Passerine birds (*suprà*, p. 198) was found by him to exist in the Eurylæmidæ (P. Z. S. 1877, p. 447). But the most novel fact pointed out by Prof. Garrod as regards these birds is that they may be divided into two main groups, according as to whether the intrinsic muscles of the syrinx are inserted into the *ends* or into the *middle* of the bronchial semirings. The former group, called by him *Acromyodi*, includes all the ordinary singing-birds with four or five pairs of muscles, the Oscines, together with two aberrant Australian groups, formed by the genera *Menura* and *Atrichia*. In these the number of intrinsic muscles is reduced to three and two pairs respectively; but they are still inserted into the *tips* of the semirings §.

* "Notes on Points in the Anatomy of the Hoatzin," P. Z. S. 1879, pp. 100–114.

† "On some Anatomical Characters which bear upon the Major Divisions of the Passerine Birds:" Part I., P. Z. S. 1876, pp. 506–519, pls. xlviii.–liii.; Part II., P. Z. S. 1877, pp. 447–452; Part III., P. Z. S. 1877, pp. 523–526, pl. liii.; Part IV., P. Z. S. 1878, p. 143.

‡ Together with his appendix to the English edition of Johannes Müller's 'Stimmorgane der Passerinen.'

§ I may here remark that I cannot at all agree with Mr. Sclater's view on the position of these two genera, which form his group "Pseudoscines" (Ibis, 1880, p. 345). By placing *Atrichia* and *Menura* away from the other Acromyodian Passeres, and interpolating the Mesomyodian ones, the important fact is ignored that, in their possession

The other group, the *Mesomyodi*, have the intrinsic muscles (which are usually reduced to a single pair, one on each side) inserted into the *middle* of the rings. In them, too, the tenth ("first") primary is always more or less long, and the tarsus, with trifling exceptions, not "bilaminate." They nearly correspond to the "Formicarioid" Passeres of Wallace, except that Wallace included in that group the Acromyodian, though in some respects aberrant, *Menura*. The Mesomyodi include all the Tracheophone Passeres, together with the Pipridæ, Cotingidæ, Tyrannidæ, Pittidæ, and a few smaller groups. A further division of these two main groups is given by Prof. Garrod in the first paper quoted (*t. c.* p. 518), the smaller divisions being based on one or other of the other characters already noticed. A considerable number of the previously unknown syringes of Passerine birds were described by him for the first time in one or other of the above communications, amongst which those of *Pitta* and *Atrichia* are particularly noticeable. The peculiar form of the nasal bones in certain of the Tracheophonæ, so that these birds are to this extent "schizorhinal," has already been mentioned when speaking of that character, as has also the paper on *Heteralocha*. Ibis, 1881, p. 27.

It is much to be regretted that Prof. Garrod did not live to make public his maturer views on the difficult subject of the general classification of birds. The only published scheme of any such classification is to be found in part ii. of his paper on the Thigh-Muscles (*suprà*, p. 194); and it is within my knowledge that he had already seen reason to deviate in some respects from the arrangement there adopted. Nevertheless I think I may say he was satisfied to the last as to the naturalness of the two main groups into which he there divided birds, the "Homalogonatæ" and the "Anomalogonatæ." It is often assumed that this division rests only upon a single character, namely the presence or absence of the ambiens muscle. As a matter of fact this is *not* the case; for the ambiens muscle is absent in many birds that are ranked amongst the Homalogonatæ. What Prof. Garrod says is this:—"The oft-named Ibis, 1881, p. 28.

of an "Acromyodian" syrinx, these birds depart essentially from the typical avian "Mesomyodian" structure, the one which there cannot be the slightest doubt is the more primitive form. "The much more important osteological characters" in which these two forms are said to diverge from the other Passeres are, as far as I am aware, two only; and these, moreover, are individual peculiarities of each genus, and by no means common to the two forms—in *Menura* the curved posterior margin of the sternum, in *Atrichia* the absence of clavicles (Garrod, P. Z. S. 1876, p. 516). As is now well known, Prof. Huxley's original description of the skull in *Menura* (P. Z. S. 1867, p. 472) was founded on a misconception of its structure, apparently owing to the imperfection of his specimen (*cf.* Parker, Trans. Z. S. ix. pp. 307, 308). Moreover the "most anomalous forms of Passerine birds yet known," or at all events the most generalized, are, according to the views of Garrod and myself, certainly the Eurylæmidæ, which last therefore, and not the "Pseudoscines," should be placed at the end, in a descending scale, of the Passerine series.

ambiens muscle is, in my mind, the *key* to the whole," and that, not because of its own intrinsic importance, but because its presence is always associated with peculiarities in other parts never found in any Anomalogonatous bird. That the same combinations of three or four different characters should have arisen *independently* in different birds is so extremely improbable, that we can hardly ascribe these similarities in combinations of characters to any other cause than to blood-relationship, the expression of which is now unanimously accepted as the true end of all biological classifications.

"The facts disclosed by a study of the myology of birds *do not*, without extraneous assistance, place the families in their true relationship to one another. Because the same muscles are present in two families of birds, it cannot therefore be said that their kinship is extremely close, or the reverse . . . . It is therefore necessary to look around to find, if possible, myological characters which have some definite relation to equally well-marked pterylographic, visceral, or osteological peculiarities" (P. Z. S. 1874, p. 114). As already insisted on, it was in this combination of characters that Prof. Garrod trusted to find the true "key" to the question.

To return to facts,—no bird which is "Anomalogonatous" has ever an accessory femoro-caudal muscle; that is, the letter B never enters its formula. Again, no bird that is Anomalogonatous has ever a tufted oil-gland *and* cæca, though this combination is nearly always found in the Homalogonatous birds. So much so is this the case, that there are only Ibis, 1881, p. 29. nine groups of Homalogonatous birds that have *not* this mentioned combination *, and in two of these the exception is caused by the entire absence of the oil-gland (in the Otididæ and the Struthiones). Of the remaining seven, in which the cæca and a tufted oil-gland are not correlated, I find, by tabulation, that four always have the ambiens muscle developed, whilst the remaining three have it present in at least some of their members. Of these latter, moreover, two have the accessory femoro-caudal (B) always present; so that it is only *certain* Parrots which have a formula like that of any anomalogonatous bird (for it must be remembered that in several Parrots the ambiens muscle *is* present). This fact will be made clearer by the accompanying table, containing the names of the three main groups of the Anomalogonatæ, Ibis, 1881, p. 30. followed by those of the seven groups above mentioned as the exceptions to the combination of cæca and a tufted oil-gland amongst the Homalogonatæ.

Thus, of the whole series of Homalogonatous birds, not one, except certain Parrots (the most specialized, no doubt, of all that series), has

* One or two genera in various families, as e. g. *Cancroma*, have also lost the oil-gland tuft. As, however, all the allied genera retain it, these slight exceptions in no way invalidate Prof. Garrod's argument.

Ibis, 1881, p. 29.

	Ambiens.	Accessory femoro-caudal.	Tuft to oil-gland.	Cæca.
Anomalogonatæ.				
Cypseliformes	−	−	−	−
Passeriformes	−	−	−	+
Piciformes	−	−	±*	−
Exceptional Homalogonatæ.				
Megapodidæ	+	+	+	−
Thalassidrominæ	±	+	+	−
Musophagidæ	+	+	+	−
Psittacidæ	±	−	+	−
Columbidæ	±	+	−	±
Cuculidæ	+	±	−	+
Cathartidæ	+	−	−	−
Other Homalogonatæ	±	±	+	+

any combination of these characters that could lead to its inclusion with the three combinations present in the Anomalogonatæ. Ibis, 1881, p. 30.

The grand division into Homalo- and Anomalogonatæ was primarily made by Mr. Garrod on the strength of the facts here tabulated. But subsequent investigations of quite different points have much strengthened his original position. One of these is the difference in distribution of the plantar tendons in the two groups of zygodactyle birds, already described above. I believe the removal of the Cuculidæ and Musophagidæ from the so-called "Picarian" birds, or "Coccygomorphæ," on account of their possessing the ambiens muscle, absent in the others, was considered by many naturalists a striking proof of the artificial nature of Prof. Garrod's system. But it has been most remarkably confirmed by his later discovery, and so is, to my mind, one of the most convincing proofs of the correctness of his arguments, until, at least, some other explanation shall be given of the facts here adduced. Yet another confirmation is afforded by the pterylosis. I here reproduce Prof. Garrod's own words:—"My study of pterylography has led me to look upon the nature of the dorsal tract as all important in determining to which great group of birds, the Homalogonatæ or Anomalogonatæ, any doubtful family belongs. When the dorsal tract develops a fork *between* the shoulders, a bird is Homalogonatous; when the tract runs on unenlarged to near the lower ends of the scapulæ, then it is Anomalogonatous" (P. Z. S. 1878, p. 931).

* In *Momotus* the tuft is absent.

Very few exceptions to this rule obtain—the Coraciidæ, in that they develop an interscapular fork, although in other respects truly Anomalogonatous, being, perhaps, the most marked one.

The Homalogonatous nature of the Cuculidæ is fully borne out by their pterylosis, the dorsal tract in them dividing between the scapulæ. In the Musophagidæ the pterylosis above is peculiar, and gives no aid in determining their affinities. The Strigidæ, Caprimulgidæ, and *Steatornis* are, judged by this criterion, *Homalogonatous*, although in them the ambiens and accessory femoro-caudal are absent, at the same time that they have cæca and a nude oil-gland. But the very difficult question of the true affinities of these groups was one on which Prof. Garrod had not finally made up his mind.

Ibis, 1881, p. 31.

Leaving these three groups aside, the following is the arrangement adopted by Prof. Garrod of his "subclass" Anomalogonatæ:—

PICIFORMES.	PASSERIFORMES.	CYPSELIFORMES.
Oil-gland tufted.	Oil-gland nude.	Oil-gland nude.
Cæca absent.	Cæca present.	Cæca absent.
External branch of pectoral tract given off at commencement of breast *.	Pectoral tract simple, or with the external branch given off beyond middle of breast.	A.
(A) X Y.	A X (Y).	
Picidæ.	Passeres.	Macrochires.
Capitonidæ †.	Bucconidæ (?).	
Upupidæ.	Galbulidæ.	
Bucerotidæ.	Coraciidæ.	
Coliidæ.	Meropidæ.	
Alcedinidæ.	Trogonidæ.	
Momotidæ.		

As regards the Homalogonatæ, these were divided (P. Z. S. 1874, p. 119 &c.) into four orders, the Galliformes, Anseriformes, Ciconiiformes, and Charadriiformes, the latter including all the Homalogonatous schizorhinal birds. The further subdivisions of these will be found in Prof. Garrod's paper as quoted, and need not be repeated here.

The Strigidæ, there included with the Falconidæ amongst the "Ciconiiformes," would almost certainly, in a revised arrangement, have been removed from there and placed elsewhere. The Tubinares, or Petrels and Albatrosses, placed with the "Anseriformes," were found, on further examination, to be far nearer the Ciconiiform birds; and in the unfinished paper on *Pelecanoides* already alluded to, the reasons for this change were to have been given, the shortness of the cæca and the double great pectoral muscle being two of the facts adduced in favour of it.

Ibis, 1881, p. 32.

In this imperfect sketch of my lamented friend's ornithological work,

* P. Z. S. 1878, p. 931.

† Including the Ramphastinæ and *Indicator* (*t. c.* p. 935).

I hope I have succeeded in showing my fellow members of the B. O. U. and others that Garrod's work and generalizations did not depend upon any single character or set of characters. No man probably has ever yet enjoyed such opportunities or ample material for research in any single group of animals as he did; and he had, in addition, the advantage of all the work previously done on the subject, the value of which was duly estimated by him in forming his own conclusions. He came to the question of the classification of birds quite fresh, with none of those prejudices on the subject which are nearly inevitable amongst those who have worked at birds in their early days and so imbibed more or fewer of the traditional ideas on the subject. In addition, he had had all the advantages of a regular medical and scientific education, and was therefore the less likely to be tempted into rash generalizations or led away by crude theories. This much is certain: no future attempt to classify birds can omit to take into consideration the contributions to this subject made by the brilliant genius of our late member, which will always remain as a lasting tribute to his memory.

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36. NOTES ON THE UNFINISHED WORK LEFT BY THE LATE PROF. GARROD ON THE ANATOMY OF BIRDS *. Ibis, 1881, p. 174.

As many of the readers of 'The Ibis' probably already know, and as I have incidentally stated above (p. 2), I am now engaged in the completion of the unfinished work left by the late Prof. Garrod on the Anatomy of Birds. Thanks to the stores of specimens accumulated by him, and my prosectorial advantages, I have in my possession (or, at all events, have prospectively) specimens in the flesh of nearly all of the most important forms of birds.

There, are, however, still left a considerable number of which I have not as yet succeeded in obtaining any examples; and of these I append a list. It is naturally my wish to make the 'Anatomy of Birds' as complete as possible, and to examine, for that purpose, as many forms of birds as can be obtained. I hope, therefore, that any members of the B. O. U., or travellers or naturalists generally, who may have it in their power to obtain specimens of any of these my "desiderata," will do all they can to enable me to acquire these forms. Ibis, 1881, p. 175.

Passeres.—In this group of birds there is so much uniformity in anato-

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* Ibis, 1881, pp. 174–177.

mical structure that my desiderata are comparatively few, and mostly confined to some of the more obscure forms and to the *Mesomyodæ*. I may mention the following as being desirable :—

Of the Old-world forms, Eurylæmidæ, especially *Corydon* and *Calyptomena*; *Philepitta*; *Hydrornis* and *Melampitta*; *Orthonyx* (particularly wanted); *Atrichia*; *Climacteris*, *Sittella*, *Xenicus*, *Acanthisitta*; *Drepanis*, or any of its allies (*Psittirostra* &c.); *Grallina*; *Drymodes*, *Psophodes*, *Petrœca*; *Eupetes*; *Irena* and any Dicruridæ; *Euryceros*; *Falculia* and *Buphaga*.

Of American forms, *Chamœa*; *Procnias* and *Pipridea*; also any of the Mesomyodian (Formicarioid) groups, especially *Phytotoma* and *Oxyrhamphus*, both particularly wanted, and any of the larger Cotingine forms, such as *Ptilochloris*, *Cephalopterus*, *Gymnoderus*, *Querula*, *Phœnicocercus*, &c.

Bucconidæ. This is the only group of birds, of any size, of which I have as yet been utterly unable to procure spirit-specimens. *Any* will be therefore most acceptable.

Meropidæ, Galbulidæ, and Trogonidæ. Any species will be acceptable, particularly any of the Old-world Trogons.

Coraciidæ. *Eurystomus* and any of the anomalous Madagascar forms (*Atelornis*, *Brachypteracias*, &c.).

Alcedinidæ. Almost any except *Alcedo*, *Dacelo*, and *Ceryle*.

Upupidæ. Any, especially *Irrisor*. (It is uncertain whether it really belongs here.)

Ibis, 1881, p. 176. Cypselidæ. Any.

Trochilidæ. Any large form, especially *Patagona*.

Caprimulgidæ. *Batrachostomus*, *Ægotheles*, *Podager*, *Nyctibius*, and almost any others.

Picidæ. Any except the three commoner English species. *Sphyrapicus* I particularly want; also *Picumnus*, *Vivia*, and *Sasia*.

Capitonidæ. Any except *Megalœma*.

Cuculidæ. Nearly any forms, especially *Phœnicophaes*, *Scythrops*, *Centropus*, and *Coua*.

Psittacidæ. In this group nearly the only forms required are *Cyclopsitta* and *Pezoporus*. Young nestlings of *Stringops* (the younger the better, or even well-incubated eggs) would also be very interesting.

Gallinæ. *Oreophasis*, *Agelastus* and *Phasidus*, *Leipoa*, and *Megapodius* are my chief desiderata here.

Columbidæ. Here also my wants are few; any species of *Carpophaga* and *Ptilopus* would be welcome; also *Otidiphaps*, if it can be got!

Tubinares. Any species will be very acceptable, as I am engaged on a memoir on the anatomy of the group for the voyage of H.M.S. 'Challenger.'

In the remaining groups the following genera are still very imperfectly, or not at all, known anatomically; all present special features of interest:—

Platalea (except *P. leucorodia* and *ajaja*), *Anastomus*, *Balæniceps*, *Esacus*, *Mergulus*, *Phaleris*, &c., *Plotus* (exc. *P. anhinga*), *Thinocorus*, *Mesites*, and *Attagis*; also the TURNICIDÆ—*Pedionomus* (particularly wanted); *Rhynchœa*, *Ibidorhynchus*, *Tachydromus*, *Pterocnemis* (=*Rhea darwinii*), *Tinamotis* and *Calodromas* (both particularly wanted; the latter, at least, ought to be obtainable); *Parra* and *Hydrophasianus*, *Heliornis* and *Podica*, *Dromas*, *Rhynchops*, and *Palamedea* (not *Chauna*).

It is also greatly to be desired that the osteology and anatomy of the lately discovered short-winged Rails of the genera *Megacrex* and *Pennula* should be properly examined before they become (as they almost certainly will shortly) extinct.

I may remark that any tolerably strong spirit will do to preserve birds in, but that it will be better, especially in the case of larger birds, to change it two or three times during the first few days that the birds remain in spirit. All that is necessary in the way of preparation is to open the abdominal cavity by a slit down the median line, so as to allow the spirit access to the *viscera*. The viscera should *not* be removed in any case. Ibis, 1881, p. 177.

In default of spirit-specimens, carbolized ones, or skeletons of many of the forms mentioned would be useful; but spirit-specimens in all cases are to be preferred. The specimens need not, of course, be in good plumage; and the wing and tail-feathers, and even others, can be cut short to save space. But, unless the birds are named, enough of the feathers should always be left on to secure identification.

I may add that I shall be very grateful if some of the many ornithologists resident in India would procure me about half a dozen specimens (adult) of wild-shot *Gallus bankiva*, in spirits, or even skeletons. As the first part of Prof. Garrod's treatise is devoted to the anatomy of the Fowl, it is desirable to have wild specimens of it for dissection, or at least to describe the bones from them, and not from any of our domestic races.

P. Z. S. 1881, p. 248.

37. NOTE ON MR. BARTLETT'S COMMUNICATION ON THE HABITS OF THE DARTER.*

The specimen put into my hands by Mr. Bartlett is a somewhat broken bag-like sac, which is undoubtedly the shed "epithelial" coat of the gizzard of the Darter. Where the "epithelium" † is thickest and best developed, at the bottom of the gizzard, the walls have remained intact; but above, where it thins off towards the pyloric and œsophageal openings, they have become broken, so that the sac is widely open here. A small patch of the characteristic hairs (*cf.* Garrod, P. Z. S. 1876, p. 343, pl. xxviii. fig. 2) of the pyloric part of the gizzard has come away with the epithelium; these alone would suffice to indicate the bird whence it was derived. The hard epithelium does not extend above the limits of the gizzard: hence none of the mucous coverings of the proventricular gland or œsophagus has been preserved in the ejected specimen. The outer surface of the cast epithelium is smooth and velvety, and exactly similar in appearance to epithelium that has been peeled off the muscular walls of the gizzard artificially.

A microscopical examination of a part of the cast epithelium shows that it is quite identical in structure with that of the unshed epithelium of the stomach.

I may add that in the stomach of a lately dead example of the species—though not that of the individual which "moulted" its stomach, which is still (February 1) alive and in good health—there is some appearance of a similar "moult" being about to take place, the epithelial layer being easily detached from the subjacent ones, whilst beneath it there is apparently a new, though still very thin, coat of epithelium in course of formation. This appearance is confirmed by sections of the epithelium.

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* Proc. Zool. Soc. 1881, p. 248. Read Feb. 1, 1881.

† I use this term in the same sense as many previous writers have done, as a convenient term for the object in question, without committing myself to any opinion as to its true nature.—W. A. F.

38. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—Part IV.* ON SOME POINTS IN THE ANATOMY OF THE GENUS *CONOPOPHAGA*, AND ITS SYSTEMATIC POSITION.†

P. Z. S. 1881, p. 435.

As regards the true relationships of the genus *Conopophaga* considerable doubt has hitherto prevailed amongst systematic zoologists. By Sundevall ‡ it was placed amongst the Tyrannidæ, on account of its depressed beak and the nature of its tarsal scutellation. Messrs. Sclater and Salvin, in their valuable 'Nomenclator Avium Neotropicalium' §, followed Sundevall—the Conopophaginæ, consisting of the genera *Conopophaga* and *Corythopis*, therein forming the subfamily of the Oligomyodian Tyrannidæ. All these authors, however, had overlooked the fact that Johannes Müller, in his classical memoir on the Voice-organs of the Passerinæ ‖, had described the syrinx of *Conopophaga aurita*, and had found it to be completely tracheophone, that of the Tyrannidæ having, of course, no such structure. Garrod was, no doubt, aware of Müller's results; for in his proposed rearrangement of the Tracheophone Passeres ¶, he made the "Conopophagidæ" a distinct family, which he placed between the Dendrocolaptidæ and the Formicariidæ. No reasons, however, for the change were there given.

A few days ago Mr. Salvin called my attention to the fact that in a skeleton of *Conopophaga melanops*, lately acquired for the Cambridge University Museum, the sternum presented *four* notches along its posterior margin, a very unusual condition in Passerine birds. This again

P. Z. S. 1881, p. 436.

Sternum of *Conopophaga lineata*, of the natural size; viewed, slightly obliquely, from the side.

drew my attention to the genus; and being fortunately the possessor of a specimen in spirit of *Conopophaga lineata* from Pernambuco, I have

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* For Part III. see P. Z. S. 1880, p. 387.

† Proc. Zool. Soc. 1881, pp. 435–438. Read March 15, 1881.

‡ Teutamen, p. 60: Stockholm, 1872. § *l. c.* p. 41: London, 1873.

‖ Ueber d. Stimmorgane &c., p. 39: Berlin, 1847. Garrod's edition, p. 32.

¶ P. Z. S. 1877, p. 452.

been enabled to confirm Mr. Salvin's discovery, as well as to make some other notes on the structure of this genus. As regards the sternum, it will be seen, from the drawing I now exhibit (p. 217) of that of *Carpophaga lineata*, to possess, as already stated, four notches, two on each side, on its posterior margin. Both are quite distinct; but the outer one is considerably the larger of the two, running up to near the base of the "costal process." The outer xiphoid process diverges considerably, so that there is a wide space between its termination and that of the internal one. This latter is terminally expanded and closely approximated, internally, to the body of the sternum, with only a very narrow cleft separating the ossified parts there. In other respects the sternum and its appendages are characteristically Passerine, there being a large bifurcated manubrium sterni, and a long, forwardly directed, costal process. The clavicles are well developed, with a large *hypocleidium* and strongly expanded scapular ends. The *carina sterni* is well developed. The only other Passerine birds in which the sternum is four-notched are, so far as is yet known, sundry species of Pteroptochidæ (*Pteroptochus albicollis*, the species of *Hylactes*, and *Scytalopus indigoticus*). In *Pteroptochus albicollis* the two notches of each side are more nearly equal in size, and the internal xiphoid process is separated by a considerable interval from the body of the bone.

As regards the skull, *Conopophaga* is typically Passerine, not being in the slightest degree schizorhinal, as already stated by Garrod (*l. c.*). The vomer is broad and bifurcated. The maxillo-palatine processes are fairly long, spongy at the base, and recurved and dilated slightly apically, and do not articulate with the vomer, as is the case (*e. g.*) in *Thamnophilus**. The "transpalatine" processes are well developed. In the macerated skull the external nares are divided into an anterior and a posterior opening, by the ossification of the alinasal cartilages. The same is the case in the species of *Thamnophilus* and in many other Passeres. I do not, however, attach much systematic importance to this character, as it occurs in *Cymbirhynchus*, and not in *Calyptomena*, and in *Hadrostomus*, *Tityra* (just), and *Lipaugus*, but in none other of the Pipro-Cotingidæ. The only Tyrannine bird in which I have observed it is *Arundinicola leucocephala*. P. Z. S. 1881, p. 437.

From the character of its skull nothing very definite can be predicated of *Conopophaga*, except that it clearly has no relation to Furnariine forms. In its visceral anatomy, myology, pterylosis, and other characters I have detected no deviation from the ordinary Passerine structure. The typical arrangement of the *tensor patagii brevis* tendon is somewhat concealed, as in *Pteroptochus* and *Hylactes* (*cf.* Garrod, P. Z. S. 1876, p. 510), by the muscular fibres at the origin of the *extensor metacarpi*

* *Cf.* Parker, Trans. Zool. Soc. ix. p. 313, pl. lvii. fig. 9.

muscle. There is no trace of a *vinculum* in the deep flexor tendons of the foot. The artery of the leg is the sciatic. In the tarsi the anterior scutes, about six in number, extend round to the posterior margin exteriorly, leaving the internal plantar space covered by a smooth skin, with no signs of scutes or scutellæ. In its possession of an "exaspidean" * tarsus, *Conopophaga* differs from all other forms of Tracheophonæ, and resembles *Oxyrhynchus*, the Tyrannidæ, and Pipridæ alone of Passerine birds.

The *Tracheophone* syrinx of *Conopophaga aurita* has been briefly described and figured by Müller †; and from that species *C. lineata* does not essentially differ. I find, however, that in this latter species the commencement of the tracheal syrinx is less abrupt than is depicted by Müller, the few preceding tracheal rings, particularly posteriorly, becoming gradually less and less deep as they approach the membranous part. The last tracheal ring is deeper and stronger than its predecessors, and is incomplete in the middle line behind. The first bronchial semiring is considerably stronger than the second one, and bears the *processus vocalis*, which extends upwards for about two rings. The last tracheal and first two bronchial semirings are less closely connected together than in Müller's figure. The tracheal syrinx forms a somewhat dilated *tympanum*. As regards the muscles, my observations agree with Müller's as to there being no intrinsic muscles, as the lateral tracheal muscle stops at the commencement of the membranous part of the trachea, from which place also the *sterno-tracheales* diverge.

This syrinx of *Conopophaga* does not exactly agree with that of any other Tracheophone group. In that it possesses *processus vocales* it resembles that of the Furnariidæ and Dendrocolaptidæ described by Müller (*Pteroptochus*, *Hylactes*, *Formicarius*, and *Grallaria*), and differs from *Thamnophilus* and *Hypocnemis*. In the absence of any intrinsic muscle it resembles *Grallaria* and *Hylactes*, as described by Garrod, as well as *Chamæza*, *Pteroptochus*, and *Formicarius*. In *Furnarius*, *Dendrocolaptes*, &c. this muscle is always present, and double. But in both *Grallaria*, *Hylactes*, and the others the *sterno-tracheales* muscles arise from the end of the vocal process. In *Conopophaga*, on the other hand, they leave the trachea before reaching that process.

The peculiarity, therefore, of its sternum, when taken with its tarsal scutellation and peculiar syrinx, seems to demand that, as has already been proposed by Garrod, the genus *Conopophaga* ‡ should form a P. Z. S. 1881, p. 438.

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* As defined by Sundevall, *l. c.* p. 57.

† *L. c.* p. 39, pl. vi. fig. 12. Garrod's ed. p. 32.

‡ *Corythopis* has not yet been anatomically examined; by Sundevall it is placed near *Formicarius*. It is therefore nearly certain to be Tracheophonine, and is probably really closely allied to *Conopophaga*.

primary division of the Tracheophone Passeres, which may be defined as follows:—

Conopophagidæ.—Tracheophonine Passeres, with a holorhinal skull and four-notched sternum, an exaspidean tarsus, and a syrinx with no intrinsic muscles, and with the *sterno-tracheales* not attached to the *processus vocales.*

As regards the possession of a four-notched sternum by these birds and the Pteroptochidæ, I am not inclined to consider it in any way a primitive character, but rather as an instance of a simple modification having been independently acquired in different groups of birds (many parallel cases might be given). The Tracheophonine syrinx must, without doubt, be regarded as a modification of some Haploophonine form *; and in all these last birds, as in the still less specialized Eurylæmidæ, the sternum has the typical form with but two notches. On the other hand, the similarity of form of the sternum in the Pteroptochidæ and Conopophagidæ may very probably indicate that these groups may both have sprung from some common stock which had already developed a peculiar sternum.

P. Z. S. 1881, p. 639.

39. NOTES ON THE ANATOMY AND SYSTEMATIC POSITION OF THE JAÇANÁS (*PARRIDÆ*). †

It having lately been my good fortune to dissect two specimens of *Parra jacana*, from Pernambuco, and an eviscerated specimen of *Metopidius africanus*, as well as to examine skeletons and skins of some other species of this group, a few notes on their anatomy may be acceptable to the Society, the more so on account of the very considerable difference of opinion that has hitherto existed amongst systematic ornithologists as to the true relationships of this group. Two main views on this subject have been put forward, one placing the Jaçanás near the Rails (Rallidæ), the other asserting that they are, essentially, modified Plovers. The former of these views has been maintained by Jerdon ‡, Sundevall §, and Milne-Edwards ||, to mention only some of the most recent ornithological writers of importance, as well as by the illustrious Nitzsch in his classical memoir on the pterylography of birds ¶. The latter view has been

* Garrod, P. Z. S. 1876, p. 517.

† Proc. Zool. Soc. 1881, pp. 639–647. Read May 17, 1881.

‡ Birds of India, iii. p. 707.

§ Tentamen, p. 130 (1872).

|| Oiseaux Fossiles, ii. p. 110 (1869–71).

¶ Pterylography, Ray Society's edition, p. 126.

adopted by Messrs. Sclater and Salvin in their 'Nomenclator,' where the Parridæ are interpolated between the Œdicnemidæ and the Charadriidæ as members of the order "Limicolæ" *. The late Prof. Garrod, in his paper on the nasal bones of birds †, says that "*Parra* should be removed to the Charadriomorphæ" from the Rallidæ, on account of the schizorhinal nature of its skull, as represented in the figure of that of *Parra* (*Hydralector*) *cristata* on p. 34 of his paper. In his subsequent paper on the muscles of the thigh in birds ‡, *Parra* (i. e. *Metopidius*) *africana* is placed amongst the "Grallæ," with the other Charadriine or Scolopacine forms, and not included in the Rallidæ. It will be my object in the present paper to still further strengthen this latter view of the affinities of the Parridæ §. P. Z. S. 1881, p. 640.

Pterylosis.

Nitzsch, in his 'Pterylography,' places *Rallus*, *Crex*, *Porphyrio*, and *Parra* as members of a group of the Fulicariæ, characterized by the narrow form of the tracts, by the presence of a distinct outer branch to the inferior tract, and by the dorsal tract being "neither interrupted nor strikingly weakened" between the shoulder-blades. He says (*l. c.* p. 126):—"The first three [genera] have *twelve* tail-feathers, and exactly the same pterylosis as that figured as occurring in *Rallus aquaticus*. In *Parra*, of which I have examined all the four principal species (*sinensis* [i. e. *Hydrophasianus chirurgus*], *œnea*, *africana*, and *jassana*), I found only *ten* tail-feathers, and a remarkable narrowing of the bands of the dorsal tract close behind the shoulder-blades; whilst, on the other hand,

* *Op. cit.* p. 142 (London, 1873). The term "*Limicolæ*" was, I believe, originally used by Nitzsch (Pterylogr. p. 194) to include the birds now included in the "families" Charadriidæ and Scolopacidæ, together with some aberrant forms, such as *Dromas*, *Cursorius*, *Thinocorus*, &c. By Messrs. Sclater and Salvin its use is still further extended to include the Œdicnemidæ, Parridæ, and Chionididæ in addition. Lastly, Prof. Garrod used it (P. Z. S. 1874, p. 122, &c.) as a term for all the non-columbine "Charadriiformes," including in it, besides Nitzsch's groups, the Cranes, Auks, Gulls, and, presumably, the Turnicidæ, Rhinochetidæ, Plataleidæ, and Parridæ as well. In fact, Garrod's restricted "family" Charadriidæ corresponds pretty nearly to the whole of Nitzsch's "Limicolæ seu Scolopacinæ." To obviate further confusion, the term "Limicolæ" should be restricted to the group mentioned by Nitzsch; and I propose to substitute, as a name for the non-columbine Charadriiformes (the "Limicolæ" of Garrod) the word "Pluviales," to correspond with the other division, "Columbæ" (including the Columbidæ and Pteroclidæ), of that great group.

† "On the Value in Classification of a Peculiarity in the Anterior Margin of the Nasal Bones of certain Birds," P. Z. S. 1873, pp. 33–78.

‡ P. Z. S. 1873, pp. 626–644.

§ Besides *Metopidius africanus*, Prof. Garrod dissected a specimen of *Hydrophasianus chirurgus*; and some MS. notes of his on that species I have incorporated in what follows.

the hindmost, or pelvic portion of it, was dilated. This genus has also weaker lumbar tracts; and these are united with the uropygial portion of the dorsal tract by sparse contour-feathers." As Nitzsch himself later on says that the pterylosis of the "Limicolæ" closely approaches that of the Rallinæ, and is but little modified from that type, the evidence from pterylosis of the Ralline affinities of the Jaçanás is not very strong. In their possession of well-marked firm rectrices, in the weakness of the lumbar tracts, and in the tendency to a division of the dorsal tract into an anterior and a posterior fork, the Parridæ differ from the typical Rallidæ, and approach the Limicoline type. The same relationship is indicated by the inner, or main, pectoral tract, though very narrow, consisting, at least at its commencement, of two or three rows of feathers in the Parridæ, as well as in the Charadriidæ; whereas in the typical Rallidæ, according to Nitzsch, it issues from the branch as only a single row of feathers.

Visceral Anatomy, &c.

The tongue is long and narrow in shape, thin, and of horny consistency. Its apex is slightly notched, and its base spinulose; for the greater part of its length it is strongly concave. The œsophagus develops
P. Z. S. 1881, p. 641. no crop; and the proventriculus is zonary. There is a muscular gizzard, lined by a rather thick and hard epithelium. The contents of the stomach, in one of the specimens examined, consisted of small seeds mixed with vegetable débris and small fragments of stone. The right liver-lobe is elongated, and twice as large as the left; and there is a well-developed gall-bladder. The cæca are lateral in position, and closely approximated to the intestine, which makes them difficult to see. They are mere nipples ·2 inch long *. In this respect *Parra* differs from all the Rallidæ (except *Porzana notata*) which have been examined, as in all of these the cæca are long, sometimes very long. Of the Pluvialine birds, only the Plataleidæ and Rhinochetidæ, with *Sterna*, *Larus*, and one or two others, have such short cæca. The intestines measure, in these two specimens of *Parra jacana*—small intestine 12·3 and 13·2 inches, large intestine 1·1 and 1·0 inch respectively.

In *Parra jacana* and in *Hydrophasianus africanus*, as also in *Metopidius africanus*, as already recorded by Garrod †, there are two carotid arteries. This is the number found in all the Rallidæ, and in most of the Pluviales, excepting the Turnicidæ and *Arctica alle*, according to Garrod ‡, where there is only the left developed.

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* In *Hydrophasianus chirurgus* there is a strong gizzard, and the left liver-lobe is smaller than the right; the cæca measure ·15 inch, the whole length of the intestines being 12 inches.—Garrod's MSS.

† P. Z. S. 1873, p. 469. ‡ *L. c.* pp. 469, 470.

Myology.

Parra jacana resembles *P.* (*Metopidius*) *africana*, as recorded by Garrod*, in possessing the ambiens, femoro-caudal, accessory femoro-caudal, semitendinosus, and accessory semitendinosus muscles, all well developed †. Their formula is therefore AB . XY ‡. In both these species the gluteus primus is well developed, covering the biceps superficially towards the median line; the gluteus quintus is also well developed. As in the Rallidæ, and the Gruidæ§ and *Eurypyga*, amongst the Pluviales, the area of origin of the obturator internus is triangular, as it is also in *Hydrophasianus*; in the Pluvialine birds generally it is oval. The two deep flexor tendons of the foot are not at all ossified, but completely blend together some way up the leg—in *Metopidius*, in fact, just below the joint. There is no slip at all to the hallux, as was also found to be the case in *Parra africana* || and *Hydrophasianus* by Prof. Garrod. This is the more remarkable on account of the very large size of the hallux in all these birds. A special tendinous slip to that digit is very frequently present in birds which have a very insignificant hallux indeed; and I know of no other case of a bird with such a large hallux as that of the Parridæ lacking the tendon. This fact would seem to indicate that the Parridæ may have been developed from some form with a more normal-sized foot and a small hallux, which had no special long flexor, the great size of their feet having been developed in accordance with their peculiar habits. P. Z. S. 1881, p. 642.

In the anterior extremity the second pectoral arises from nearly the whole length of the sternum; in all three genera the third pectoral is wanting. The expansor secundariorum is strong and T-shaped, as in all Ralline and many Pluvialine birds. In *Parra jacana* (as in *Hydrophasianus*, according to Garrod) there is a distinct biceps slip to the patagium, as in all the Rallidæ, the Charadriidæ, Gruidæ, and many other Pluvialine birds. In *Metopidius africanus* it is apparently absent, the absence being probably correlated with the peculiar expanded form of the radius (to be hereafter described).

In the wing-membrane the *tensor patagii brevis* presents a peculiar arrangement, the tendon being completely divided into two portions—an inner, more slender, and an outer, stronger one. The former runs on to the fibrous tissue near the superficial origin of the *extensor metacarpi radialis longior*, and there stops; the latter continues over this last muscle to the ulnar side of the arm, where it is lost in the fibrous covering-tissue adjacent. Before crossing, however, it sends off a short, special wristward slip to the superficial tendon of origin of the

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* P. Z. S. 1873, p. 641.

† In *Hydrophasianus* all these five muscles are also present.

‡ *Cf.* Garrod, P. Z. S. 1874, p. 123.

§ Garrod, P. Z. S. 1876, p. 199.

|| P. Z. S. 1875, p. 348.

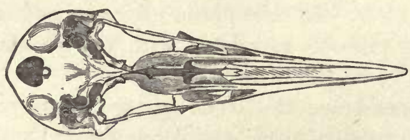
metacarpal *extensor*, as in many other groups of birds. There is also a thin fibrous expansion given off just before this to the teudon of the *tensor patagii longus*, and the tissue of the patagium generally, as in many Pluvialine birds *. This splitting up of the *tensor patagii brevis* tendon into two distinct slips, the external one in turn giving off a special wristward slip, occurs in many Pluvialine birds (*e. g.* in *Numenius arquatus*, *Totanus calidris*, *Machetes pugnax*, *Himantopus nigricollis*, *Thinocorus*, *Attagis*), but never in the Rails, where the tendon is always much more simple, not being divided into two separate parts, or giving off a wristward slip. In fact, in most Rallidæ it runs quite simply, as a narrow straight tendon, on to the origin of the *extensor metacarpi* muscle, and there stops.

The trachea is provided with the usual pair of sterno-tracheal muscles; and the lower larynx, which is of simple structure, has also only a single pair of intrinsic muscles.

Osteology.

From a consideration of the pterylographic, visceral, and myological features only of the Parridæ, perhaps no very definite conclusion as to their affinities could be drawn. But their osteological characters, in this case, leave no doubt as to their real position. All the skulls of Parridæ which I have examined, including those of *Parræ jacana* and *gymnostoma*, *Metopidii indicus*, *africanus* and *albinucha*, and *Hydrophasianus chirurgus*, like that of *Hydralector cristata* figured by Garrod †, are strongly schizorhinal, therein differing completely from that of the Rails, and
P. Z. S. 1881, p. 643. resembling that of the Pigeons, Plovers, and their allies (the "Charadriiformes" of Garrod ‡) only amongst Homalogonatous birds.

Fig. 1.



Skull of *Parra jacana*, from below; natural size.

There are well-developed basipterygoid processes, which are always absent in the Rails, though of very frequent occurrence amongst the "Pluviales," occurring in all the Charadriinæ and Scolopacinæ I have examined.

In *Parra jacana* and *Metopidius albinucha*, the long, narrow, slightly

* In *Hydrophasianus* much the same arrangement of the *tensor patagii brevis* obtains, to judge from a small drawing in Garrod's MS.

† P. Z. S. 1873, p. 34, fig. 5.

‡ P. Z. S. 1874, p. 117.

decurved vomer is emarginate apically, as in certain Charadriidæ * (see fig. 1). In the Rallidæ it is, I believe, always sharp at the point.

The maxillo-palatine processes are rather slender and directed backwards; they have the form of concavo-convex lamellæ, are not at all swollen, and do not unite by some way in the middle line, the vomer appearing between and (when the skull is viewed from the palatal aspect) below them.

There is no ossified internasal septum, nor any ossification of the narial cartilages. The lachrymal is small, ankylosed with the naso-frontal region of the skull above, and with the "pars plana" below.

On the posterior aspect of the skull there are no traces of the occipital fontanelles, which are found in so many of the birds related to the Plovers.

The supraorbital impressions for the nasal glands, which are so conspicuous in most Plovers, the Gulls, Auks, and many other birds, are absent in the Parridæ.

The combinations depending on the presence or absence of basi-pterygoid processes, of occipital foramina, and of impressions on the top of the skull for the supraorbital glands, coincide, as may be seen from the following Table (p. 226), pretty accurately, with hardly an exception, with the chief groups of the Pluviales (the web-footed Laridæ and Alcidæ being omitted as irrelevant to our present purpose) as determined by other characters. In the Table + and – represent respectively the presence or absence of the structure indicated. In the Plataleidæ and Gruidæ the nasal glands occupy the truncated edge of the cranium above the orbits, and hardly appear on its upper surface: this condition I have indicated by the use of the double sign (±).

The drawing (fig. 2, p. 227) of the sternum of *Metopidius albinucha* will show how unlike it is to that of the Rallidæ. In the latter group the sternum is always peculiar in that the xiphoid processes exceed in length the body of the sternum, which tapers to a point posteriorly, and from which they are separated by very long and well-marked triangular notches. The carina sterni also is less well developed; and the clavicles are weaker and straighter, being less convex forwards, than in the Parridæ. The sternum and clavicles of *Parra* and *Metopidius* in general form, on the other hand, resemble closely the type found in some of the Pluvialine birds (e. g. *Thinocorus*, *Attagis*). P. Z. S. 1881, p. 645.

The pelvis, again, of the Rails presents certain well-marked peculiarities. If that of *Rallus aquaticus* be taken as a typical form, it will be found that the ilia are long and narrow, and but little expanded in their preacetabular part. The postacetabular portion of the pelvis is but little bent down on the preacetabular part; and the ischia and pubes

* *Cf.* Garrod, P. Z. S. 1877, p. 417, figs. 2–4.

P. Z. S. 1881, p. 644.

	Occipital foramina.	Basipterygoid processes.	Supraorbital impressions.
PLATALEIDÆ.			
Ibis rubra	+	–	±
Platalea ajaja	+	–	±
—— leucorodia	+	–	±
GRUIDÆ.			
Grus cinerea	+	–	±
—— americana	+	–	±
—— australasiana	+	–	±
Aramus scolopaceus	+	–	±
CHARADRIIDÆ.			
Numenius arquatus	+	+	+
—— phæopus	+	+	+
Recurvirostra avocetta	+	+	+
Tringa canutus	+	+	+
—— cinclus	+	+	+
Ægialites hiaticula	+	+	+
Eudromias morinellus	+	+	+
Vanellus (cristatus ?)	+	+	+
Machetes pugnax	+*	+	+
Hæmatopus ostralegus	+	+	+
Himantopus nigricollis	+	+	+
Limosa melanura	+	+	+
PARRIDÆ.			
Metopidius albinucha	–	+	–
—— indicus	–	+	–
Parra jacana	–	+	–
Hydrophasianus chirurgus	–	+	–
TURNICIDÆ.			
Turnix lepurana	–	+	–
Hemipodius varius	–	+	–
? ——			
Dromas ardeola †	–	–	+
Chionis alba	–	–	+
Attagis gayi	–	–	+
Thinocorus rumicivorus	–	–	+
—— dorbignyanus	–	–	+
Cursorius gallicus	–	–	+
Glareola pratincola	–	–	+
RHINOCHETIDÆ.			
Rhinochetus jubatus	–	–	–
Eurypyga helias	–	–	–
MESITIDÆ.			
Mesites unicolor ‡	–	–	–

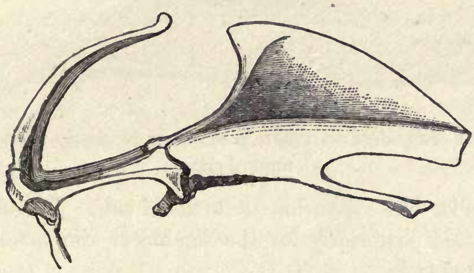
* Sometimes ossified.

† There is a perfect skeleton of this peculiar form in the Cambridge University Museum, which I have examined.

‡ I only know the cranial characters of this bird from the plate illustrating M. Milne-Edwards's memoir (Ann. Sci. Nat. [6] vol. vii. art. no. 6).

are but little everted. The ischia are united by broad bony plates to about the three most posterior "sacral" vertebræ; between these plates and the expanded part of the ilia above are well-developed and deep fossæ, occupied, in the fresh state, by the posterior portion of the kidneys. Viewed from above, the well-marked "postacetabular" ridge, which divides off the dorsal from the lateral aspect of the pelvis, running P. Z. S. 1881, p. 645.

Fig. 2.



Sternum and shoulder-girdle of *Metopidius albinucha*, viewed laterally; natural size.

from just behind the antitrochanteric eminence to the posterior spine of the ilium, presents, a little behind those two points, a strongly projecting process. The greatest breadth of the postacetabular part of the pelvis is therefore here, and not at the more anteriorly-situated prominence, close to the antitrochanter. Viewed from the side, this ridge forms a sort of overlapping roof to the slightly excavated external pelvic fossa. The genera *Ocydromus*, *Aramides*, *Fulica*, and *Porphyrio* do not essentially depart from this type.

In *Parra* and *Metopidius** the ilia are wider and more expanded anteriorly. The postacetabular ridge has hardly any median projection; P. Z. S. 1881, p. 646. and the pelvis is widest, dorsally, just behind the antitrochanters. The plates of bone between the ischia and sacrum are narrower, and the posterior part of the renal fossæ less well developed, and more open, in consequence. In all these points these forms thus approach the Limicoline birds.

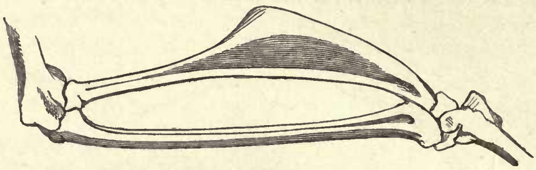
There is one other point of interest in the osteology of the Parridæ. This is the extraordinary form assumed by the radius in some of the genera. In birds, as a rule, the ulna is a stouter bone than the radius, this last being almost universally a slender cylindrical bone. In *Metopidius africanus*, as already noticed by M. A.Milne-Edwards †, as well as

* Milne-Edwards has also described the difference of the pelvis in the Jaçanás as compared with that of the true Rallidæ: *cf.* 'Oiseaux Fossiles,' ii. p. 123.

† 'Oiseaux Fossiles,' ii. p. 134.

in *M. albinucha* and in *M. indicus* (as I have been able to ascertain by extracting the wing-bones from a skin), the radius presents the form shown in the drawing (fig. 3), being dilated and flattened into a sub-

Fig. 3.



Wing-bones of *Metopidius albinucha*, to show the peculiarly modified radius; natural size.

triangular lamellar-like expansion for its distal half. Its superior surface is slightly grooved posteriorly for the tendon of the *extensor metacarpi radialis longior* muscle.

This dilated portion forms the margin of the patagial space for its distal portion. A considerable portion of the marginal tendon of the *tensor patagii longus* is inserted into the radius at the angle of the bone; the main tendon, however, continues in a groove on the inferior aspect of that bone, a little behind the border, to its ordinary insertion. About half of the peculiar flattened radius is left bare of muscle above, the *extensor metacarpi*, as already stated, playing over its lower half. Below, the flattened area is largely covered by the fibres of the *pronator radii superficialis*, which extend up nearly to the margin of the bone; below this is the *pronator radii profundus*, which likewise has an extensive insertion into the lower part of the bone. The margin of the bone, where it is superficial, is slightly roughened; and no doubt the peculiar form of radius is associated with the quarrelsome habits of these birds, this dilated and somewhat scimitar-shaped bone being probably capable of inflicting a very severe downward blow.

In *Parra jacana* and *P. gymnostoma* the radius presents the ordinary form; and the same is the case in *Hydrophasianus chirurgus*.

P. Z. S. 1881, p. 647. In these two genera, it is to be observed, the metacarpal "spur" is much more developed and sharp than in the species of *Metopidius*, where it is small and blunt; so that there is a correlation apparently between a sharp spur and a simple radius, and a blunt spur and flattened radius. In *Hydralector gallinacea* there is a blunt spur, with, so far as I can make out from a skin, a flattened radius.

The "claw" or "spur" of the wing of the Jaçanás has, it may be observed, no relation whatever to the "claw" or nail of the pollex, which is also present, though small, in all the three genera I have examined. The "spur," in *Parra jacana* at least, consists of an external, translucent, yellow epidermic layer, which invests a central core of compact fibrous tissue, this in turn being supported by a bony projection developed at the radial side of the first metacarpal.

As regards the position of the Parridæ in the group Pluviales, it appears to me that they form a well-marked family, with no very obvious relationships to any of the other families of that group, approaching, however, perhaps most nearly to the Charadriidæ, from which they are easily distinguishable by the absence of supraorbital glands and occipital foramina, by their enormously elongated toes, by the number of rectrices, and other points. A brief definition of the Parridæ may be given as follows:—

Charadriiform birds, with ten rectrices, short cæca, and a tufted oil-gland; with the ambiens, accessory femoro-caudal, and accessory semitendinosus muscles developed, and with the obturator internus triangular; with a two-notched sternum, and with the digits, including the hallux, greatly developed; with the skull provided with basipterygoid processes, but lacking occipital foramina and supraorbital gland-impressions.

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40. ON THE PETREL CALLED *THALASSIDROMA NEREIS* BY GOULD, AND ITS AFFINITIES.*

P. Z. S. 1881, p. 735.

In this Society's Proceedings for the year 1840, the late Mr. Gould described a "beautiful fairy-like" new species of Stormy Petrel from Bass's Straits, which he called *Thalassidroma nereis* (tom. cit. p. 178), under which name it is figured in the last volume of the 'Birds of Australia.'

Dr. Elliott Coues, in his revision of the family Procellariidæ †, treating of the species under the name *Procellaria nereis*, says:—"I have had the pleasure of examining Mr. Gould's types of this species from Bass's Straits, Australia, now in the collection of the Philadelphia Academy. It is a beautiful little species, quite unlike any other known Stormy Petrel. In form it comes nearer to *Procellaria pelagica* than to any other species; and it is *probably congeneric with it, though it differs somewhat* ‡ in the proportion of the tarsus and toes, and very widely in its pattern of coloration. . . . . The proportions of the tibia and tarsus differ from those of *pelagica* in the greater comparative length of the former."

* Proc. Zool. Soc. 1881, pp. 735–737. Read June 21, 1881.

† Proceedings of the Academy of Natural Sciences of Philadelphia, 1864, p. 81.

‡ The italics are mine.—W. A. F.

Amongst the Petrels mentioned at various times by the late Prof. Garrod as having been examined by him, a species several times occurs which is doubtfully named "*Procellaria* (or *Thalassidroma*) *fregata*?" * The specimens dissected by him are now before me, and have been identified by Mr. Salvin as being really referable to the *Procellaria nereis* of Gould, an example of which, from the Falkland Islands, is now in the museum of Messrs. Salvin and Godman. A careful examination of the three spirit-specimens of this bird, as well as of the skin mentioned, has convinced me that this species is not referable to the true genus *Procellaria* as represented by *Procellaria pelagica*, and is in fact in no way related to that group of Petrels, but has its nearest allies in the flat-clawed genera *Oceanites*, *Fregetta*, and *Pelagodroma*.

In his paper on the muscles of the thigh in Birds † the late Prof. Garrod divided the Nasutæ, or Petrels, into two groups, the "Storm-Petrels" and the Fulmaridæ, the former group differing from the latter in that they possess the accessory semitendinosus muscle (Y), but lack intestinal cæca. In the Fulmaridæ, on the other hand, the accessory semitendinosus muscle is absent, but cæca are present. The species of Storm-Petrels on which this generalization was based are called, with doubt ‡, "*Procellaria pelagica* and *P. fregata*," the latter being the
P. Z. S. 1881, p. 736. species now identified by Mr. Salvin as *P. nereis*. As regards the first-named species, there can be little or no doubt that the bird really dissected by Prof. Garrod, and called by him "*Procellaria pelagica*," was Wilson's Petrel (*Oceanites oceanicus*), as in this bird there are no cæca §, at the same time that the accessory semitendinosus muscle is present. The true *Procellaria pelagica* (of which I have lately dissected two perfectly fresh examples) agrees with the Fulmaridæ, as defined by Prof. Garrod, in having cæca ||, but no accessory head to the semitendinosus; and *Cymochorea leucorrhoa* agrees in both these points with *Procellaria pelagica*.

The so-called "*Procellaria nereis*" of Gould is therefore obviously not a true *Procellaria* at all; and this view is confirmed by other characters, such as the shape of its nostrils, the elongated tarsi, which are much longer than the mid toe ¶ and covered anteriorly with transversely

* *Cf.* P. Z. S. 1873, pp. 470 and 641.

† P. Z. S. 1874, p. 122.

‡ P. Z. S. 1873, p. 641.

§ *Cf.* also Macgillivray, in Audubon's 'Ornithological Biography,' v. p. 646.

|| *Cf.* Macgillivray, *l. c.* p. 313; also Wagner in Naumann's 'Vögel Deutschlands,' x. p. 556.

¶ In *Procellaria pelagica* and *Cymochorea leucorrhoa* the tarso-metatarse is not longer, and may be shorter, than the 3rd toe. As against 21·5 and 21·5, and 23 and 26 millim. in the two first-mentioned genera, in the so-called *Procellaria nereis* the lengths of the two are respectively 34 and 26 millims.

arranged scutella *, the very minute hallux, and the lamellar, concave form of the claws. It belongs, in fact, to the group of *Oceanites*, *Fregetta*, and *Pelagodroma*, but is not exactly congeneric with any of them. I propose therefore to make it the type of a new genus, to be called *Garrodia*, in memory of my lamented friend A. H. Garrod, not only as a token of my personal esteem for, and indebtedness to him, but also as some slight recognition of the thanks ornithologists generally owe him for the additions he made to our knowledge of the anatomy of birds.

The genus *Garrodia* may be shortly defined as follows :—

GARRODIA. *Genus ex ordine Tubinarium* OCEANITÆ *maxime affine, tarsis pro digitis longioribus et antice scutellatis, necnon margine sterni posteriore integro distinguendum.*

Type *Procellaria nereis*, Gould.

Garrodia is perhaps most closely allied to *Oceanites*, as already stated, but differs from that genus in having the tarso-metatarsi covered anteriorly with a series of transverse scutella instead of being "entire," in their slightly greater proportional length as compared with the third toe †, in the even more minute hallux, and in the more flattened and lamellar form of the claws. The sternum too is posteriorly entire, whereas in *Oceanites oceanicus* it is slightly notched. The coloration of the two genera is also quite different. From *Fregetta*, *Garrodia* may be easily distinguished by the very different proportions and forms of the nails and feet in that genus, and from *Pelagodroma* by its much shorter feet and entire tail.

These four genera—*Oceanites*, *Garrodia*, *Pelagodroma*, and *Fregetta*— form a very well-marked family of the Tubinares, which may be called Oceanitidæ, as distinguished from the remainder of the group, or Fulmaridæ of Prof. Garrod. Anatomically, these four genera agree together, and differ from the Fulmaridæ (on nearly all the genera of which, including *Diomedea* and *Puffinuria*, I have notes), in the two important characters already mentioned—the absence of cæca and the presence of the accessory semitendinosus muscle. Externally they may be at once recognized by their peculiar elongated tarsi, lamellar nails, and by never having more than 10 secondaries, *Procellaria* and *Puffinuria* having 13, and the remaining Fulmaridæ more (in *Diomedea*, according to Nitzsch, as many as 40). My family Oceanitidæ, in fact, corresponds to Bonaparte's section "** *Unguibus depressis*" of his Procellaridæ ‡, and to Coues's "second group" of the similarly-named section in his 'Review' §,

P.Z.S. 1881, p. 737.

* In *Procellaria pelagica* the tarsi are pretty uniformly covered with somewhat irregular hexagonal scutes.

† In a specimen of *Oceanites oceanicus* (in spirit) the middle toe measures 29 millim.; in one of *Garrodia* the length is 26 millim. The length of the metatarse in both is 34 millim.

‡ Consp. Av. ii. p. 197 (1857).

§ *Op. cit.* p. 74, where characters for it are given.

with the addition, in each case, of *Garrodia*, included by both authors in the restricted genus *Procellaria*.

Being now engaged in a report, for the Voyage of H.M.S. 'Challenger,' on the anatomy of the Petrels collected during that expedition, I propose to reserve further details of the differences and characters of these two groups, and of the genera composing them, till that occasion.

P. Z. S. 1881, p. 778.

41. ON THE CONFORMATION OF THE THORACIC END OF THE TRACHEA IN THE "RATITE" BIRDS.*

In the present communication I propose to follow out the line of work developed by the late Prof. Garrod in his paper on the trachea of the Gallinæ †, by describing in detail the structure of the bifurcating trachea in the "Ratite" birds.

So far as I am aware, no proper description of this structure in the birds in question has ever been given, though the statement, apparently originally due to Meckel ‡, that in them "there is no lower larynx," has been very generally followed and copied, even in the latest text-books on the subject §. Prof. Owen has briefly described the bifurcating trachea in the Ostrich || and *Apteryx* ¶; and his accounts, as far as they go, are accurate enough. More recently E. Alix has very briefly mentioned some peculiarities of this part in the Rhea; and his account will be found quoted below.

P. Z. S. 1881, p. 779. *Struthio camelus* (figs. 1, 2), on account of its size and simple structure, may be described here first. The trachea, inferior to the insertion of the *sterno-tracheales*, slightly narrows, having above the antepenultimate
P. Z. S. 1881, p. 780. ring a diameter of about one inch. The tracheal rings are here, as elsewhere, entire simple rings, of an average depth of about ·15 inch, and are separated only by very slight interannular intervals. The trachea is slightly compressed and posteriorly carinated for about the last 7 rings. The last ring but four is somewhat produced downwards in the middle line, both anteriorly and posteriorly; it is, in consequence, narrower

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* Proc. Zool. Soc. 1881, p. 778–788. Read June 21, 1881.

† "On the Conformation of the Thoracic Extremity of the Trachea in the Class Aves. Part I. The Gallinæ," P. Z. S. 1879, pp. 354–380.

‡ 'Traité général d'Anatomie comparée,' x. p. 571 (1838).

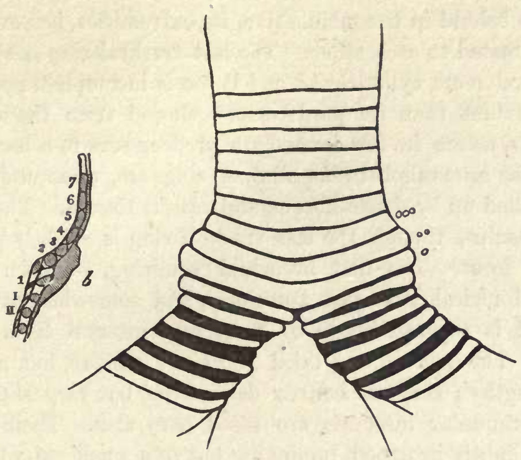
§ *Cf.* Huxley's 'Anatomy of Vertebrates,' p. 313; Macalister, 'Morphology of Vertebrates,' p. 161.

|| 'Catalogue of the Physiological Series of the Museum of the Royal College of Surgeons,' ii. p. 1C3, prep. 1159 (1834).

¶ Trans. Zool. Soc ii. p. 279.

P. Z. S. 1881, p. 779.

Fig. 1.



Bifurcating trachea of *Struthio camelus*, from before.

b. Section of wall of trachea, from behind, to show the vocal cord formed by the thickening of the mucous membrane of the interior. I. II., first two bronchial semirings. 1, 2, &c., last tracheal rings.

Here, and elsewhere in these figures, o indicates the last, oo the penultimate, ooo the antepenultimate tracheal rings.

Fig. 2.

The same, from behind. About natural size.

laterally than elsewhere. The antepenultimate ring presents the same features more strongly developed. In two of the four specimens examined it sends down a small pessuliform process of cartilage in the middle line behind, filling the chink left between the posterior extremities of the two next (incomplete) rings. The penultimate ring is narrower and

P. Z. S. 1881, p. 780.

more cylindrical than its predecessors; it is also wider transversely, and incomplete behind in the middle line, its extremities, however, being closely approximated to each other. The last tracheal ring is still wider transversely, and more cylindrical; and it too is incomplete posteriorly, to a greater extent than its predecessor; viewed from the side it is convex upwards, as are its few immediate predecessors in a less degree. The interannular intervals between all these rings are, when undisturbed, mere chinks filled up by dense fibrous and elastic tissues. There is no trace of a pessulus, though the last tracheal ring is slightly produced downwards in front. The first bronchial semiring, on each side, is narrow and cylindrical, strongest anteriorly, and somewhat attenuated posteriorly. It is separated only by a narrow interval from the last tracheal ring. The second and third rings are similar, but are more slender and lengthy; they are convex *downwards*, but very slightly so; hence the interannular intervals are small here also. Their anterior ends are very slightly inturned, impinging but to a small extent on the *membrana tympaniformis*, which completes the bronchial tubes internally, and, in consequence of the absence of any three-way piece, passes continuously from one bronchus to the other, so closing the tracheal tube inferiorly. The fourth, fifth, and succeeding bronchial rings are similar in character; but their ends, which tend to be dilated posteriorly, are successively more and more incurved to about the tenth. Nowhere are the bronchial rings complete.

There is, at most, only a trace of a *membrana semilunaris*, in the form of a very feeble, scarcely raised, antero-posteriorly directed fold of mucous membrane.

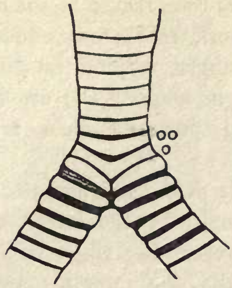
Internally, the mucous membrane of the interior is greatly thickened, forming a vocal cord, in the region of the last three tracheal rings and first two bronchial semirings (vide fig. 1, *b*).

There is no trace of any intrinsic voice-muscle; and the lateral tracheal muscles stop at the point of insertion of the *sterno-tracheales*.

The genus *Apteryx*, in the simplicity of the structure of its lower larynx, stands on the same level as *Struthio*. In *Apteryx mantelli* (figs. 3, 4) about the last dozen tracheal rings are quite simple in form, with narrow interannular intervals, and no anterior and posterior notching. The penultimate ring is produced slightly downwards, in a triangular way, both anteriorly and posteriorly. The last ring is also produced downwards anteriorly, but is incomplete in the middle line behind; it is slightly wider and stronger than the preceding rings. The first two bronchial semirings on each side closely resemble it in form; the first semirings of opposite sides are almost in contact at both extremities, the next pair being more widely separated at those joints. There is only a narrow space between the last tracheal and the first bronchial ring. The

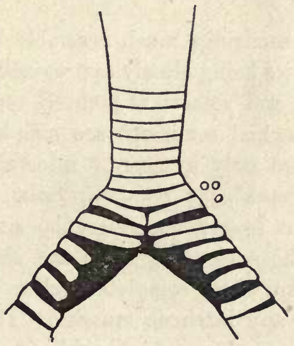
P. Z. S. 1881, p. 781.

Fig. 3.



Bifurcating trachea of *Apteryx mantelli*, from before.

Fig. 4.



The same, from behind. About twice the natural size.

succeeding bronchial semirings are perfectly simple, rather deep and stout pieces of cartilage, separated by narrow interannular spaces, and completed internally by a broad *membrana tympaniformis*; nowhere do they become complete circles. As in *Struthio*, there is no pessulus, and no intrinsic muscle. There is a slight antero-posteriorly directed vertical fold of mucous membrane between the two bronchial apertures internally, and also a feebly developed vocal cord on the external wall of the bronchi, where they diverge from the trachea. The lateral muscles stop some way before the end of the trachea, at the place where the *sterno-tracheales* are inserted. *Apteryx australis*, *A. haasti*, and *A. oweni* have all been examined by me, and all agree closely in their tracheal structure with P. Z. S. 1881 p. 782. *A. mantelli*. My specimens of *A. australis* and *A. oweni* (two) agree together in having the last *three* tracheal rings incomplete posteriorly; whilst in *A. mantelli* and *A. haasti*, of which I have seen only single specimens, the *last* ring *alone* is complete.

In the Casuariidæ we meet with peculiarities in the structure of the bifurcating trachea not existing in the other "Ratitæ." In *Casuarius galeatus* (figs. 5, 6, p. 237) the trachea is somewhat dilated for the terminal inch or so of its extent, transversely and also posteriorly. The last tracheal rings (for a number varying in different specimens, in the specimen in question 12, in another 23) are incomplete in the middle line behind, though the posterior ends are closely approximated together *.

These rings are tolerably uniform in breadth posteriorly, tapering only somewhat at their extremities; the interannular intervals are mere chinks. Anteriorly, however, the rings being dilated in the median line and attenuated laterally, the intervals are better developed. The last 5 or 6 rings are more and more curved downwards anteriorly, whilst their posterior moieties are somewhat dilated, their ends gradually receding more and more from each other in the middle line. There is no trace of a *pessulus*.

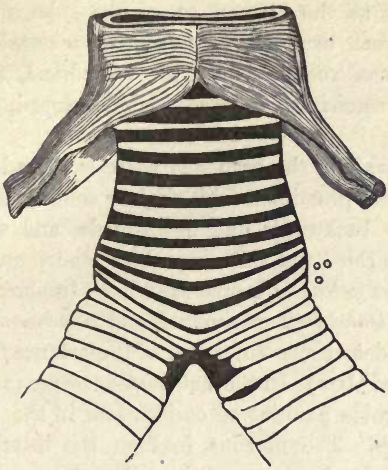
The first bronchial semirings much resemble the last tracheal rings, their anterior extremities being closely approximated together, and their posterior ones dilated, and somewhat pointed, terminally. The second, third, and fourth bronchial semirings are simple cartilaginous hoops, tolerably deep, separated only by narrow intervals, and, as usual, completed internally by a *membrana tympaniformis*. The fifth, sixth, and seventh are similar but longer semirings, the sixth and seventh being dilated anteriorly. The succeeding rings are similar but quite simple hoops, never forming anywhere complete circles.

There is no trace of any intrinsic muscles. The *sterno-tracheales* are inserted on the trachea at about the twelfth ring from the last. Anteriorly they expand on the tracheal wall, and are in contact with each other over the middle line, as is also the case in *Dromœus*, though not in the other three genera. A small part of each muscle runs to be inserted into the posterior wall of the trachea near the margin. The lateral muscle of the trachea passes between these two portions of the *sterno-trachealis* of its side, but does not pass down further than the commencement of the tracheal tympanum.

* Between the extremities of each imperfect tracheal ring runs a short band of connective and elastic tissue, with the fibres running transversely. These extend the whole length of the trachea, and when well developed have the appearance of a longitudinal band running along the middle line of the tube posteriorly. By the contraction of these fibres, the ends of the tracheal rings, where these are incomplete, or their more slender middle portions where perfect, are drawn together, and pressed into the interior of the tube, so forming what at first sight looks very much like a longitudinal, though incomplete, tracheal septum, such as is found in some Procellariidæ and other birds. In consequence of this structure, a transverse section of the tracheal tympanum posteriorly presents two strong convexities separated by a median concavity.

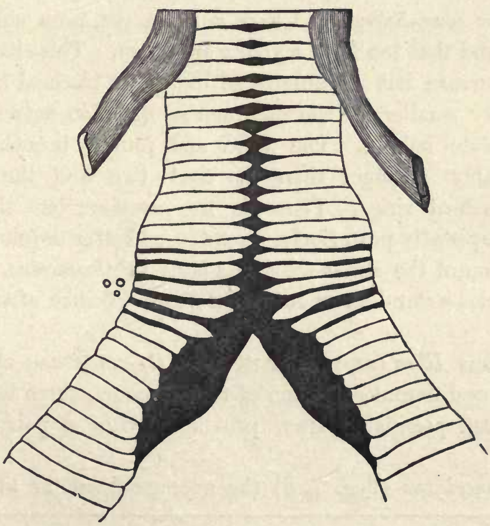
Fig. 5.

P. Z. S. 1881, p. 783.



Bifurcating trachea of *Casuarius galeatus*, from before.

Fig. 6.



The same, from behind. About natural size. The portion of the *sterno-tracheales* muscles at their insertion is represented in each figure.

As compared with *Struthio* and *Apteryx*, all the tracheal and bronchial rings are much less firm and more cartilaginous in *Casuarius*, as also in *Dromæus*. P. Z. S. 1881, p. 784.

The *membrana tympaniformis* completing the trachea below is a simple membrane, passing continuously from one bronchus to the other, with no intervening pessulus.

Internally, a very slight thickening of this membrane in an antero-posterior direction, at the bifurcation of the tube, may be seen; but there is nothing that can be properly called a *membrana semilunaris* present. The external vocal cord, on the other hand, situated over the first two bronchial semirings, is very well-developed, with a sharply-defined margin.

On the internal wall of the bronchus there is, in addition, a second, much slighter and less prominent fold, slightly concave forwards, running somewhat obliquely backwards and downwards, and supported by the anterior ends of the third and sixth bronchial semirings.

Besides *Casuarius galeatus*, I have examined tracheæ of *CC. beccarii*, *bennetti*, *uni-appendiculatus* (2 specimens), and *westermani*; and in none of these species can I detect any difference of importance from the arrangement I have described above. In the last-named species (an adult specimen) there is a considerable amount of ossification in the last tracheal and first bronchial rings. The mucous fold on the internal walls of the bronchi varies much in development in different specimens. In adults there is a great accumulation of the fibrous and elastic tissues of the mucous membrane in the region of the tracheal tympanum.

Of *Dromæus novæ-hollandiæ* I have only, as yet, been able to examine one trachea, and that too from a young specimen. This closely resembles that of *Casuarius*; but the number of imperfect tracheal rings seems to be considerably smaller, in the specimen in question only the last three being incomplete behind. The third and fourth bronchial semirings are considerably stronger than the first two and the immediately preceding tracheal rings. There is no *pessulus*; but the *membrana semilunaris*, especially posteriorly, seems to be better developed.

The insertion of the *sterno-tracheales* is as in *Casuarius*. The lateral tracheal muscles extend down to within about 1·5 inch of the end of the trachea.

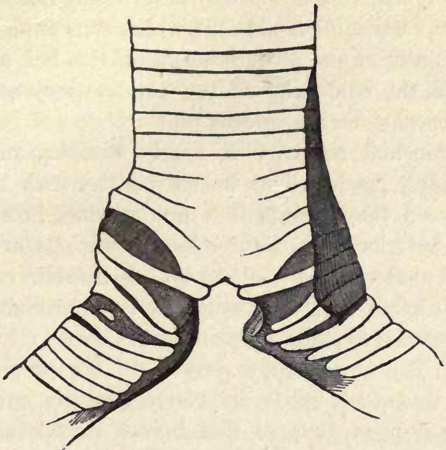
In the genus *Rhea* (as represented by *R. americana* and *R. macrorhyncha*) a very different condition of things occurs, there being a highly-specialized and peculiar syrinx, provided with a pair of intrinsic muscles *.

P. Z. S. 1881, p. 785. In *Rhea americana* (figs. 7, 8) the average diameter of the trachea

* I had observed the peculiar syrinx of *Rhea* some months before I met with M. Alix's short paper on this bird in the "Bulletin" of the Société Philomatique for 1874 (p. 38), in which he points out, for the first time, the fact that *Rhea* possesses a true syrinx. His account, which I here reproduce, runs as follows:—"Il y a chez le Nandou un larynx inférieur. Les cordes vocales sont placées à l'origine des bronches, dont les premiers anneaux sont incomplets, en sort que la paroi interne qui leur correspond a l'aspect d'une membrane tympaniforme. Le reste des bronches est formé par des anneaux complets." This description is, as will be seen, very incomplete, and, in the last statement, incorrect.

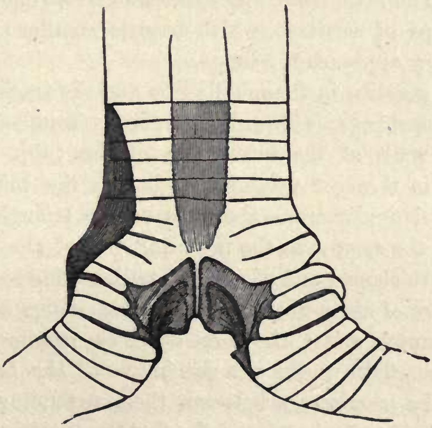
interiorly is about 1 inch, and it is somewhat compressed from before backwards. The cartilaginous tracheal rings are complete behind, and

Fig. 7.



Bifurcating trachea of *Rhea americana*, from before.

Fig. 8.



The same, from behind. About the natural size. The intrinsic muscle has been removed on the right side. In fig. 8 the fibrous band running down the middle of the trachea posteriorly, as described above in *Casuarius*, is also represented.

closely approximated to each other. The last four tracheal rings are soldered together to form a cartilaginous box, the constituents of which are marked out by the interannular sutures, which are only interrupted in the middle line anteriorly and posteriorly. The exact number of tracheal rings which are fused to form this box varies in different specimens from P. Z. S. 1881, p. 786.

four to six; in some cases it is, apparently, formed by four rings on one side and five on another. The lowest tracheal ring is strongly concave downwards, but in front in the middle line is transversely truncated. Posteriorly the tympanic box is deeply and widely notched. There is a distinct, narrow, cartilaginous *pessulus*, which runs from behind forwards, connecting the anterior and posterior walls of this box, and interrupting, in the mid line, the continuity of the *membrana tympaniformis*, which completes the bronchial walls internally.

The first bronchial semiring is nearly straight, and of cylindrical form. It is closely connected at its extremities with the last tracheal ring; but between these points is a pretty wide, lunate, interannular interval. The anterior ends of these first semirings are inturned considerably, but do not meet each other, or the pessulus; posteriorly they do not extend inwards, by some way, as far as the preceding or succeeding rings. The second bronchial semiring is similar in form, but dilated slightly behind; it is closely approximated to the preceding ring in the greater part of its extent, but is anteriorly strongly curved downwards (in a somewhat sinuous way), so that here a considerable space is left between the two semirings in question. The third and fourth rings are considerably dilated, and produced inwards, posteriorly; anteriorly, in the particular specimen figured, they are fused into a comparatively narrow ring. The fifth, sixth, and succeeding semirings are quite simple incomplete hoops of cartilage, which become smaller and less complete internally as they approach the lungs.

Between the *pessulus* in the middle line and the tracheal box and first four bronchial semirings, is spread a membrane, completing the tracheal and bronchial walls at the bifurcation of the tube. This *membrana tympaniformis* is thinnest posteriorly; but in the middle part of its extent, over a triangular area—the base of the triangle resting on the *pessulus*, whilst the apex is at the posterior end of the fourth bronchial semiring—it is thickened and of a fibro-cartilaginous consistency.

From the sides of about the last ten tracheal rings a single thin but broad band of muscle arises, the fibres of which, running downwards and forwards, are inserted into the anterior halves of the first five bronchial semirings and the membranes between them, extending, in some specimens, almost to the anterior tips of the first two semirings. This muscle is therefore in all respects a true intrinsic syringeal one. The lateral tracheal muscle stops anteriorly to the origin of the intrinsic one.

Internally, there is a well-marked, sharp-bordered *membrana semilunaris*, resting on the pessulus, developed between the bronchi. In the space corresponding to the interval between the last tracheal and first bronchial rings, an accumulation of the fibrous and elastic tissues of the lining membrane of the bronchus gives rise to a well-developed vocal cord.

Rhea macrorhyncha closely resembles, in all respects, *R. americana* in the structure of its syrinx. In the single specimen I have by me, the tympanic box is anteriorly marked by four sutures on one side, and by three only on the other, as sometimes happens in *R. americana* (as, *e. g.*, in the specimen described and figured above). P. Z. S. 1881, p. 787.

Reviewing the facts herein detailed, the most striking fact that comes out is the great difference exhibited by *Rhea* when compared with the four other genera described. In the possession of a tracheal box formed by the fusion of the few last tracheal rings, in the greater amount of specialization of the first two bronchial semirings of each side, in the presence of distinct interannular membrane-covered fenestræ, in the development of a well-marked cartilaginous *pessulus*, and in the possession of a pair of true intrinsic syringeal muscles running from the trachea to the bronchial semirings *Rhea* stands out by itself as sharply opposed to all the remaining "Ratite" birds. Of the latter, *Struthio* and *Apteryx*, as far as regards tracheal structure, form one group, the Casuariidæ another, the difference between the two being, however, comparatively slight as compared with those between them generally and *Rhea*.

Struthio and *Apteryx*, in the tendency of the trachea to narrow before its bifurcation, in the greater amount of solidity of the cartilaginous structures, in the more sharply-defined junction between the two constituent parts of the bifurcating trachea, owing to the better development of the few last tracheal rings, differ from the Casuariidæ, where the terminal part of the trachea tends to develop into an expanded *tympanum*, the cartilaginous structures are softer and more pliant, the terminal tracheal rings are narrower, and tend, especially in *Casuarius*, to become imperfect posteriorly, and the junction of trachea and bronchi is less marked. In the Casuariidæ, too, the insertion of the *sterno-tracheales* is different from that of the other genera.

As regards the alleged absence of a lower larynx (or "syrinx") in these "Ratite" birds, it is obviously untrue as regards the genus *Rhea*. In the other genera, an answer is less easy, and its nature must depend upon what is meant by the term "lower larynx."

The presence of intrinsic voice-muscles cannot be regarded as essential in the definition of that term, any more than the development of a *pessulus*; indeed either or both (e. g. *Conopophaga*) may be absent in birds with well-developed vocal organs. If the presence of semirings externally, and of a *membrana tympaniformis* internally, forming the walls of the bronchi, and of vocal cords developed in the interior of those tubes, be held to be sufficient to characterize a "syrinx," then it will be incorrect to say that the Ratite birds have no voice-organs *. As I have here shown,

* It is sometimes, though most erroneously, supposed that because a bird has no intrinsic voice-muscles, it is, therefore, mute. Were such the case, all the Gallinæ,

P. Z. S. 1881, p. 788. all these three structures are present, variously developed, in the genera in question, together with at least a rudiment of a *membrana semilunaris*. If a bird existed with its tracheal rings in no way modified at the bifurcation, with the bronchi, in their course thence forward to the lungs, completely encircled by tracheiform rings of simple form, and with no vocal cords or semilunar membrane, it might be said with truth that in such a form "there is no lower larynx." But, so far as I know, no existing bird possesses so simple an arrangement, though some of the Cathartidæ approach such a type very nearly.

Ibis, 1881, p. 312.

42. ELEVEN WEEKS IN NORTH-EASTERN BRAZIL.*

HAVING been able during the past summer to gratify a wish that every Ibis, 1881, p. 313. naturalist must feel more or less strongly—to visit personally some part of the tropics—by making a short excursion to the provinces of Pernambuco and Parahyba do Norte in Brazil, some account of my ornithological doings there may be acceptable to my brother members of the B. O. U.

Although Pernambuco is situated nearer to Europe than any other important city in South America, and is, indeed, the first port usually touched at in that continent by the various lines of mail-steamers to the Brazilian Empire and River Plate, very little appears to be known as regards any branches of its natural history. Mr. Darwin was there for a few days on his homeward voyage in the 'Beagle,' and has given us, in his 'Journal'†, some account of it, but he says nothing about its zoology. Swainson, in 1817, visited this part of Brazil ‡ and collected some bird-skins, some of which are now, I believe, in the Cambridge Museum. Collections of bird-skins made in this locality have also from time to time come into the hands of Parzudaki and other dealers, but nothing, I believe, has been recorded of the avifauna of the district. Pernambuco being thus, as was pointed out to me by Mr. Sclater, comparatively little known and easily accessible from this country, I determined on making a short trip there. I left England accordingly on June 24th, in the Royal Mail Steamer 'Guadiana,' and arrived at Lisbon five days afterwards. Here I landed for a few hours, and of course called on the well-known Portuguese naturalist, Professor Barboza du Bocage. Unfortunately,

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Ducks, *Chauna*, and many other noisy birds should be voiceless. As regards the Ratitæ, the statement made by Meckel that they are mute or nearly so (*l. c.* p. 571), is, I believe, equally groundless. I am assured by Mr. Bartlett that all, except perhaps the Apteryx, have the power of making considerable noises. As regards the Ostrich, indeed, Livingstone states that it is frequently difficult to distinguish its bellowing from the roaring of the Lion.

* Ibis, 1881, pp. 312–362. † Nat. Voy. (1870) pp. 497–499.

‡ Lardner's Cab. Cycl. "Tax. and Biogr. of Nat." p. 344.

however, it was a Saint's day, or some similar "*festa*," and he was absent in the country and the Museum closed. The only birds of interest I saw at Lisbon were three nice living Blue Magpies (*Cyanopica cooki*) in one of the numerous bird-shops near the river. Stormy Petrels (*Procellaria pelagica* ?) had appeared on June 26th in the Bay of Biscay, and followed the ship for a day or two to Carril, and now, after leaving Lisbon, they were again seen once or twice. St. Vincent was reached on July 5th; but unfortunately the ship was put into quarantine, having taken on board a passenger from the Lazaretto at Lisbon; consequently there was no getting on shore. Ibis, 1881, p. 314. Thus I had to console myself by watching from the ship the numerous Egyptian Vultures (*Neophron percnopterus*) flying about the town, and was also gratified by seeing, for the first time, one or two Frigate-birds (*Fregata aquila*) soaring high in the air. As I again saw several of these birds (all in immature plumage) on my voyage home in October at the same place, I have little doubt that *Fregata* breeds somewhere in the Cape-Verd group, very likely on the "Bird Rock" that lies at the mouth of the harbour of St. Vincent. After leaving these islands no birds appeared for some days, save a solitary black-and-white Petrel (? *Fregetta grallaria*) seen in the distance; its flight, I noticed, was very different from that of the *Procellaria*! Passing Fernando Noronha on the evening of July 10, a Noddy (*Anous* sp.*) flew on board and was caught by a sailor.

Numerous flying-fish and *Physaliæ*, the usual accompaniments of an intertropical voyage, helped to break the monotony of the sea, till Pernambuco was reached on July 12.

Pernambuco or, as I shall henceforth call it, Recife (the latter word meaning a reef, from the celebrated sandstone reef, described by Darwin and others, which forms its harbour) lies low, being built on a sort of delta of two small rivers, the Capibaribè and the Beberibè, which here flow into the sea. A little to the north of Recife is the old town of Olinda, situated on a hill of perhaps 200 feet or so above the sea, and commanding an extensive view of the flat and marshy country to the south which immediately surrounds Recife. Looking inland from this, the ground is seen to rise gradually, and then becomes more or less forest-covered, these low hills running to the south and west, and continuing into the hilly country which runs thence, more or less parallel with the coast, both north and southwards.

Recife itself, now probably the second city of the Brazilian Empire, with a population of about 90,000 souls, consists of three towns, connected with each other by excellent iron bridges. That with the port is Recife proper; the other two are called San Antonio and Boa Vista. Ibis, 1881, p. 315.

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* I will not venture to ascribe any specific name to this bird, seeing the difficulty that attaches to its correct determination.

Northwards there lies between Recife and Olinda a low, mangrove-covered, swampy tract, separated from the sea by a beach of sand and shingle, whilst to the south lies Cocoa-nut Island and more swampy country. Towards the west lies the suburb called Boa Vista; and here, and extending more or less to Caxangá (an outlying village celebrated for its pine-apples, with which Recife is connected by a street-railway), are situated the villas and houses of the more wealthy inhabitants. These are generally surrounded by gardens, often well kept and stocked with all kinds of tropical plants, native or otherwise. Here, in a quarter called Estancia, I found excellent accommodation at a boarding-house kept by two American ladies, and tenanted chiefly by Englishmen engaged in business in Recife. As the house stood in a large garden of its own, with numerous fruit-trees, and abutted on a considerable tract of marshy and little-cultivated ground, I determined on making this my head quarters, and after safely passing my baggage through the Custom House, set to work on the birds and insects.

There are some considerable patches of wood on the outskirts of the town in this direction, and numerous more or less deserted gardens, orangeries, and pieces of marshy ground, in which birds were fairly abundant, though in the town itself—excepting Urubùs (*Cathartes atratus*), a stray Humming-bird or two, Swallows (*Hirundo leucorrhoa*), and "Lavenderas" (*Fluvicola climacura*), which last are to be seen everywhere and are very tame, like Robins—not a bird is to be seen. No regular forest is met with till near Caxangá, about 8–10 miles from Recife, where the country becomes hilly and covered with thick wood, which, in places, is, I believe, undoubted virgin forest, though most of this has been cleared and replaced by second-growth (*capoeira*) of varying size and thickness.

Unfortunately the weather was not all favourable to collecting during my stay in Recife, the rainy season, which usually, I was told, ceases about the end of July, lasting on more or less for another month *. As Ibis, 1881, p. 316. the soil here is, as nearly universally elsewhere in Brazil, a thick red clay, the roads and by-paths remained almost impassable, rain falling heavily nearly every day for some hours.

In the "Gymnasium" of San Antonio is a small museum, with a decent, though badly named, series of birds and Mammalia. Most of the

* The dry and hot weather (which also is the season for yellow fever on the coast) in Pernambuco commences about September and continues till March. November, January, and February are usually about the hottest months. May, June, and July are all very wet months, on the coast at least. The heat, even during the hot season, is never very great; during my stay, the ordinary temperature was about 78°–80° F. in the shade, and about 8°–10° cooler at night. The thermometer rarely falls below 65° even on the coldest nights, and at that temperature one begins to shiver in the tropics and want blankets! Further information on the climate of Pernambuco will be found in a paper by M. Beringer in the 'Annuaire' of the French Meteorological Society, vol. xxvi. p. 28 (1878).

birds, however, are either from Pará or Rio, comparatively few from Pernambuco itself. I noticed two specimens of *Rhea macrorhyncha* (of which more below) and an *Ara spixi*, said to be from Angola ! Amongst the Mammalia I saw some good specimens of the big Armadillo (*Priodontes*), which were said to be from the Sertões of the interior.

After being in Recife for about ten days, an opportunity occurred of making a flying visit to Goyanna, a town situated near the coast about fifty miles north of Recife, and a great emporium of the sugar-trade. As there is a decent road the whole way, which passes by Olinda and Iguarassu, and the weather was not at all settled, we decided to and drive. I was thus enabled to see something of the general features of the country, though there was little chance of shooting birds. Between the two towns the country rises somewhat, the more elevated parts being pretty generally covered with forest, often thick, whilst the lower slopes of the hills, and the moister bottoms between them, are nearly uniformly cleared or planted with sugar, some of the fields being of enormous extent. Birds were plentiful, especially in the more wooded parts ; and I now saw Jacamars and Parrots alive and wild for the first time, as well as " Sangre de Boi " (*Ramphocœlus brasilius*) and many other birds not to be found in the immediate vicinity of Recife. Ibis, 1881, p. 317.

After about three weeks' stay at Estancia, I paid a week's visit to Cabo, a station about twenty miles from Recife on the Recife and Saõ Francisco Railway, and the head quarters of the staff of that Company. Mr. Wells Hood, the general manager of the line, with whom I had gone out from England, possesses a capital residence here, and was kind enough to entertain me during my visit to Cabo. Here the country, which is generally flat so far, begins to rise in low, rounded hills, of no great elevation, which are covered, on their tops and steeper slopes, with the remains of the virgin forest. Unfortunately the weather during my stay at Cabo was exceedingly bad. It rained continuously for about three days, which resulted in a general flood of all the low-lying ground in the vicinity. Hence my collection of birds did not increase much, though I believe from what I saw that Cabo would in more favourable weather be a good locality. On August 12 I returned to Estancia, making excursions thence to Caxangá and other places in the vicinity. Having pretty well exhausted the neighbourhood of Recife by this time, on August 18 I started for a trip to Parahyba do Norte, the capital of the next province to the north of Pernambuco, in company with my friend Mr. C. A. Craven, of the Recife Gas Company, whose acquaintance I had made in Recife, and whom I found much interested in the natural history of the country. Parahyba is about ten hours' run up the coast, and I found the steamers belonging to the Brazilian Steam Navigation Company by no means worthy of the evil reports I had heard of them. They are fine, well-built boats, receiving a heavy government subsidy for each trip made. By their means communication is kept up between

the imperial capital and the capitals of the more northern provinces of the empire up to Pará. Parahyba is situated in reality only about four to five miles from the sea-coast, on a river which is navigable for these steamers nearly up to the town. The river, however, turns off considerably to the north at about the point where the town is situated, so that
Ibis, 1881, p. 318. it is a trip of some ten to fifteen miles up the river from the bar at its mouth to where the steamer stops. The country is low, and the river is fringed on each side with mangrove-swamps, behind which the forest-covered country, which rises towards the interior, appears. On the mud-banks exposed at low tide many white Egrets (*Ardea candidissima*) might be seen, as well as tens of thousands of a large and brightly coloured land-crab, with vermilion white-tipped claws, which gave quite a bright appearance to the scene. A railway, the Conde d'Eu, has just been commenced at Parahyba, to run inwards for about fifty miles, with the object of developing the sugar business. The inaugural fêtes which celebrated the turning of the first sod had just terminated when we arrived, and the English engineers charged with the construction of the line were now the most important and popular personages in the town. Their then chief, Mr. A. M. Rymer Jones, a son of the well-known naturalist lately deceased, was kind enough to entertain me at the house they occupied, and he and his companions made us very much at home during our stay there.

The country round Parahyba is flat, but rather thickly covered with forest, which extends from near the town to near the sea. I succeeded in securing the services of a Brazilian "Caçador" to shoot and show the way about. Though the number of birds I got did not at all equal the anticipations I had formed from his glowing accounts of the abundance of all kinds of beasts and birds around Parahyba, I nevertheless got a considerable number of new ones, and had several very enjoyable excursions with him and some of my English friends. Besides the thick forests, nearer the town there is a good deal of scrub and bush-covered country, where small birds were rather plentiful. In the forests, indeed, these were far less abundant than in the more open parts; and several times I walked for miles along tracts in the high and thick forests scarcely seeing or hearing a bird of any kind. "Antonio," however, assured us that at the proper season of the year, *i. e.* when the fruits were ripe, these forests abounded with "Tocanos," "Trocas" (*Columba speciosa*), "Gallegas" (*Columba rufina*), and many other birds of which I saw
Ibis, 1881, p. 319. nothing. Antonio himself was armed, like most Brazilians, with an ancient muzzle-loader of French make; it was quite uncertain whether or not this weapon would go off when needed. Usually it missed fire three or four times in succession, by which time the bird aimed at had generally been prudent enough to retire out of range. Hence he did not increase my bag very much, though his astonishment at the shooting-

powers of my own gun, a double-barrelled central-fire of 16 bore, was immense, a successful shot being invariably greeted with much gesticulation of delight and loud remarks of "*Espingarda boa, espingarda ingleza*," &c.

After a very pleasant week at Parahyba I returned to Recife by the steamer on the 24th. The 'Espirito Santo,' which had come from Pará, had on board as miscellaneous an assortment of passengers as I have ever travelled with, and it would be difficult to say whether there were more parrots or slaves on board; of the latter we had at least 200, on their way south to Rio to be sold for the coffee-plantations. Besides the parrots, chiefly *Chrysotis æstiva*, there were a lot of other birds and beasts, including a nice and tame *Lagothrix* and some electric eels. Of the birds the most noticeable was an *Icterus chrysocephalus*, said to have come from the Rio Negro. This I bought, and kept alive in Recife, but unfortunately it died on its way home just as we got to Lisbon. I never saw the species alive in Europe nor elsewhere in Brazil.

When I left England I hoped to be able to go overland from Recife to the great waterfall Paulo Affonso, the "Niagara of Brazil," on the S.-Francisco river. However, the state of the roads up to the present time, as well as the difficulty of getting an interpreter (my own knowledge of Portuguese being very rudimentary), had prevented my making a start as soon as I had hoped. At length I succeeded in getting hold of a man who would do, and a day or two after my return from Parahyba, started with him from Recife. I had also endeavoured to get some one to skin and shoot, but in this was unsuccessful, the only man I could hear of wanting terms for his services which were quite unreasonable. The Recife and S.-Francisco railway runs for about 70 miles in a S.S.W. direction towards the river from which it derives its name. From its terminus at Una (or Palmares) another line of about the same length is now in progress, continuing it on to Garanhuns, which is situated about halfway in a straight line between Recife and the Paulo Affonso. It was originally intended to have continued the line to the river above the falls near Boa Vista, and so to have brought down all the traffic of the upper part of the S.-Francisco river to the port of Recife. This, however, has proved too expensive for the government, and the "Prolongamento," as it is called, is now destined to stop at Garanhuns. There is therefore but little chance at present of the Recife and S.-Francisco railway ceasing to be a misnomer. A line, however, has been made and opened from the river above the falls near Tacaratú to Piranhas, situated below them, so that the traffic that was to have come to Recife now goes down to Penedo and Maceio at the mouth of the river.

Ibis, 1881, p. 320.

The line of railway after leaving Cabo passes through a country similar to that which I have described as commencing there. The cultivation of sugar is general, and it is only on the tops of the hills, which are more or less rounded, hummocky, and low, the highest being perhaps 700–800 feet in height, that any extent of the virgin forest is left. In some places along the line patches of quite open country may be seen, which are covered with grass, without trees or under-growth, and in general character a good deal resemble our south downs. I at first thought they were natural, but afterwards found out that they were *inclosed* spaces, used for horses and cattle. The grazing has evidently prevented them from becoming covered with a thick growth of *capoeira*, which always covers the hills where these have been cleared for sugar and afterwards allowed to lie fallow for a time. The destruction of the forests is still going on, as new ground is continually cleared by burning and cutting away the undergrowth for more sugar, so that in a few years there will, if this goes on, be little trace of the old forests left.

Ibis, 1881, p. 321. At Palmares the railway ceases, and henceforward all travelling and traffic has to be done on horseback, there being no roads in the interior worthy of the name. The earthworks of the "Prolongamento" are now nearly complete, only a few of the deeper cuttings and a tunnel or two being unfinished. The line of railway now forms the chief road to the interior; but at this time, after the end of the rainy season, the stiff red clay had become worked up, in most places, into the most frightful mud conceivable, so that the horses were often up to their knees in it, and the rate of progression in consequence was a walk. At Palmares I was fortunate enough to fall in with the engineer-in-chief of the first section, Dr. Abel, a most pleasant and well-educated Brazilian gentleman. He too was going up country with the paymaster, so that I had the advantage of his company and escort (two Brazilian troopers) for the first part of my ride. As far as Barra do Jangada (a small village situated on the river Pirangí, which falls into the Una near Palmares), about thirty miles from Palmares, the country retains much the same features, though it gradually rises towards the interior. The hills perhaps are higher, and in some places, as around Catende, still pretty thickly covered with "*matto*" (the Brazilian term for the virgin forest), there being less sugar-cultivation here than nearer the coast. Towards Barra do Jangada cotton appears for the first time, a sure sign of the increasing elevation of the country. Riding along in this way I had no opportunity of shooting, but from the saddle I saw many birds already seen or secured. The "Sangre de Boi," however, disappeared soon after leaving Catende, and I saw no more of it as we approached the Sertões. Another day's ride brought us to Quipapá, the most important town between Una and Garanhuns.

After leaving Barra the country gets decidedly more hilly and open, and the forest begins to disappear, though many blackened and dead trunks of old forest trees standing on the higher hills show that this is due in large part to man's action. The soil is still clayey, resting on solid rock, apparently granite or gneiss, which in some places on the shoulders of the hills is left quite bare in great rounded patches. These at first suggest glacial action; but I am inclined to think that in reality they are merely the beds of old streams which formerly flowed down over them before the disappearance of the forests on the hills around had reduced the rainfall, and so caused their drying-up. I had no chance of shooting before getting to Quipapá, though between that town and Barra I fell in with a fine specimen of the much-dreaded Jararáca (*Trigonocephalus brasiliensis*?), a rather rash attack on which resulted in nothing further on my part than a narrow escape from being bitten. Ibis, 1881, p. 322.

Quipapá is distant 12 leagues from Palmares, on the Pirangí, and is at an elevation of about 1450 feet above the sea. The mean annual temperature is about 72°·5 F., the maximum being about 92° and the minimum 62°. For these details I am indebted to my friend Mr. H. E. Weaver, an English engineer who resides there, and who is chief of the second section of the "Prolongamento." He entertained me most hospitably at his house for several days, and aided me greatly in obtaining specimens of all kinds, as well as in other ways. There is no high forest very close to Quipapá, though there are still patches of it on the higher hills here, as elsewhere. The lower slopes, where not cleared for sugar, are covered with a rather thick growth of brushwood, in which, particularly along the river, birds were rather abundant. The weather too had now become markedly finer; in fact, since leaving Recife, hardly a drop of rain had fallen. Soon after leaving Una I had made up my mind that any idea of getting to the S. Francisco in the limited amount of time (about a month) now at my disposal must be abandoned, as I was due at Cambridge by the middle of October. I very much regretted having to give up the Paulo Affonso, but getting there and back in a month would have entailed continual travelling, and I should have had no chance whatever of collecting. I therefore determined to go no further than Garanhuns or thereabouts, staying *en route* at various places to collect. At Quipapá I remained till September 6, and then went on a few miles to a Brazilian friend living at Vista Alegre, two houses in a valley off the main line of the railway. From here I went, after a couple of nights, to Macuca, where I found a most hospitable (if somewhat primitive) welcome from Mr. J. Watt, also an English engineer employed on the Prolongamento. The country here much resembles that around Quipapá, but there is less forest and sugar and more *capoeira*. I continually added new birds to my list, and no doubt if I had had any assistance could have much increased the number both of species and specimens. But I had to do all my skinning myself; the Brazilians, though they talked much, did little, and that chiefly in snakes and lizards: my interpreter was useless for any purpose but to interpret (I doubt if he had ever fired a gun in his life), and my English friends were too busy with Ibis, 1881, p. 323.

their professional duties to be able to spare much time to shoot; moreover, there were no guns available except those of the natives, and, as I have already said, the capabilities of these weapons as firearms were small.

After a few days most agreeably spent at Macuca I went on to Garanhuns, the termination of the "Prolongamento," distant about 80 miles from Una. Garanhuns is situated in the zone of country called the "Agreste," that intervenes between the forest-clad "Matto," which extends inwards 60 to 70 miles from the sea-shore, and the open, elevated country, or Sertões (pronounced "Sertongs"), of the interior. The "Agreste" zone participates to some extent in the features of both "Matto" and "Sertaõ"; the forests have not altogether disappeared, but are smaller in size and of a different character; the climate is much drier, and the vegetation lower and more scrubby in character.

In the Sertões, I am told (for I did not actually get into the real Sertões country), the vegetation becomes still more low and scrubby, and the aspect of the country generally arid and stony. There is little water, and cultivation is confined chiefly to the ridges of hills that intersect the general level of the plateaux of 3000–5000 feet forming the Sertões. In the height of the dry season many of the shrubs and trees lose their leaves. The growth of cotton and the raising of stock are the two great industries pursued in the Sertões, which probably extend over nearly the entire area of the interior of the province of Pernambuco. The distance from Macuca to Garanhuns is about 33 miles; after leaving Canotinho, about an hour and a half's riding from Macuca, the aspect of the country begins to alter visibly. The soil becomes sandy, and the vegetation generally lower and more scrubby, with patches of forest in places. Great *Cacti*, too, some 40–50 feet high, and forming large trees in some places, become conspicuous features in the landscape, and two or three species of *Begonias* also appear. In bird-life the "Salta Caminho" (*Zonotrichia pileata*) for the first time appears, hopping about the sandy roads, and marking the changed nature of the country.

Ibis, 1881, p. 324.

Garanhuns is a large village (although called a city) of perhaps more than 2000 inhabitants, and lies at an elevation of about 3000 feet above the sea. The country round is hilly, though none of the hills attain any great elevation; these are pretty uniformly covered with a thick scrub of low bushes and aromatic herbs, with, in some places, small patches of "*matto*." There is little water. The temperature is noticeably cooler than nearer the coast, though sufficiently hot when the sun shines; indeed, on account of its dry soil and rather bracing atmosphere, Garanhuns is acquiring some celebrity in Pernambuco as a sanitarium, during the dry season, for the residents in the lower parts. I was most hospitably entertained, during my week's stay at Garanhuns, by Senhor Doutor José Aloes Lima, the Juiz Municipal, who most kindly placed an empty house at my disposal, where I slept and kept my apparatus. The country round Garanhuns seemed to be rather rich in birds; but partly from the thickness of the scrub, which in some cases was nearly impenetrable, and partly, I think, from the recent occurrence of a prolonged "*Secca*," or drought, during which everybody who could went out and shot small birds indiscriminately, thereby rendering them very shy, I failed to get several species I saw there and did not elsewhere meet with. A more prolonged stay would, I feel sure, have added numerous species to my lists. I also believe that Garanhuns would prove a very rich station for a botanist, judging from what I saw of its flora during my rambles after birds or insects. Ibis, 1881, p. 325.

Garanhuns is the principal town of a considerable district, and every Saturday a fair takes place there, which is largely attended by the "*Matutos*," or peasants of the country round. I was told this fair would be a capital chance of obtaining animals and birds from the country people who come in to attend it; and I therefore decided to stay a couple of days to witness it, rather than going on to S. Bento, in the Sertões, about 35 miles north of Garanhuns, and returning thence by a different route to Macuca, as I had originally intended. However, the fair, though it certainly gave me an excellent chance of seeing "the natives" (and, perhaps I should add, of their seeing me), produced nothing, or next to nothing, in the way of "*bichos*," a most convenient term used in Brazil for denominating all and any animals from an elephant to a blackbeetle. I managed, however, to pick up a live "Ema" (*Rhea macrorhyncha*), of which more anon, at Garanhuns, as well as a lot of Tinamus, sundry Hawks, Guans, and other live birds, so that when I left I had a regular caravan of living animals, which necessitated my taking on an extra horse or two and man for their safe conveyance to Palmares. I finally left Garanhuns on September 19th, and returning by the same way as I came, stopped *en route* a night at Macuca and two days at Quipapá, and reached Recife September 24th. A few days were spent in packing up and settling things generally; and on September 29th I left, with my live animals, which had now increased to about 35 in number, in the Royal Mail Steamer 'Neva,' and arrived at Southampton October 15th.

Before concluding this account of my trip, I ought to return my best thanks to the numerous gentlemen in Brazil who did all in their power to help me, and especially to my friends Mr. Wells Hood of Cabo, who most kindly procured me numerous valuable introductions, to Messrs. W. Elliott and C. A. Craven of Recife, to Mr. Curling of Parahyba, as well as to Messrs. Weaver, Watt, Abel, and the other engineers of the "Prolongamento," and to Dr. Lima of Garanhuns.

The total number of species of birds of which I obtained or observed Ibis, 1881, p. 326.

specimens during my trip was 116. In the following list they are treated of in systematic order, according to the nomenclature of Messrs. Sclater and Salvin's 'Nomenclator Avium Neotropicalium,' unless otherwise stated. I am much indebted to Mr. Sclater for having kindly gone through and named the greater number of my birds for me, whilst Mr. Salvin was good enough to give me the names of the few others.

As far as can be judged from the results of a short trip like mine, the avifauna of Pernambuco is essentially South-east Brazilian, with few, if any, Amazonian forms. It would appear from my observations on the birds, and from the general features of the country, that Pernambuco is far less rich in birds than either Bahia or Pará, the comparative poverty no doubt being due to the long time that the country, at least near the sea, has been colonized, and to the consequent destruction of the primæval forests. Moreover, as the forest only forms a comparatively narrow zone along the coast, with a dry and elevated "campos" country behind, there has been no possible retreat towards the interior for the original inhabitants of the coast forests, and many of the most characteristic forms have, in consequence, disappeared or become scarce. Of course, my collections do not represent any thing like the total number of species to be found in Pernambuco; but I think the above conclusion will be confirmed by further collections from that district.

From what I heard of the nature of the country, Ceará, and most likely Maranhão as well, must probably be included within the limits of the South-east Brazilian fauna, so that the boundary between it and the Amazonian province must lie still further north-west on the coast, whilst in the interior it may correspond to the watershed between the Tocantins and the Paranahyba.

The following is an account of the birds of which I obtained or observed specimens. The specimens are mostly deposited in Mr. Sclater's collection.

Ibis, 1881, p. 327.

1. Turdus fumigatus.

I am not quite certain as to the correctness of the above name, though it is probably this species that occurs in this part of Brazil, as the only specimen of this Thrush that I shot fell into a swollen stream and was lost. Two I bought alive also escaped.

The "Sabiá," as it is called by the Brazilians, is very much esteemed by them as game, and therefore relentlessly shot down; hence it has become a very shy bird, at least in the neighbourhood of towns. It has a rather pleasant song, and is also on this account sought after by the natives, who keep it as a cage-bird very commonly. I saw caged specimens in nearly every place I visited from Parahyba to Garanhuns, but only a few times observed it in its native state at Cabo and Recife, so can say nothing further on its habits.

2. Turdus rufiventris.

I found this Thrush common all over the districts I visited, except in the immediate neighbourhood of Recife. In its habits it much resembles the common Thrush of England (*T. musicus*), spending a good deal of its time on the ground in pursuit of its food. It is usually to be seen in paths in the lower second growth, or in the clearings for railways, or on the line itself, and is not found in the thick forests. The Brazilians call this Thrush, as well as the preceding species, "Sabiá," and esteem it highly for eating-purposes. Hence probably it has become rare near Recife, and shy elsewhere in the neighbourhood of towns.

Eyes brown; beak greenish yellow, the upper mandible greyer; feet dirty flesh.

3. Polioptila leucogastra.

I first met with this elegant little bird near Parahyba, and subsequently saw it frequently in the interior between Quipapá and Garanhuns. It goes about in small companies of two or three, and is a most active little creature, in almost perpetual motion from twig to twig, the meanwhile constantly flipping its tail up and down.

Eyes brown.

4. Donacobius atricapillus. Ibis, 1881, p. 328.

This bird I first observed from the train on the railway between Cabo and Una, frequenting the marshy bottoms of the valleys. I subsequently saw it at Cabo, and found it more or less abundant in suitable situations all along my route thence to Macuca. It is a very noisy bird, with a loud chattering cry. It flies about in small companies of three or four, and is found among the marshy vegetation that grows along the banks of the stream. The bird is a very conspicuous one, both owing to its noisy cry and the habit it has of fluttering its short and rounded wings, when the white bar at the base of the primaries forms a very much more striking mark than would be imagined from the skins. I heard the name "Casaca do Couro," signifying "Leathern Jacket," applied to this bird by a Brazilian friend who had paid some attention to animals; but whether it is the same bird as that mentioned by Capt. Burton ('Highlands of Brazil,' ii. p. 316) under the same name, and noticed by him on account of its remarkable nest, I do not know. I never saw *Donacobius* nesting. As mentioned by Burmeister (Thiere Bras. ii. p. 130) there is a narrow naked space, about an inch long, on the neck of this bird, behind the angle of the jaw, which shows conspicuously in the shot bird. It is coloured bright chrome-yellow (Burmeister says "*fleischroth*"), and with the bright yellow irides makes a freshly shot *Donacobius* a far more beautiful object than one that is skinned. This brightly coloured nude space is probably present in both sexes, as the only specimen I procured was a female. I do not at present recall any precisely similar case of ornamentation by a bright nude skin-space on this part of the neck in any other bird—certainly not in any other Passerine. The feet are grey.

5. TROGLODYTES FURVUS.

This is the common Wren of the country, and is very abundant everywhere in the neighbourhood of houses or gardens, though it is not much of a forest-bird. It has a remarkably strong song for such a small bird, and may often be seen perched on the roofs of the houses of Ibis, 1881, p. 329. the villages in the early morning, carolling. For its notes it is, I think, on the whole the best singing-bird I heard whilst in Brazil.

Eyes brown; feet flesh-coloured.

6. BASILEUTERUS AURICAPILLUS (Sw.)*.

I shot a single female specimen of this bird, the only one I saw, in the depths of some high forest near Quipapá.

7. CYCLORHIS ALBIVENTRIS.

I found this curious bird rather common nearly all over the country I visited, though nowhere abundant. It is found amongst the vegetation of the more open parts, usually singly, and seems to be a very quiet bird, hopping about from leaf to leaf of the bush or tree it is in, and not uttering any cry; at least I never remarked any.

The irides are beautiful bright orange-yellow; the strangely shaped bill has the upper mandible dark flesh-coloured, the lower pale bluish slate. The feet are pale dirty fleshy.

8. HIRUNDO LEUCORRHOA.

This Swallow I found very common in Recife, where it might be seen flying about in numbers in some of the streets, as well as over the rivers which separate the various parts of the town. I also observed it at Parahyba; but in the interior it seems to disappear, and be replaced by the *Atticora* next mentioned.

9. ATTICORA CYANOLEUCA.

I did not bring home any specimens of this Swallow, the only one I shot having been too much damaged to skin; I have, however, little doubt that this is the species I met with, as I continually saw it in numbers, and was able to examine it often through my field-glasses. It was very abundant at Cabo, and might be seen there sitting in numbers,

* *Cf.* Berlepsch, Ibis, 1881, p. 240.

particularly in the morning, on the telegraph-wires of the railway opposite Mr. Hood's house; I also saw it at Parahyba and Garanhuns, perched on the roofs and eaves of the churches, and therefore not to be shot at with impunity. In Recife, on the other hand, I never saw it at all, though the last species, as already mentioned, abounded there. Ibis, 1881, p. 330.

10. STELGIDOPTERYX RUFICOLLIS.

This Swallow I found common in numerous places from Recife and Parahyba on the coast inland as far as Macuca. It perches freely, and may be often seen along the roads and railway, where there are cuttings exposed.

Eyes brown.

11. DACNIS CAYANA.

I only rarely met with this species, once near Caxangá, and another time near Recife, where I came across a small flock of three or four in an old, overgrown garden some two miles from Estancia; of these only one was a full-plumaged male. I also saw one or two near Parahyba.

Irides red-brown; beak blackish brown, with the base of the mandible fleshy; legs fleshy, the claws greyer.

12. DACNIS PLUMBEA.

I only met with this bird in the garden at Estancia, and there only saw it a few times. It hops about the trees and bushes in a systematic sort of way, going from leaf to leaf in search of small insects and other food, which it picks up off the leaves. I did not observe any full-plumaged male.

Eyes (in the female) greyish brown; legs dirty flesh-coloured; beak pale fleshy, with the culmen broadly darker, horny black.

13. CŒREBA CYANEA.

Only once did I come across this bird—a single specimen in immature plumage that I saw in the garden at Estancia.

14. CERTHIOLA CHLOROPYGA.

This little bird is one of the very commonest in those parts of Brazil I was in, being most abundant in all the gardens near Recife, and almost equally so elsewhere in the neighbourhood of houses, though sometimes seen in the wilder parts. It assiduously visits all the shrubs that may happen to be in flower in any particular spot, collecting from the blossoms its meal of insects, mixed, no doubt, with the nectar of the flowers. It has a weak, though rather pleasing, song of a few notes, the last note being considerably more powerful than those that precede Ibis, 1881, p. 331.

it. It is known by the Brazilians as "Guarratan," a name, however, which it shares with the *Euphonia* and some other Tanagers.

Eyes brown.

15. EUPHONIA VIOLACEA.

This violet-and-yellow Tanager I found sparingly round Recife, and also at Parahyba, both in gardens and in the vicinity of high forest. I did not, unfortunately, see enough of its habits to throw any light upon the *raison d'être* of the peculiarly developed stomach of this genus, a feature first observed by the late Dr. Lund, and lately redescribed and figured by myself *. This bird is kept commonly as a cage-bird by the Brazilians, who call it "Guarratan," a name, as already observed, also applied to several other small brightly plumaged birds.

16. CALLISTE FASTUOSA.

This very beautiful Tanager, to my mind one of the finest of the beautiful genus it belongs to, is believed to be peculiar to the province of Pernambuco, from which skins are occasionally received by the dealers in Paris and elsewhere. It is a species often seen, too, alive in the larger Zoological Gardens of Europe, though no naturalist seems to have yet met with it in the wild state. It does not appear to be common in Pernambuco—at least I only met with it twice, once near Macuca, where I shot a female out of some bushy *capoeira*, and again at Quipapá, where I saw what I believe was this species in the virgin forest. The bird, however, was perched at a great height from the ground, in the topmost branches of a large tree, and only the brilliant orange-yellow of its rump was visible. Whilst staying at Cabo, a freshly shot adult of this bird was also brought to me to skin, so that probably
Ibis, 1881, p. 332. it is also to be found considerably nearer to the coast than the localities I saw it in.

Eyes brown.

17. CALLISTE FESTIVA.

I only saw this beautiful *Calliste* once, when I fell in with a small party of it in a patch of virgin forest near Quipapá, and succeeded in shooting a fine male.

Eyes brown.

18. CALLISTE FLAVA.

This beautiful, though peculiarly coloured, bird is, perhaps with the exception of *Tanagra cana*, the commonest Tanager in the provinces I

* P. Z. S. 1880, pp. 143–147, "On the Structure of the Stomach in certain Genera of Tanagers."

visited. I met with it everywhere from Recife to Garanhuns; and though never seen in numbers, it appeared to be fairly abundant. It frequents chiefly gardens or plantations of fruit-trees, but I have also seen it in thick forest country. It was abundant in the garden at Estancia, frequenting the orange-trees, sapotís (*Achras sapota*), and other fruit-bearing plants; and I have also met with it feeding on the flowering shrubs of the virgin forest. It goes about either singly or in small companies, and most of the specimens seen are either immature or females. The adult males are usually met with singly, though I have seen three perched close together in the same tree. I failed in my endeavours to bring living specimens to England, though I got one as far as St. Vincent.

Eyes brown; feet lead-grey.

19. Tanagra sayaca.

This Tanager is abundant all over the country. It is found, like the last species, in small flocks of four or five, and is common near the vicinity of houses and gardens wherever there are fruit-trees. At Estancia it abounded, visiting the orange- and lemon-trees, also the sapotís, mamans (*Carica papaya*), and other fruits in season. It did not apparently mix with *T. palmarum*, and left the cocoa-palms to the latter species, preferring the lower and bushy trees. The Brazilian name is "Sayaçu," a name, however, which they also apply to *T. palmarum*.

Eyes brown.

20. Tanagra palmarum. Ibis, 1881, p. 333.

This Tanager is very abundant near the coast, and may be seen in numbers quite close to Recife. In the interior it is less common, though I saw it once or twice near Macuca. The specific name is very appropriate, as the bird frequents the cocoanut-palms, flying in small flocks from one tree to another, and settling about the root of the "crown," where it probably finds abundant food in the shape of insects and spiders.

Eyes brown; feet leaden grey.

21. Ramphocœlus brasilius.

I first met with this splendid bird on the road between Iguarassu and Olinda, and subsequently found it abundantly, in favourable situations, nearer Recife, as well as at Parahyba and all along the line of railway as far as Catende. It seems, however, an essentially low-country bird, and as the country rises in the interior disappears. This bird goes about like several of the other Tanagers, in small parties, composed chiefly of immature or female birds, so that the number of those seen in the gorgeous crimson and black dress of the adult male is comparatively small. It is always to be found in the low bushes and vegetation that grow about the lower slopes and bottoms of the valleys in the neighbourhood of water, and is never, according to my observation, found in gardens or the virgin forests. It has a quick, rather loud, sharp, chirping note, of a single syllable, repeated several times in sharp succession, which one soon gets to recognize. The Brazilian name is "Sangre de Boi," *i. e.* ox's blood, from the brilliant crimson of the plumage of the male.

Irides orange-brown.

22. Tachyphonus melaleucus.

This Tanager is widely spread over the province of Pernambuco, where I met with it at nearly all the places I visited, from Caxangá to Garanhuns; and I also obtained it at Parahyba. It is usually seen singly or in pairs, the black male with the chestnut female. The stomach of one I examined contained insects.

Eyes brown.

Ibis, 1881, p. 334.

23. Nemosia pileata.

I obtained this species of *Nemosia* in the garden at Estancia, where, however, I only observed it once or twice. The only other place I met with it was at Cabo, where I once saw two or three in Mr. Hood's garden.

Eyes bright yellow; legs horny yellow, with the claws horny.

24. Nemosia fulvescens.

I first met with this Tanager at Quipapá, where it was not uncommon in the low bushy *capoeira* near the river. It was usually seen in small companies of three or four, hopping about amongst the leaves like a *Dacnis*. I also saw it at Garanhuns, but not nearer the coast.

Eyes brown; beak and legs grey.

25. Saltator magnus.

I only once met with this bird, which I shot in thick and high forest some miles from Parahyba.

Eyes brown.

26. Orchesticus capistratus.

This curious Bullfinch-like Tanager I first met with near Vista Alegre, about halfway between Quipapá and Macuca. I subsequently saw it at both those places, as well as at Garanhuns; indeed it seems rather a common bird in this part of the province. It is nearly always seen singly near, but not in, high forest, and perches in the larger trees that rise above the bushes and undergrowth of the *capoeira*. It appears to be not at all shy, and is easily shot. The sexes are similar.

Eyes reddish brown; feet black-grey.

27. Orchesticus ater.

This bird was rather abundant round Parahyba in the neighbourhood of the forest, and in its habits resembles the last species. At Vista Alegre I found both species together in the same locality, but beyond that point it seems to be replaced by *O. capistratus*.

At Parahyba I obtained a specimen which is in all probability the *young* bird of this species, though it was the only one seen in that plumage. It is of a dark olive-green above, lighter below, with the forehead, chin, breast, and angle of the wing greenish yellow. It is probably *O. ater* in this phase of plumage that was described by Sclater as *Tanagra olivina* (cf. Sclater, P. Z. S. 1881, p. 213). Ibis, 1881, p. 335.

I bought a single living specimen of this bird in a shop in Recife, and brought it safely to London, where it is still living in the Zoological Society's Gardens. I never before saw it living in Europe.

Eyes reddish brown; the beak leaden grey, with the tip broadly black (in the adult).

28. Guiraca cyanea.

The Blue Grosbeak I first saw on the road between Iguarassu and Olinda, and I subsequently met with it at most of the places I stayed at as far as Parahyba and Garanhuns. It frequents low bushy ground, and is usually seen singly or in pairs. The Brazilians call it "Azulin."

Eyes brown.

29. Oryzoborus torridus.

I only twice met with this little Finch, which I saw singly near Cabo and Parahyba.

An allied species (*O. maximiliani*?) is kept as a cage-bird by the Brazilians, who give high prices for them, they being much esteemed for their song, which is supposed to be only surpassed by that of the "Patitiva." They call it "Bicuda," from its large beak.

30. Amaurospiza unicolor.

Whilst staying at Quipapá a Brazilian servant of Mr. Weaver's brought me a fresh specimen of this rather rare little Finch, which he had obtained near the town. This was the only specimen I saw.

Eyes brown; feet fleshy grey.

31. Spermophila nigro-aurantia.

I obtained this species at Recife, frequenting the same localities as the

Ibis, 1881, p. 336. next two, but it appeared to be less common. I also saw, and shot, what I believe was a specimen of this bird near Vista Alegre, but did not succeed in finding it. The Brazilians call it "Caboclo," a name applied to the tamed aboriginal Indians in Pernambuco. It may sometimes be seen in Recife in cages with crowds of sundry other *Spermophilæ*, Canaries (*Sycalis*), Cardinals (*Paroaria*), &c.

32. Spermophila gutturalis.

This little *Spermophila* was very abundant in the garden at Estancia, frequenting the reedy and marshy parts, where it congregates in small flocks, feeding on the seeds of the grasses, sedges, and other similar plants. I also saw it abundant afterwards at Quipapá, as well as in the low bush-covered country round Garanhuns, so that it is by no means confined to the sea-board or even to the neighbourhood of water. It is often kept as a cage-bird.

Eyes brown.

33. Spermophila hypoleuca.

This species of *Spermophila* is also common and widely distributed, frequenting grassy or open places, and often coming into gardens. It appears to feed mainly on grass-seeds, and is social in its habits. The females are brown. Called by the Brazilians "Papa Cupim," *i. e.* grass-eater. This name it shares with *S. gutturalis*.

Eyes brown; bill (in the male) fleshy red.

A closely allied species (*S. plumbea*, distinguished easily by its smaller and black beak) I never succeeded in identifying for certain in a wild state, though it is greatly esteemed by the Brazilians as a cage-bird. They call it "Patitiva de Parahyba" (those caught at that place being supposed to be particularly excellent songsters) and often pay considerable prices for good singers. The song is loud for the size of the bird and rather pretty, though monotonous, and not at all comparable to a Nightingale's, or even a Red Cardinal's (*Cardinalis*).

34. Volatinia jacarina.

This little Finch, though not very common as a rule, I found widely
Ibis, 1881, p. 337. spread, extending from Parahyba and Recife on the coast to Quipapá and Vista Alegre in the interior. The adult males may often be seen singly, and they have a peculiar habit of selecting some particular twig on a bush or small tree as a pet perch. Here they sit for a long time, twittering out a little song of a few notes, and then jumping vertically up some little way in the air, and, turning a somersault, alighting in the same place. I have watched them on several occasions repeat this performance a number of times consecutively, continuing, in fact, till they were disturbed. They would then fly off to some other place, and go on with

their performance. The females and young birds are brown, and these seem to be more sociable, going about in small flocks. The Brazilians call the bird "Saltadó."

The eyes are brown.

35. PAROARIA LARVATA.

The Red-headed Cardinal I found common at Parahyba, and again saw it in the neighbourhood of Garanhuns, so that it occurs all over the district I traversed. It is usually seen singly or in pairs in the more or less cleared and open ground near cultivation. Many dozens are brought into the market at Recife to sell as cage-birds.

The Brazilians call it "Gallo do campina."

36. ZONOTRICHIA PILEATA.

This bird marks the approach of the traveller, as I have already mentioned, to the Sertões of the interior. I never once saw it on the coast, or anywhere in the "*matto*" zone, though on passing Canotinho and getting on to the sandy soil of the interior, it almost at once becomes abundant. Round Garanhuns it was very common, hopping about the highroads, often two or three together, and very tame.

The Brazilian name is "Salta Caminho," or "Road-Hopper."

37. COTURNICULUS MANIMBE.

I only got this bird at Caxangá, where it seemed rather common, frequenting the heaps of rubbish left near the railway station.

Eyes brown.

38. CHRYSOMITRIS YARRELLI. Ibis, 1881, p. 338.

Of this pretty little bird I obtained a living specimen at Parahyba, which is now alive in the Zoological Gardens. I subsequently saw one near Garanhuns, and a pair near some forest close to Quipapá. The Brazilian name was, I understood, "Pinta Silva" (? Pintasilgo = Goldfinch).

39. SYCALIS FLAVEOLA.

The "Brazilian Canary" is a very abundant bird in the parts of Brazil visited by me, being found from the coast, at Parahyba and Recife, to the interior. Large flocks of it, sometimes containing one or two hundred individuals, may be seen in suitable localities, which are usually the more or less cleared grounds in the neighbourhood of *engenhos*, or sugar-farms. In these places it frequently consorts with numbers of the little green Tapacú Parrakeets (*Psittacula passerina*). A specimen which I shot near Cabo "towered" in the air as wounded Partridges and other birds often do, to a height of fifty or sixty feet or more, and then dropped down dead; on examination I found it had been shot through the brain.

The "Canario" is a very common cage-bird with the Brazilians, nearly every house having one or more pairs.

40. Cassicus persicus.

This is one of the commonest and most characteristic birds of the country near the coast, where it is very abundant, and may be seen commonly, even in the neighbourhood of Recife, nearly anywhere where cocoa-palms grow. It usually goes about in small parties of about four or five, which keep up, when perched, a continuous chattering, often leading to their discovery before being seen themselves. Towards evening they seem to collect in larger parties, as at that time numbers might often be seen returning homewards, always flying in the same direction, and usually making for a clump of palms, on which, no doubt, to pass the night. In the interior it is much less common, and I often went several days without seeing one. The Brazilians call it "Sheshou," and keep it often in cages.

Irides deepish blue.

Ibis, 1881, p. 339.

41. Icterus tibialis.

This bird I first observed at Quipapá, where it was not uncommon in the vicinity of the town, flying about in small companies of twos and threes. I afterwards found it at Macuca and Garanhuns, and saw a single specimen in the garden at Cabo a few days before I sailed, though I did not see the species at all during my previous stay there. The bird is also found at San Lorenzo, a village about 20 miles west of Recife, as a living specimen I bought in Recife came from there. The bird is not rarely to be seen caged in the houses of the Brazilians, who call it "Sheshou de Bananeira," to distinguish it from the common "Sheshou" (*Cassicus persicus*). It is also sometimes called "Soldado," or soldier. I succeeded in bringing three specimens alive to London, two of which are still living in the Zoological Gardens, where it has not before, I believe, been exhibited alive.

Eyes reddish brown; feet bluish grey.

42. Molothrus bonariensis.

I never met with this species in the wild state, but saw several in cages in Recife, Quipapá, and elsewhere, and was told that it was found in the neighbourhood.

43. Leistes superciliaris.

This Red-breasted Hangnest I only saw at Cabo. Here it was abundant in the open, down-like fields that are found on the *engenhos* where the forest has been cleared and subsequently inclosed for the use of cattle and horses. I only once or twice saw the full-plumaged birds; all the others were immature, and these kept in large flocks like Starlings, feeding, like them, largely on the ground on the insects and other creatures always present where cattle are feeding.

This is, I believe, the most northern locality from which the species has yet been recorded. It is replaced further north by a representative (*L. guianensis*) which has no white supercilia.

44. Aphobus chopi.

A single female skin that I brought home is apparently referable to a small form of this species, which I found rather abundant at one or two localities, Vista Alegre and Macuca, in the interior of Pernambuco. Though local, the bird was common where it occurred, flying about in large flocks, like Starlings, in the neighbourhood of sugar-plantations. They were rather wary and not easily approached. The Brazilians called it "Arumará."

Ibis, 1881, p. 340.

Eyes brown.

45. Fluvicola climacura.

This bird is, I consider, the most characteristic of the country of all the species met with during my trip. Save in the thick forest, it may be seen nearly everywhere, even in the busiest parts of the town of Recife, close to the sea, and everywhere it is conspicuous alike by its tameness and its sharply contrasted colours. To the structure of a Tyrant-bird it unites the habits of a Wagtail and a good deal of the appearance of a *Saxicola*. It spends a great part of its time on the ground, running swiftly, like a Wagtail, after the insects which it puts up, and seizing them as they rise from the ground. It is by no means afraid of man, coming up to within a few yards of the houses, and mixing freely with the poultry and dogs of the establishment. Usually it is seen in twos or threes, but never, so far as my experience goes, in flocks or larger parties. Frequently two may be seen perched on the top of a wall or house, "standing up" to each other, with fluttering wings, spreading tails, and outstretched necks, chattering away vigorously at each other the whole time. It is nearly the only bird that is not shot or eaten by the Brazilians. They call it the "Lavendera," or Washerwoman, from a legend of its having formerly performed those functions to the Virgin Mary. Hence they hold it almost an act of sacrilege to kill one, and think very much the same of a man who shoots a "Lavendera" as we do in England of one who kills a Robin. In consequence of this immunity from destruction, the Lavendera is, as I have already said, exceedingly tame and familiar everywhere, and even nests close to the houses. One or two nests that I observed were built in low bushes, and composed of a loose fabric of

Ibis, 1881, p. 341.

grass-stems, vegetable fibres, &c. Both the birds seemed to take part in the construction of the nest, and made a great business of it, though it was apparently done in a desultory sort of way, and as much for pleasure as business. At least two nests I observed closely were never finished, and apparently ultimately abandoned.

46. Arundinicola leucocephala.

This bird I only observed near the sea-coast round Recife, at Caxangá, and near Parahyba. It frequents the margins of ponds or rivers, as its name well indicates, and is usually seen solitarily, though near Caxangá I came across three or four together on the edge of the same pool, a family party of parents and young birds, the latter being distinguishable by their less-defined colouring.

Eyes brown; beak blackish horny, the lower mandible at base (normally) yellowish; legs and claws black, the soles paler.

47. Machetornis rixosa.

I obtained this bird at Recife, and subsequently saw it at Cabo. Its habits resemble those of *Myiozetetes*, from which, indeed, I did not, at the time of getting my specimen, distinguish it.

48. Todirostrum cinereum.

This little Tody-like Tyrant I found rather common from Recife and Parahyba to Garanhuns. It is usually seen singly, but I have sometimes seen two or three together, chasing each other and fighting furiously, like Humming-birds. It hops about nimbly from twig to twig of the particular bush or shrub it is in, in search of insects, and does not, as far as I saw, select a particular perch from which to dart off at any passing insect, like so many of its congeners.

49. Euscarthmus gularis.

I only met with this bird once or twice round Garanhuns, where it occurred usually singly, actively hopping and creeping about the thick scrub which is so prevalent there, very much in the same way as the last species.

Irides brown.

Ibis, 1881 p. 342.

50. Serphophaga subcristata.

I shot a single specimen of this bird in the thick scrub near Garanhuns.

51. Phyllomyias semifusca.

This little bird was abundant in gardens round Recife, resembling in its habits *Elainea pagana*.

52. Elainea pagana.

This Tyrant I also met with commonly, from the sea-coast to Garanhuns. In its habits it resembles the other larger Tyrannidæ, but has no loud call-note. It is common in gardens, and has rather a pleasant, low, warbling-like song of a few notes; when the bird sings, its throat-feathers are considerably puffed out. The elongated head-feathers form a sort of crest, which is erected when the bird is excited.

Eyes brown.

53. Myiozetetes similis.

This species of Tyrant-bird is very abundant in those parts of Brazil I visited. In its habits it resembles *Pitangus sulphuratus*, being usually seen singly or in pairs, perched in conspicuous positions on the projecting or topmost branches of the trees, and flying off from them in pursuit of its prey. It is common in gardens, even in the neighbourhood of houses, and, compared with the *Pitangus*, it is a silent bird, without the characteristic notes of that species. The Brazilians, however, do not discriminate between the two, and call both alike "Bentivi."

Eyes greyish brown.

54. Pitangus sulphuratus.

This bird is one of the very commonest and most characteristic of the country, being seen nearly everywhere, and from its habits most conspicuous, even to the casual observer. The "Bentivi," as it is called, from its note, almost always selects some prominent twig or branch of a tree on which it perches, and from that post of vantage flies off after any passing insect; then, having captured it, it returns to its favourite spot to repeat the process, varied only by continually uttering its loud, somewhat plaintive, but screaming cry, *ben-ti-vi*, *ben-ti-vi*, &c. Frequently two may be seen together, but they are not at all gregarious in their habits. Where these birds are common, as in most gardens in the neighbourhood of houses, the ear soon gets to recognize their continued *ben-ti-vis* as a pleasant evidence of the Neotropical fauna. The flight is weak and undulating and never long sustained. Ibis, 1881, p. 343.

55. Hirundinea bellicosa.

The first specimen of this curiously coloured Tyrant I saw was just after landing at Parahyba, where it was perched on the roof of one of the houses close to the river. Subsequently I saw it again several times, both there and at Quipapá, in similar positions, but being always in the towns, and on houses, or, more frequently, churches, I was unable to get a shot at one, for fear of consequences in the shape of a "row" with the police or other authorities. From its post of vantage it flies off after passing insects, and after capturing them returns to its former perch, in the manner of other Tyrannidæ. I was rather surprised to meet a pair of the same birds a few days afterwards at Macuca, both of which I got. They were met with in *capoeira*, a long way from any houses, perching in the larger trees which rose above the thick scrub and bushes below.

Eyes brown.

56. Myiobius nævius.

I shot a single specimen of this Tyrant in a patch of high forest near Macuca.

Eyes straw-yellow.

57. Myiochanes cinereus.

I only got this species twice, in the high trees of the forest near Quipapá and at Macuca. It appears to be solitary in its habits.

Irides brown; feet black; upper mandible blackish brown, lower pale orange.

58. Myiarchus tyrannulus.

Ibis, 1881, p. 344. I first met with this bird near Quipapá, and afterwards obtained several specimens between there and Garanhuns. It is a quiet solitary bird, which usually I met with perched on the sides of paths or tracts through the brushwood, and was not shy.

Irides brown.

59. Tyrannus melancholicus.

This is nearly as common as *Pitangus sulphuratus* or *Myiozetetes affinis*, and occurred at every place I collected in. It is solitary, and in its habits does not materially differ from those species, though it is perhaps less frequently found near houses, resorting more to the open country, and being often seen in large fields where there are few or no trees. It then selects a stone, post, or some small shrub for its perch. It is a quiet bird, unlike the *Pitangus*. Brazilians and strangers alike confound all these yellow-breasted Tyrant-birds under the common appellation of "Bentivi."

60. Pipra rubricapilla.

I first met with this bird in the outskirts of the forest near Caxangá, where I obtained a pair of specimens and saw others. I also afterwards saw what I believe to have been a young male (just acquiring the red colour of the head) in some scrubby forest between Recife and Beberibé, but not having a gun at the time, could not get it. My experience of this *Pipra* was that it was nearly always found in the thickest and most dark parts of the forest, where no other birds were to be seen or heard. They feed, I think, on berries.

The irides (of the male at least) are pale yellowish white, in the female or young bird they are darker.

61. Chiroxiphia pareola.

I shot a single male specimen of this bird, the only one I saw, in some thick and dense forest near Parahyba.

62. Pachyrhamphus atricapillus.

I obtained a single female specimen of this bird from a small boy at Macuca, who had shot it with an earthen pellet discharged from a bow—a style of shooting much indulged in by the youthful Brazilians, who become very good marksmen in this rather primitive method. Ibis, 1881, p. 345.

Irides brown.

63. Conopophaga lineata.

I only once met with this bird, and that was one day when out shooting with Mr. Weaver in a patch of forest on the top of the hills near Quipapá. We were going along a narrow path in the forest, which was so thick as to prevent our seeing more than about a yard in any direction. We could hear a number of birds with a very loud chattering cry around us, and occasionally could get a glimpse of one as it hopped about in the dense undergrowth. A lucky shot on my friend's part secured a specimen; but further efforts were fruitless. The silvery-white tufts of feathers on the sides of the head are very striking on the freshly shot bird.

Irides brown.

I may here remark that the genus *Conopophaga* has been wrongly placed by Messrs. Sclater and Salvin in their valuable 'Nomenclator.' By them it is included as a member of the "Oligomyodæ," the Conopophaginæ being placed as the first subfamily of the Tyrannidæ. We know, however, from the researches of Müller (Stimmorgane d. Passerinen, p. 39, and, *ibid.*, Garrod's edition, p. 32), that *Conopophaga aurita* possesses a typically *Tracheophone* syrinx, so that it is amongst those forms that the genus must be correctly located (*cf.* Garrod, P. Z. S. 1877, p. 452, also a paper by the writer, P. Z. S. 1881, p. 435).

64. Furnarius figulus.

The Oven-bird does not appear to be found in the immediate neighbourhood of Recife, but I found it at nearly all the other places I stayed at, from Parahyba to Garanhuns. At Cabo, where I first saw it, it was abundant close to Mr. Hood's house, both in the garden and on the line of railway adjoining. It is a very noisy bird, and, in the mornings particularly, may often be seen, sometimes two or three together, perched on the roofs of houses or on the telegraph-wires, pouring forth a loud song of peculiar chattering notes. It also spends a good deal of its time on the ground, and when there walks in a peculiar way, with an action that somewhat reminds one of a high-stepping horse. Unfortunately I never saw a nest of the *Furnarius*, nor did I hear from the Brazilians any stories of it similar to those narrated by Burmeister. Ibis, 1881, p. 346.

65. Synallaxis frontalis.

This bird and the next I did not distinguish on the spot, so I can give no exact particulars as to the exact range of the two species, which may very possibly occur together. I met with these birds at all the localities I stayed at, from the coast to Garanhuns, and usually they were abundant. They frequent low shrubs and bush-covered ground, and creep about actively in the thick vegetation, singly or in pairs, uttering continually a loud cry, repeated several times, sounding like *acqui, acqui*.

Irides brown; feet dirty fleshy; beak grey, the upper mandible except at base, darker.

66. Synallaxis albescens.

I did not at the time distinguish between this and the last species, which it much resembles in habits.

The eyes are red-brown.

67. Synallaxis cinnamomea.

This is one of the most abundant birds in Pernambuco and Parahyba, being found nearly everywhere in suitable positions; that is, where the country is not densely forest-clad and in the vicinity of water. It was very abundant in the garden at Estancia, and is a very noisy bird, with a peculiar loud chattering cry. A couple of males, which are larger and brighter than the females, might often be seen flying after and chasing each other, and in these cases a female bird was usually not far off. It builds a large nest of sticks, many of which are of considerable size and thickness. In Mr. Hood's garden at Cabo a pair of these birds had a nest in a low bush a few yards from the windows, and I used often to watch the bird flying in from the garden with sticks, sometimes con-
Ibis, 1881, p. 347. siderably longer than the birds themselves. I think both sexes took a share in the construction, in which they were most assiduous. The nest was a large, somewhat triangularly shaped mass of sticks and twigs, thickly matted together, and with an opening for the birds at one end. Very possibly the same nest is used for a number of years in succession, being repaired and increased in size every breeding-season.

Eyes chestnut-brown; legs blue-grey, with the soles lighter.

68. Thamnophilus palliatus.

This bird is abundant in some places and its presence is betrayed by its very curious loud chattering notes, which are commenced in a high key, and fall lower as their conclusion is approached. The bird creeps about, singly or in pairs, the bushes and small trees of the more open parts, and is by no means shy. I got specimens at Cabo and Parahyba, and also saw it near Macuca and Garanhuns, so that it is probably widely distributed.

The irides (in both sexes) are pale yellowish white; the beak and legs are leaden grey.

69. THAMNOPHILUS TORQUATUS.

I only once got a specimen of this bird, which I shot near Quipapá; afterwards I obtained one from my friend Herr Müller, who had shot it near Recife, where also I believe I saw it once or twice. The bird I shot at Quipapá attracted my attention by its remarkable cat-like miauling cry, very different from that of *T. palliatus.*

The irides are chestnut-brown.

70. HERPSILOCHMUS PILEATUS.

This little bird was rather abundant near Garanhuns, frequenting the thick scrub, and flying actively about, in small parties of three or four, amongst the tops of the bushes, like a *Parus* or *Polioptila.* I did not meet with it elsewhere.

71. HERPSILOCHMUS, sp. inc.

I shot a single specimen of a second species of the genus near Macuca, but, having been preserved in spirit, it is not in sufficiently good order to describe or identify. Mr. Sclater, who thinks it is probably new, has kindly given me the subjoined note on it:— Ibis, 1881, p. 348.

" A single example of a species allied to *H. pileatus* of Pelzeln, but probably distinct, having the head striated with white."

72. FORMICIVORA GRISEA.

I obtained specimens of this bird at Parahyba and Quipapá, and also believe that I saw it in the second-growth woods outside Recife, but it was nowhere common.

Eyes brown; beak black; feet dark grey, the nails blacker.

73. FORMICIVORA RUFATRA.

I got this bird in the bush-covered country around Parahyba, but did not afterwards meet with it.

Irides brown; legs lead-coloured.

74. APHANTOCHROA CIRROCHLORIS.

I shot a single specimen of this Hummer out of a large tree, in which it was perched high above the ground, in a patch of forest covering the top of a hill near Macuca.

75. Chrysolampis moschitus.

I shot a specimen of this widely distributed species out of a high tree in some forest near Garanhuns.

76. Chrysobronchus virescens.

The commonest Humming-bird at Recife, where it may be seen all round the town in gardens, coming sometimes into houses; and I have also seen it once or twice hovering round the flowering bushes in the gardens in the town itself. I also got it at Cabo. The name applied to all Humming-birds is "Bejaflor," or "Kiss-Flower."

77. Eucephala cærulea.

This Hummer I believe I saw several times near Recife, in the lanes and roads outside the town. At Parahyba it was rather common, and there I shot specimens.

78. Hydropsalis forcipata.

Ibis, 1881, p. 349. Whilst staying at the house of my friend Dr. Lustoza, situated in a valley off the line of railway between Quipapá and Macuca, I shot a single specimen of this bird. It was with another flying about at dusk over the ground near the house, and settling occasionally on the pathway. The long outer rectrices gave it a curious appearance on the wing. Brazilian name "Bacuráu."

79. Chloronerpes affinis.

I shot a single specimen, a young bird, of this species in the outskirts of some forest near Macuca. This was the only Woodpecker I obtained specimens of, though I saw at various times at least three others, but always out of shot. The Brazilian name for Woodpeckers generally is "Pica-paô."

Irides brown; legs and beak dark grey, the lower mandible whitish grey.

80. Ceryle americana.

This species of Kingfisher I found abundant in the neighbourhood of the coast round Recife and at Parahyba. It occurred even just outside the town, a couple of these birds haunting the small stream and ponds in the gardens round Estancia, perching on the walls and on the mangrove-bushes on the look-out for small fish and other animals as prey. When perched the tail is directed nearly straight backwards, in a line parallel with the axis of the beak, an attitude which gives the bird a remarkable character.

81. GALBULA RUFO-VIRIDIS.

I saw my first live Jacamars when driving between Iguarassu and Goyanna, in the thick forests that in many places border the highroad between the two towns. Here they seemed to be rather abundant, coming out in the early morning and perching on the trees or telegraph-wires (!) lining the road. I once saw as many as three close together, though they are usually solitary. They seemed quiet and apathetic, and not at all shy, flying off, like Tyrannidæ, from their perch after food and again returning. Subsequently I again met with Jacamars, but only singly, in the woods near Caxangá and at Parahyba. I tried very hard to obtain live specimens, but, in spite of offering good rewards, the Brazilians were much too lazy to trouble themselves about procuring living birds. The name "Jacamar" I never heard used by them; they call the birds "Bejaflor do matto," or "Bejaflor Grande," evidently thinking the bird only a kind of gigantic Hummer. Ibis, 1881, p. 350.

The irides are brown.

82. CROTOPHAGA ANI.

The "Anu," or, as it is called by many Englishmen, the "Black Parrot" (I suppose from some fancied resemblance in the bill), is one of the most characteristic birds of Brazil. They may be seen everywhere in the neighbourhood of cultivation, coming even into the gardens round Recife, and being most abundant in the neighbourhood of cattle. They are eminently social birds, the flocks usually numbering about twenty individuals, though sometimes much less. They like to perch on low trees and bushes, and a bush may often be seen with a dozen or more of these "black birds" settled on it. If alarmed one rises and flies slowly away, the others following with a chorus of their low, plaintive, rather whistling note, which sounds a good deal like *ennui*, with the last syllable accented. In flight the long tail is extended straight out behind the body, and the wings are kept rather horizontal and move but slowly and feebly. The Anu seems very fond of the sun; and I have sometimes seen twenty or more perched in a row on the top of a wall sunning themselves and preening their feathers. Whilst so engaged they often elevate their tail and bring it forward over the head, in much the same way as Toucans sometimes do.

83. GUIRA PIRIRIGUA.

This Cuckoo I only saw at Parahyba, where I once or twice came across a small flock of three or four individuals in the garden near the town. In flight and cry it much resembles *Crotophaga*; and the Brazilians rightly recognize the affinity of the two genera by calling the present species "Anu branco," or "White Anu," as opposed to the common or black species.

Ibis, 1881, p. 351.

84. Diplopterus nævius.

I only once saw this bird, at Garanhuns. It was feeding in the road, from which it flew up, as I approached, into a neighbouring tree. Thence it flew down again into an adjoining maize-field, where its colour matched well with that of the soil. A successful stalk on my part ended its career.

The irides are palish brown.

85. Piaya cayana.

This Cuckoo I first saw at Cabo; afterwards I met with it at Parahyba, and again at Quipapá. It is usually seen singly, and is apparently by no means rare. Though generally seen in trees, it seems awkward and by no means at its ease off the ground. It sits quietly for a long time, and then, when disturbed, creeps off through the leaves and flies away on the other side. It has a loud screaming cry, which frequently betrays its presence. Once, at Quipapá, I saw one being mobbed by some small birds, just as Owls or Hawks often are in this country. The Brazilians know the bird well, as it is rendered conspicuous both by its colour and cry, and call it "Almo do Gato." The colouring of the soft part makes this bird, when alive or freshly killed, far handsomer than would be inferred from the skin alone.

The irides are bright ruby-red and the eyelids scarlet; the beak is yellowish green; the feet grey, with the soles yellowish.

86. Conurus jendaya.

This Parrakeet, called by the Brazilians "Jandaia," may often be seen tamed in houses, and to this species no doubt belonged most of the *Conuri* that I continually saw flying in small flocks of from four to twenty or so, both at Parahyba and between Quipapá and Garanhuns. These birds, however, were so wary that I only once succeeded in at all making out what they were by means of a glass, which clearly revealed their yellow undersides. At other times they were invariably high in the air, far out of gun-shot and almost out of sight; indeed their presence was usually first indicated by their cries, which were audible long before they themselves became visible. Only once, in a patch of forest near Quipapá, did I get anywhere within shot of these birds, and then they were off directly they became aware of the presence of a stranger.

Ibis, 1881, p. 352.

87. Conurus cactorum.

Numerous living specimens of this little Parrakeet were brought to me by the natives at Garanhuns, who called it simply "Perriquito." I have already noticed the abundance of large *Cacti* in the sandy districts around Garanhuns, and on these, no doubt, these Parrakeets largely subsist. I never succeeded in identifying the bird in a wild state, though I every day saw or heard flocks of a *Conurus* flying high in the air around Garanhuns. Prince Maximilian also met with it in the Sertões of Bahia (*cf.* Burmeister, Thiere Bras. ii. p. 170).

88. Chrysotis æstiva.

This was the only species of *Chrysotis* I saw at all in the districts I traversed. Of it, however, one sees many dozens for sale in all the shops where live birds &c. are sold in Recife, and nearly every hut in the country has also its "Papagaio." In the wild state I only met with it in the forests near Parahyba, where we several times saw it, usually flying high over the trees in small flocks, and, like other Parrots, vociferating vigorously whilst on the wing. With the aid of my "Caçador," Antonio, we succeeded, after a long hunt, in finding a lofty forest tree where the Parrots were feeding, as evidenced by the heaps of its "shelled" fruit that lay on the ground below, or came pattering down from above as we stood beneath the trees. Hoping to get a good view of some Parrots "at home," I proceeded to lie down on my back beneath the trees, in order to have a good look at the birds above through my glasses. However, they saw us before we could "spot" them, hidden as they were by the thick canopy of leaves, and flew screaming off to some less disturbed spot, no doubt to resume their meal on some other tree.

The Brazilians call *Chrysotis æstiva* the "Papagaio" *par excellence.* Artificially produced varieties, with more or fewer yellow feathers, are called "contrafeitos," and are considered to be both more beautiful and more valuable than those that have not been thus tampered with. Ibis, 1881, p. 353.

89. Psittacula passerina.

I first saw the South-American "Love-bird" on the road between Iguarassu and Olinda, and subsequently in nearly every place I stayed at. In the interior it is very abundant, flying about in large flocks, often in company with the Brazilian Canary (*Sycalis flaveola*), generally frequenting the gardens or plantations round houses, especially where there are castor-oil (*Ricinus*) trees. Its flight, though quick, is not prolonged. You see two or three alight in a bush or small tree, which sit there quietly till they are joined by two or three more; then perhaps a few more arrive, and so on, till twenty or thirty are assembled in the same tree, and after a while they fly off, together or in small batches, as they arrived. Mr. Weaver, at Quipapá, told me that a few weeks before my visit these Parrakeets were immensely numerous there, and that the numbers we then saw were nothing to what there had been previously, before the greater part had gone more inland towards the Sertões, as they do towards the commencement of the dry season. The Brazilians call it "Perriquito Tapacú."

Eyes brown.

90. Strix flammea.

Whilst staying at Quipapá a boy brought me a specimen of a Barn-Owl, which, as far as I could see, differed in no important respect from English specimens.

91. Gampsonyx swainsoni.

I shot a single specimen of this pretty little Hawk out of a high tree near Parahyba.

Irides red; feet orange-yellow; beak and claws black.

92. Herpetotheres cachinnans.

Whilst staying at Garanhuns I bought a beautiful pair of living specimens of this Hawk, which had come, with some other birds, from Aguas Bellas, a village in the Sertões, some seventy miles beyond Garanhuns. Unfortunately they succumbed to the jolting and heat of the journey down to Palmares, dying the day before we reached Recife. The Brazilians considered it a rare bird, and called it "Couaõ." As noticed by Burmeister (Thiere Bras. ii. p. 92), these birds, after a good meal, showed a naked "craw" protruding through the breast-feathers.

Ibis, 1881, p. 354.

Irides dark brown.

93. Polyborus tharus.

The "Cara-cará" I saw several times on the coast, both near Recife and around Parahyba. In the interior I did not identify it. On the wing it has a decidedly fine appearance.

94. Cathartes aura.

The Red-headed "Urubú" is never, as far as I saw, to be met with in towns, though it was by no means rare in the country. I first saw it at Goyanna, and afterwards met with it plentifully at Parahyba and near Cabo. It is usually seen singly or in pairs; but on one occasion, at an "engenho" near Cabo, I saw a considerable number, perhaps twenty, of it together. The Brazilians, as a rule, did not distinguish between *C. aura* and *C. atratus*. *Gypagus papa*, however (a species I did not meet with, though it occurs sometimes not far from Recife), is well known to them as the "Urubú Ré," or King Urubú.

95. Cathartes atratus.

The "Urubú" is one of the first birds to attract the stranger's eye on his landing in Recife, as every day several of these birds may be seen flying heavily about in the outskirts of the town, or even over waste places in it, on the look out for offal of any kind. Before Recife boasted of a drainage company (a benefit it now possesses) the Urubús are said to have been much more numerous than they now are, and, indeed, they were then the main agents for sanitary purposes. Even now they are useful in this way, to some extent, as scavengers, and a considerable fine is imposed for shooting one. The white patch on the remiges is very conspicuous on the bird when flying, and diminishes somewhat the monotony of its appearance. Outside the large towns this Urubú is replaced, apparently, by *Cathartes aura*. Ibis, 1881, p. 355.

96. Ardea candidissima.

When on the Parahyba river, between the bar at its mouth and the anchorage below the town, I saw great numbers of this beautiful white Egret, either flying slowly up stream in twos and threes, high in the air, or wading about on the mud-flats left bare by the tide in search of food.

97. Butorides cyanurus.

This small Bittern was very common in marshy ground round Recife, and a pair or two frequented the reed-beds at the bottom of the garden at Estancia. These had a nest in the mangrove-bushes near the stream. The nest was a loose platform of sticks, a couple of feet or so, I was told, above the ground.

The native name is " Socoa."

98. Sarcidiornis carunculata.

Of the South-American Black-backed Goose I found a fine living pair in the garden at Estancia, and their owner was kind enough to send them to London for the Zoological Gardens, where they now are. These birds had been brought down some months before from the Sertões of the interior by a " matuto " for sale in Recife.

According to Mr. Sclater (P. Z. S. 1876, p. 695), in the American *Sarcidiornis* " the sexes are nearly equal in size, the female bears a comb on the head as well as the male, and the flanks are conspicuously black." These remarks were based upon the examination of three specimens then living in the Zoological Gardens, supposed to be " an adult male and an adult and younger female," and to have been imported from Maranham. The pair of birds I brought back, however, do not agree with the above-quoted description, inasmuch as the female bird is much smaller than the male and has no wattle at all on the head, in those respects agreeing with the hen of the Indian species (*S. melanonota*). Of the three birds mentioned by Mr. Sclater, two have since died, and on dissection turned

Ibis, 1881, p. 356. out to be males; the third is still (February 10) alive, and in all respects agrees with the male of my pair, having a large comb, and being much bigger than the female. There can be no doubt, therefore, that this specimen too is a male, and that Mr. Sclater's so-called "females" were, in reality, only young males. The female of my birds has little, if any, more black on the flanks than a female *S. melanonota* in the adjacent inclosure, so that the only remaining available distinction between the two forms is the black sides of the male of the American bird; and this character, as far as I have yet seen, seems to hold good.

[P.S. Since the above was written, both my birds have, unfortunately, died. Their sex was verified by dissection.—May 19, 1881.]

99. Columba picazuro.

This Pigeon is well known to the Brazilians as the "Azu Branca," or White-winged Dove. I was told it was sometimes abundant round Parahyba, and also heard of it at Quipapá, Garanhuns, and other places. However, I never succeeded in seeing it wild, though I got several living specimens at Parahyba and elsewhere.

100. Columba rufina.

I obtained a single living specimen of this Pigeon at Parahyba, where I was told that, at some seasons of the year, when certain fruits were ripe, it was common in the forests around.

The Brazilians know it as the "Gallega."

101. Scardafella squamosa.

I first met with this pretty Dove in some of the gardens in the outskirts of Parahyba. Afterwards, when riding between Macuca and Garanhuns, I several times flushed little coveys of it, which rose up from the road and took refuge in the nearest tree. Usually these parties consisted of about four. When rising they make, apparently with their wings, a curious rattling noise, whence they are called by the Brazilians "Rôla Cascavel,"—*Cascavel* meaning a rattle, and being also the name applied by the natives to the Brazilian rattlesnake (*Crotalus horridus*), which is by no means rare in the district.

Ibis, 1881, p. 357. 102. Chamæpelia griseola

I got specimens, through Herr Müller, of this little Ground-Dove from the neighbourhood of Recife, where, I think, I also saw it several times, as well as near Parahyba.

103. Chamæpelia talpacoti.

The Rôla, as this little Pigeon is called by the Brazilians, is a very common bird all over the parts I visited. It is found solitarily or in pairs, and is much esteemed for the pot, and persecuted in consequence.

104. Leptoptila ochroptera.

Of this Dove, or a closely allied species, I got one or two living specimens at Garanhuns, which had been caught in the surrounding country. The Brazilians know it as the "Juruté."

105. Penelope superciliaris.

I obtained a single living specimen of this bird at Garanhuns, which had been caught originally at Panellas, a small village north of Quipapá. I was told that further in the interior, towards Aguas Bellas, the present species is not uncommon in some of the Serras that intersect the plateau of the Sertões. Its Brazilian name is "Jacú."

106. Ortalis albiventris.

Whilst staying at Macuca, one evening, a little before sunset, I was surprised by the very loud calls of a bird I had never heard before, and which proceeded from the wooded hills on the other side of the valley where Mr. Watts's house lay. On inquiring of him what bird it was, I was informed it was the "Aracuaõ," which was described as a sort of small Pheasant, of a brownish colour, that was sometimes met with in small parties in the forests, and was well known to the natives. A few days after, at Garanhuns, a live Aracuaõ was brought to me which had been caught in the neighbourhood. This I bought and brought alive to London; and it turns out to be the present species, which was also found by the late Dr. Wucherer in the neighbouring province of Bahia. I subsequently saw other living examples of the species in Recife. With regard to the peculiar loud cry of the present species, it may be remembered that, like many other Cracidæ, the male bird has a convoluted trachea, the fold (which lies outside the pectoral muscles) in some cases extending as far as the posterior end of the sternum. Ibis, 1881, p. 358.

107. Rallus longirostris.

My friend Herr Müller, of Recife, during my absence in the interior, got a specimen of this bird for me, which he had shot in the close vicinity of Recife.

108. Rallus nigricans.

A second species of Rail, also brought to me alive at Quipapá, I identified with this species from Burmeister's description. It fell a victim to rats during my absence.

Irides bright red; feet dull red; beak yellowish green, greyer at the tip.

109. Aramides cayennensis.

Whilst staying at Quipapá some boys brought in for sale a living specimen of this Rail, which they had caught near the town.

110. Cariama cristata.

The occurrence of the Cariama in the Sertões of Pernambuco is a fact of some interest, as it marks, I believe, at present the most northern limit of this curious genus. I did not myself see the Cariama in the wild state; but I saw, at Garanhuns, one that had been captured by the Indians near Aguas Bellas, a town some seventy miles further S.W. in the direction of the Paulo Alfonso falls. I was also told that it occurs not rarely in the open country near San Bento, another small town about thirty-five miles north of Garanhuns, and, like Aguas Bellas, also in the Sertões. The Brazilian name of the Cariama is, I may observe, "Siriema," a form also used by Burmeister in his elaborate treatise on this bird. "Ema," as we shall presently see, is the name given to the Rhea (*R. macrorhyncha*), which is found along with the present species in the open plains of the Sertões, and "Siri" is a diminutive of Indian extraction, the word thus signifying "little Ema."

Ibis, 1881, p. 359. 111. Parra jacana.

The "Jaçaná" (the *c* is soft, and the final *a* strongly accented) is a very common and conspicuous bird in the low country near the sea, and may be seen on nearly every large weed-covered pool of any extent. Near Recife it might be seen in numbers on some large ponds on the Beberibé road, about a mile outside the town; and at Parahyba it was equally abundant close to that place. I did not see it further inland than Catende. In its actions the Jaçaná strongly resembles a Waterhen. It is not apparently shy, but usually keeps well out of reach on the weeds in the middle of the pond. When flying, the canary-yellow-coloured primaries are very conspicuous, and, with the light colour of the soft parts, greatly show off the chestnut and black plumage of the bird. Near Recife I saw three or four of the young birds in down, of a mottled black and white colour, walking about with their parents on the weeds.

112. Gallinago frenata?

A Snipe is not uncommon at some time of the year in the more marshy districts of Pernambuco, and affords some sport to the English and other residents in Recife. I saw the bird once or twice at Cabo, and between Quipapá and Macuca got from a Brazilian friend a nest of two eggs, on which the hen bird was sitting. Unfortunately my friend omitted to shoot the bird; but I believe there is no doubt that it belongs to the present species.

The Brazilian name is "Agaxadera."

113. Crypturus tataupa.

The "Nambu," as the present species of Tinamou is called, is not at all an uncommon bird in the neighbourhood of Macuca and Garanhuns, where I several times heard its cry, and once or twice flushed it. Its flight, however, though strong, is short, the bird soon settling again; and the country is so thickly covered with brushwood and undergrowth that it is, in consequence, no easy matter to shoot these birds, at least without the aid of dogs. Sometimes they are stalked and shot by the Brazilian sportsmen; but more usually they are snared. At Garanhuns I bought a lot of seventeen Nambus and a pair of the next species for 2500 reis (about five shillings)—not a bad bargain perhaps!—from a boy who had just caught them; and afterwards I had many more offered to me for sale. Ibis, 1881, p. 360.

The beak is vermilion-red, the feet dirty pink-red, and the irides rich red-brown.

114. Crypturus noctivagus.

This Tinamou is known as the "Zabillé;" of it, too, I got living specimens at Garanhuns, which had been caught in the district round. One of these that died, and which I preserved in spirit, Mr. Salvin has identified with the above-named species.

115. Rhynchotus rufescens.

I saw one or two living birds of this species in confinement at Garanhuns, and was informed that it too occurred in that neighbourhood.

116. Rhea macrorhyncha.

Rhea macrorhyncha was originally described by Mr. Sclater some twenty years ago (P. Z. S. 1860, p. 207, & Trans. Z. S. iv. p. 356, pl. lxix.), from a specimen living in the Zoological Society's Gardens, of unknown origin. Since then several more specimens (some half dozen in all, perhaps) have been secured at intervals; but the exact locality of any of these has never, I believe, been precisely ascertained, though it has been supposed to be the "campos" of Northern Brazil or Guiana (*cf.* Sclater P. Z. S. 1877, p. 160).

When I arrived in Pernambuco I made anxious inquiries about the existence of any Rhea in that part of Brazil, and was told by several persons that it existed in the interior, in the dry and open Sertões; and the dry country near the falls on the S. Francisco river was especially mentioned as a locality where it was to be found abundantly. In the small museum in the "Gymnasium," I found two stuffed Rheas, one adult, and one in the tawny-brown plumage of immaturity, which, as far as I could see, were probably *R. macrorhyncha*; these were said to have come from the Sertões. At Garanhuns I was fortunate enough to come across a living specimen of this bird, brought along with a Cariama and two *Herpetotheres cachinnans*, from Aguas Bellas, where it had been captured young by the Indians. This bird was not yet adult, though Ibis, 1881, p. 361.

nearly full-grown. As I was very anxious to make out for certain the species, I bought it, and, after a good deal of trouble, succeeded in getting it alive to Recife, and eventually to London, where, however, unfortunately, it did not live long. The "Ema," as the Rhea is called by the Brazilians, is well known to the people in the Sertões; it is now said to be rare near Aguas Bellas, but, I was told, is still found pretty numerously (as is the Cariama) in the open grass-covered country near San Bento. Indeed during the *secca*, or drought, that has prevailed for the last few summers in this part of the country, and which resulted in a general famine, the "Emas" became so tame through hunger that they might be found close to the town itself, and even came into the gardens, and so were caught. My friend Mr. Weaver, of Quipapá, told me he had had a young live Ema for some time in his house, which had been sent him as a present by a lady. This specimen came from Pianco, a small town in the province of Parahyba; so that evidently the range of *Rhea macrorhyncha* extends to the north of Pernambuco. I hope, ere long, to obtain, through the agency of some of my Brazilian friends, specimens of the eggs and young of this bird to compare with those of the commoner species. What the exact northern extension of the latter is I do not exactly know, though it certainly extends north of the River Plate into Uruguay; probably the barrier between the two species is a continuously wooded country lying between that district and the Sertões of Bahia, where the species is also most probably found. Capt. Burton, who alludes to the existence of a Rhea in Brazil several times, saw one himself on the banks of the S. Francisco near the Rio do Corrente, above Bom Jardim ('Highlands of Brazil,' ii. p. 296), and others at Jaguára (*l. c.* ii. p. 26), in the province of Minas.

I hope on some future occasion to be able to compare the skeletons of
Ibis, 1881, p. 362. *Rhea americana* and *R. macrorhyncha*; externally, though certainly closely allied, the latter species is distinguishable by its generally browner colouring, by the darker crown, which is nearly black, and by its longer bill.

'Nature,' xxiv. p. 380.

43. THE DESCENT OF BIRDS.*

There is one passage in the report of Prof. Mivart's lecture on chamæleons ('Nature,' vol. xxiv. p. 338) that I cannot allow to pass without demurring to, and that is the suggested probability of a "double

* 'Nature,' xxiv. p. 380 (Aug. 25, 1881).

origin" for the class Aves. I do not wish at present to raise the issue as to how far the division of all living birds into two groups—"Ratite" and "Carinate"—is, or is not, a natural one; for at present we have not, I think, sufficient information or evidence on the subject to allow of any very definite reply. But any one who is acquainted with the structure of a Tinamu will, I think, be unable to conceive of the many resemblances that group of birds presents to some of the "Ratitæ" as having been developed independently of any genetic connexion between the two—and that is what Prof. Mivart's suggestion practically amounts to. That structures so peculiar as feathers—which, as far as we know, are absolutely confined to birds, though universal amongst them—should have been twice over developed, is to me in the highest degree improbable—as improbable, almost, as that the resemblances of the Tunicates and *Amphioxus* to the rest of the Chordata should also be accidental.

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44. NOTE ON THE SYSTEMATIC POSITION OF *EUPETES MACROCERCUS*.* P. Z. S. 1881, p. 837.

SOME months ago Mr. R. B. Sharpe directed my attention to the remarkable similarity in general facies of *Eupetes macrocercus* to the genus *Mesites*, and suggested that that bird might be in reality closely allied to the last-named one, and not at all congeneric with the other species usually included in the genus *Eupetes*. P. Z. S. 1881, p. 838.

Our knowledge of the internal structure of *Mesites* is due to M. Alphonse Milne-Edwards, who, in the 'Annales des Sciences Naturelles' † has described its osteology, with some remarks on the muscles and other points. From its osteology, as well as from the presence of two carotid arteries, and of the ambiens and accessory femoro-caudal muscles, the non-passerine nature of *Mesites* is rendered absolutely certain. M. Milne-Edwards associates it with the Rails. From the presence of powder-down patches ‡, combined with the schizorhinal nature of the skull, I should prefer to locate it near *Eurypyga* and *Rhinochetus* in my group Pluviales §.

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* Proc. Zool. Soc. 1881, pp. 837, 838. Read Nov. 15, 1881.

† 6e série, Zool. t. vii. art. no. 6, pl. vii.

‡ First discovered by Mr. E. Bartlett, *vide* P. Z. S. 1877, p. 299.

§ *Antea*, p. 221.

It is to be regretted that M. Milne-Edwards has not in any way touched upon the pterylosis of *Mesites*; and as yet I have been unable to obtain any skin of that form to supplement this deficiency. From a skin of *Eupetes macrocercus* I have, however, been able to ascertain a sufficient number of points to show that, unlike *Mesites*, this form is certainly Passerine.

The pterylosis is quite Passerine, there being a nude oil-gland, twelve rectrices, and nineteen remiges, of which ten are primaries. Of these last the tenth (or so-called "first") is half as long as the ninth. The saddle of the dorsal tract is covered by very long feathers, some being as much as 3 inches in length. The aftershaft is apparently quite absent, as is the case in some other Passeres (e. g. *Artamus* and *Eurylæmus*) according to Nitzsch. There are no traces of any powder-down patches.

In the leg there is no plantar vinculum, as in all the Eleutherodactylous Passeres *, and as in them only, if we except *Upupa* and certain Ardeidæ.

The arrangement of the terminal tendon of the *tensor patagii brevis* is also Passerine, as described by Garrod †, with the slight difference that, as in *Menura* and *Atrichia* ‡, the recurrent tendon is more or less intimately blended with that of the *extensor metacarpi* subjacent to it.

The skull, extracted from the skin, is also typically Passerine, with the characteristically truncated vomer of those birds. The maxillo-palatines are long and thin, and recurved apically; the transpalatines well developed. Like all other known Old-World Passeres, *Eupetes* is holorhinal.

The exact place in the Passerine series of *Eupetes* has yet to be determined; judging, however, from the bilaminate tarsal planta, it is a truly Oscinine form, and therefore very probably to be included in the "Timeliidæ."

P. Z. S. 1881, p. 836.

45. NOTE ON THE STRUCTURE OF THE PALATE IN THE TROGONS (*TROGONIDÆ*).§

It is my desire in the present communication to correct an error which, though it has been before the ornithological world some years, has hitherto apparently escaped attention—the more so, as it has some bearing upon the general question of the classification of birds.

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* P. Z. S. 1880, p. 391.

† 'Scientific Papers,' pp. 356, 357.

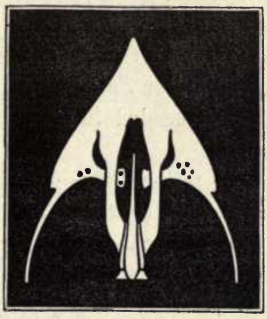
‡ *L. c.* p. 358, pl. xxiv. fig. 2.

§ Proc. Zool. Soc. 1881, pp. 836, 837. Read Nov. 15, 1881.

The only description of the palate of the Trogons I have met with is that contained in Prof. Huxley's celebrated paper on the Classification of Birds in the Society's 'Proceedings' for 1867. It runs as follows *: "The only Trogon skull I have had the opportunity of examining is that of *T. reinwardti*. It possesses basipterygoid processes, in which respect it resembles *Caprimulgus*, and is unlike all the other genera which remain to be mentioned. The palatines have a general resemblance to those of the Musophagidæ; the vomer seems to be equally rudimentary; and the *maxillo-palatines*, though less spongy, *unite in the middle line.*" The Trogonidæ are therefore included in Prof. Huxley's Desmognathous series.

Recent examination of the skulls of several species of Neotropical Trogons (including *Trogones puella*, *mexicanus*, *atricollis*, and *caligatus*, and *Pharomacrus mocinno*), for the opportunity of which I am indebted to the kindness of Mr. Salvin, as well as of one of *Harpactes reinwardti* (the species described by Prof. Huxley) from the Eyton collection, has convinced me of the incorrectness of the last part of Prof. Huxley's description. In fact, the Trogons are not in the slightest degree desmognathous, but schizognathous, Prof. Huxley's error having probably been due to the imperfect preparation of the specimen which he inspected. P. Z. S. 1881, p. 837.

As will be evident from the drawing I now exhibit (see figure) of the



Palate of *Pharomacrus mocinno.*

palate of *Pharomacrus mocinno*, the somewhat spongy and remarkably transverse maxillo-palatines do *not* unite with each other, or with any median ossification, across the central line. On the contrary, their inner ends are free both from each other, from the lower border of the nasal septum, which is ossified, and from the thin and filiform vomer, which runs between their ends to terminate in a point a little anteriorly to them. The same is the case in the other five species already named.

The Trogons being thus, as I have shown, not desmognathous, would have, if Prof. Huxley's group of "Coccygomorphæ" were retained, to be

* *L. c.* p. 444.

removed thence to some other position, presumably in his suborder "Schizognathæ." But, in fact, as we now know from Prof. Garrod's investigations*, the so-called Coccygomorphæ are an artificial group, made up of at least three very distinct series of birds. Furthermore, the fact that the Trogons are schizognathous, whereas their near allies, such as the Bucconidæ, Galbulidæ, Coraciidæ, *Podargus*, &c., are desmognathous, shows that the structure of the palate has not that unique and peculiar significance that has been claimed for it in the classification of birds.

Rep. B. Assoc. 1881, p. 671.

46. ON THE ANATOMY AND CLASSIFICATION OF THE PETRELS, BASED UPON THOSE COLLECTED BY H.M.S. 'CHALLENGER.' †

After stating the reasons why hitherto the anatomy of this group of birds had been hardly at all studied, the author, who has been enabled, thanks mainly to the specimens collected by the 'Challenger,' and entrusted to him for anatomical examination by Sir Wyville Thomson, to dissect nearly all the chief genera of this group, proceeded to give an account of the results as yet arrived at.

After describing briefly some of the more remarkable peculiarities of structure of the group of Petrels or *Tubinares*, of which about 150 species are now known, the author proceeded to consider the questions of their classification and affinities.

The *Tubinares* form a very well-defined group, separated off from all other birds by a combination of characters, external and internal, not found elsewhere, as well as by some peculiar to the group itself. Two well-marked families now exist: one, the Oceanic Petrels (Oceanitidæ) represented by four genera, and about eight species; the other (Procellariidæ) containing all the remainder of the group, and being divisible again into three subfamilies, the Albatrosses (Diomedeinæ), the Diving Petrels (Pelecanoidinæ), and the true Petrels (Procellariinæ), this last division containing by far the greater number of the genera and species.

As regards the affinities of the group, the author was of the opinion that the Petrels are probably much modified descendants of some ancient form, which was related to the Ciconiiform birds of Garrod, *i. e.* the Storks, American Vultures, Accipitres, Steganopodes, and their allies. Any relationship to the Gulls (Laridæ) was not borne out by the anatomy of the two groups in question.

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* 'Scientific Papers,' pp. 214, 215, &c.

† Rep. Brit. Assoc. 1881, p. 671.

47. OBSERVATIONS ON THE INCUBATION OF THE INDIAN PYTHON (*PYTHON MOLURUS*), WITH SPECIAL REGARD TO THE ALLEGED INCREASE OF TEMPERATURE DURING THAT PROCESS.*

P. Z. S. 1881, p. 960.

THE first exact observations of the incubation of their eggs by the females of the constricting Serpents included in the genus *Python* were made, forty years ago, by M. Valenciennes in the Jardin des Plantes at Paris, his account having been published in the 13th volume of the 'Comptes Rendus' for 1841 †. In this case the species observed was *Python bivittatus*: a female, about 10 feet long, which had been in company with a male of the same species of rather smaller size, and with which she had been seen several times *in copulâ*, laid at the beginning of May fifteen eggs, round which she coiled herself up, and so remained for fifty-six days, when eight of the eggs hatched, producing young snakes about half a metre in length. During the period of incubation Valenciennes observed a marked increase of temperature in the female, highest at the commencement of incubation and gradually diminishing thence till its close. His observations on the temperature are recorded in a table appended to the memoir already cited; and to them I shall have further occasion to refer in the sequel.

In the year 1862, a large female *Python sebæ* laid a number of eggs, and also incubated on them, in this Society's Gardens, as described by Mr. Sclater at length‡. The period of incubation lasted 82 days; at the end of that time the eggs were removed, as none had hatched, and they were evidently decomposing. On examination five or six were found with embryos inside, one of these being eleven inches in length. A few observations on the temperature of the female were taken, that of the male in the same compartment being taken at the same time. In every case, the female was found to be several degrees warmer than the male, the difference ranging between 2°·8 F. and 12°·4 F. when the surface temperature was recorded, and between 6°·8 F. and 20°·0 F. when that between the folds of the animals was measured.

During the past summer we have again had an opportunity of observing the incubation of a Python in the Society's Gardens. A female *Python molurus*, about 12 feet long, which had been living in company with two somewhat smaller males (one of this species, the other being a *Python bivittatus*), deposited during the night of June 5th–6th a number of eggs, about twenty. Round these she coiled herself up, in the same way as already observed by Valenciennes and Mr. Sclater, the eggs being nearly entirely concealed from view by her folds. In this position she

* Proc. Zool. Soc. 1881, pp. 960–967. Read Nov. 29, 1881.

† *Tom. cit.* pp. 126–133.

‡ P. Z. S. 1862, pp. 365–368.

remained for six weeks, without once eating, and with only one break in her incubation, in the early part of July, when she left her eggs for a few hours, returning to them again however and coiling herself up as before, though now the regularity of her folds was not so great as it had been previously. On July 18th (that is, after a period of forty-three days from the date of laying), as the eggs were evidently decomposing, they were removed: and their state on examination was found to be very similar to that observed by Mr. Sclater on the previous occasion. Several of those examined showed no traces of having been impregnated; at least, no signs of any development inside remained; one or two, however, contained embryos, one of which was about 11 inches long, and had its scales well developed.

P. Z. S. 1881, p. 961.

From the discrepancies existing between the observations of Valenciennes and those made here previously on the temperature of the incubating Pythoness, it seemed highly desirable to utilize the opportunity afforded by this last instance for a further and more extensive series of observations on the phenomenon in question. Mr. Zambra, of the well-known firm of Negretti and Zambra, who had himself taken part in the observations made in 1862, was kind enough to give me his most valuable aid and assistance in this investigation. He not only supplied us with excellent self-registering thermometers of the newest pattern and most delicate make, but was also kind enough to attend regularly—often, I fear, at considerable inconvenience to himself—to superintend and take the necessary readings. With the assistance of Mr. Bartlett, Mr. Clarence Bartlett, and the keeper of the reptiles, J. Tyrrell, Mr. Zambra and I were thus enabled to take a very considerable number of observations on the point in question, with instruments of a more accurate kind than had been available for our predecessors. Our first observations were taken on June 14th, about nine days after the eggs were laid; and they were continued thence without intermission, at intervals of two or three days, till the eggs were removed on July 18th. The readings were always taken about the same time of day, from 12 to 2 o'clock, in order to avoid any differences that might be due to the diurnal variation of temperature. Following Mr. Sclater's example, we took a double series of observations, one set on the incubating female, another on the male of the same species, which, after it had been removed from the female when the eggs were laid, was kept in the cage next to that of the female under conditions practically identical. The temperature of the Snakes was ascertained, first by placing the thermometer on the surface of their bodies, and then by placing it between the folds of their coils. In each case their bodies were covered by the blankets under which they usually rest; and, as far as possible, the different readings, of which we usually took three in each set, were obtained in as many different places in the coils, one towards the centre, the others more towards the outside. The temperature of the air was taken by suspending a thermometer a little way above the floor of the cages; that of the gravel in the cages by burying the bulb of the thermometer in the gravel, in the same position in each cage, and over the hot-water pipes which run beneath the floors of the cages.

The observations are given *in extenso*, as we took them, in Table I. (p. 290). In Table II. (p. 292) I have given the average temperatures of the two Snakes, as deduced from these observations, as well as the difference for each set of readings in the temperature in the two sexes. In the diagrams (figs. 1 and 2, p. 288) I have recorded these averages in a graphic form, the upper line marking the average temperature *between* the folds and the middle line the average *on* the folds, whilst the lowest one indicates the temperature of the air in the respective cages. This last curve is nearly identical in the two cases, that in the male's cage averaging, however, a trifle higher. Although this is the case, it will nevertheless be observed that *both* the temperature-curves of the female are higher than the corresponding ones for the male, especially the upper one. All four are clearly influenced by the variations in the external medium, the maxima temperatures of the snakes' bodies being attained when the air is hottest or nearly so.

P. Z. S. 1881, p. 962.

Not only are the temperature-curves of the female higher, but, as shown by their less amount of angularity, the temperature of the female continues more constant throughout the time observed. This, no doubt, may in part be due to the fact of the female being in a condition of repose throughout, with no variations produced by exercise, the assimilation of food, or other causes.

Taking the averages of the first four columns of Table II., we get respectively 82°·98 F. and 86°·03 F. as the temperature of the male, and 84°·38 F. and 89°·07 F. as that of the female, according to whether the temperature is taken on the surface or between the folds. The figures give a difference of 1°·4 F. and a little over 3°·0 F., the difference being in each case in favour of the female.

The *maxima* readings obtained were, as may be seen from Table I., 89°·6 F. (July 4) and 89°·8 (July 15) for the male (surface and folds), and 89°·8 F. (July 15) and 92°·8 F. (July 1) for the female. The maximum observed by Valenciennes was 41°·5 C. (106°·7 F.), or nearly 14° higher than the highest I observed.

The greatest difference between the temperature of the air and that of the surface of the two Snakes was 8°·3 F. (on June 16th) in the case of the male, and 9°·6 F. (on June 18th) in the case of the female. The greatest differences between the air and the coils were also observed on the same days, and amounted to 11°·6 F. in the case of the male, 16°·7 F. in the female. Valenciennes found on one occasion the difference, as

P. Z. S. 1881,
p. 963.

Fig. 1.
Male.

Fig. 2.
Female.

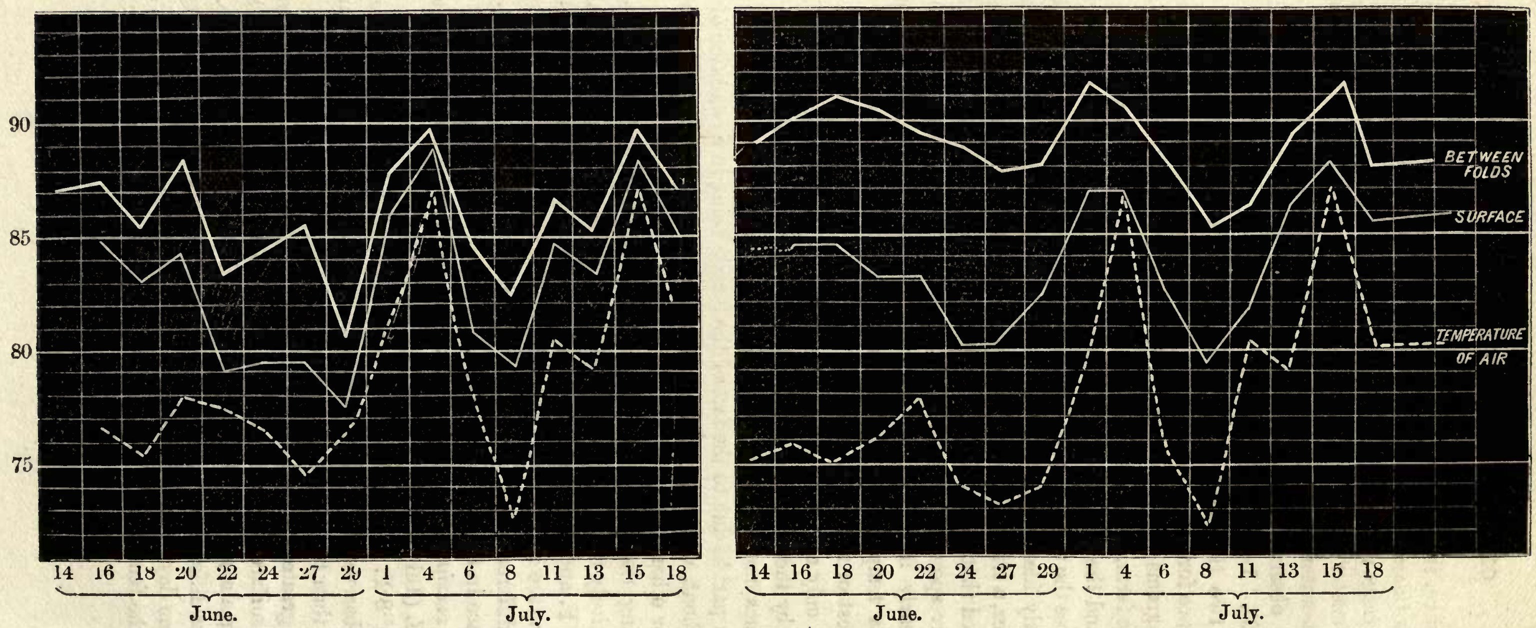

Diagram showing the temperature-curves of the male (fig. 1) and female (fig. 2) (incubating) Pythons. The top line indicates the temperature of the Snakes' bodies between their folds, the middle line that on the surface, the lowest line that of the air of the cages in which they were.

measured between the coils, as much as 21°·5 C. (between 18°·0 C. and 39°·5 C.) or 38°·7 F., a difference enormously greater than any we observed.

It would seem therefore that, if his observations are to be relied on, throughout the case recorded by Valenciennes the female developed a far greater amount of heat than ours did, though she was kept in a cage that was apparently considerably colder*. As in this case more than half the eggs hatched out, it may be that the failure of our animal to do the same was due to the lack of heat. There is also in our case none of that steady fall in temperature, from the commencement to the close of incubation, observed by Valenciennes. In his case, at the commencement of incubation the female had a temperature of 41°·5 C. (106°·7 F.) between the folds (the highest observed at all), falling at the end to 28° C. (82°·4 F.). In our case, the maximum temperature was very nearly obtained on three different occasions.

P. Z. S. 1881, p. 964.

The second set of observations, those made here in 1862, are hardly complete enough to allow of much comparison; but throughout that series the differences between the sexes are greater, though the absolute temperatures are considerably lower † than the average ones I obtained.

Renewed observations will be required to satisfactorily settle the amount of the increase of temperature—a fact of which there can now, I think, be no doubt—which is produced in these reptiles by the process of incubation. The average difference of 3° F. which I have obtained is, it may be observed, very nearly identical with that which occurs in the case of the temperature of fever-patients as compared with the normal. And as the increase of heat in an incubating bird is essentially of the same nature as that produced by an inflammation of a tissue, and such is also presumably the case in an incubating reptile, the nearness of the results thus arrived at is, in itself, an argument in favour of the correctness of my observations.

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* The extreme temperatures of the air recorded by Valenciennes—who took his observations when the cages were coldest, *i. e.* before the fresh hot water was put in—are 17°·C. and 23° C. (62°·6 F. and 73°·4 F.) respectively. The temperature of the two cages in which our animals were kept was only on three occasions *less* than the highest in Valenciennes' series.

† Except in the case of one reading of 96° F., taken on the female, which was on that day 20° F. warmer than the male. This observation, however, is, I think, open to doubt.

TABLE I.

Record of Observations on the Temperature of the incubating (Female) and non-incubating (Male) Pythons.

P. Z. S. 1881, p. 965.

Date.	Air in cage.	Air under blanket.	Gravel of cage.	Male on folds.	Male between folds.	Female on folds.	Female between folds.	Remarks.
June 14 ……	♂			84·8	86·9 86·7 87·6		89·5 88·5 88·9 88·7	
	♀ 75·0	77·2	82·5					
„ 16 ……	♂ 76·6			86·7 83·5 84·6	88·1 87·1 87·5 86·7	83·6 86·9 83·3	90·8 88·8 90·3	An observation taken on the tail of the male gave 82°·3. Two on another male on the tree in cage gave 76°·7 (each time).
	♀ 75·7	78·7	83·3					
„ 18 ……	♂ 75·5	79·6	84·5	82·6 83·5 83·6	86·3 83·8 86·5	84·4 85·4* 84·0	91·3 90·0 91·7	The male had fed the previous night. * Tail.
	♀ 75·0	81·3	83·8					
„ 20 ……	♂ 78·0	77·2	86·3	84·0 84·5 84·5	87·9 88·0 89·6 88·4 88·4	85·0 82·9 82·7	88·6* 92·7† 91·3 92·0 87·2	* The blanket over here was wet. † Tail.
	♀ 76·2	76·4	83·5					
„ 22 ……	♂ 77·4	79·1	84·7	77·3 79·8 80·1 78·6	84·5 82·8 83·8	80·9 83·4 85·9	88·9 89·7 89·9	The temperature of an egg, on the exposed surface, was 88°·3 (two observations).
	♀ 77·8	82·3	84·0					
„ 24 ……	♂ 76·3	73·7	83·5	79·2 78·6 80·7	84·4 84·4 84·3	78·3 80·6 81·8	88·7 89·3 88·0	Temperature of an egg 88°·1.
	♀ 74·4	73·9	79·5					
„ 27 ……	♂ 74·6	75·4	83·8	81·0 77·7 79·4	85·6 84·4 86·6	82·4 81·2 77·6	87·9 88·6 88·0 87·2	
	♀ 73·4	76·2	82·0					

P. Z. S. 1881, p. 966.

TABLE I. (*continued*).

Date.	Air in cage.	Air under blanket.	Gravel of cage.	Male on folds.	Male between folds.	Female on folds.	Female between folds.	Remarks.
June 29 ……	♂ 76°·6	79°·8	83°·0	78°·6	79°·3	83°·0	88°·0	
				76·9	80·4	83·6	89·0	
				77·0	82·2	81·0	87·5	
	♀ 74·0	78·2	82·2	77·7		82·8		
July 1 ……	♂ 80·8	81·5	85·4	87·0	88·0	88·4	90·8	
				85·2	85·5	85·8	91·5	
				87·0	89·6	87·6	92·8	
	♀ 79·5	80·0	86·2	84·6	88·4	85·8	90·8	
„ 4 ……	♂ 87·0	86·6	90·6	88·2	89·2	86·2	90·0	
				88·6	89·6	85·6	90·0	
				89·6	89·8	88·8	90·8	
	♀ 86·6	82·4	89·0		91·1		90·8	
„ 6 ……	♂ 78·8	82·6	89·2	81·4	82·6	80·2	90·0	
				81·0	87·0	83·7	90·0	
				80·4	84·0	85·2	83·8†	† On neck.
	♀ 76·2	81·5	87·2		85·0	81·5	88·7	
„ 8 ……	♂ 72·8	77·2	84·0	79·8	83·0	78·6	85·0	
				79·3	83·2	79·6	86·2	
				79·0	80·4	79·4	85·4	
	♀ 72·3	76·2	82·0		83·4			
„ 11 ……	…	…	…	84·3	86·6	80·8	86·8	Two observations on a male that had been in the water gave 80°·4 and 79°·8 between the folds.
	♂ 80·3	83·0	85·2	84·4	85·8	81·7	85·5	
				85·6	86·8	83·3	87·1	
	♀ 80·2	79·0 80·3	84·8		86·6			
„ 13 ……	♂ 79·3	80·7	85·1	83·4	85·5	85·4	88·7	The eggs are all exposed.
				83·3	85·9	86·2	89·6	
				84·3	85·1	87·1	89·0	‡ A male that had been in the water gave 82°·1 between the folds.
	♀ 79·2	83·3	83·8				89·7	
„ 15 ……	♂ 87·1	87·7	90·3‡	87·7	89·8§	86·8	90·9	§ Only one observation, the male being very restless. A Boa (♂) in the same cage gave also 89°·8 as its temperature between the folds.
				88·7		87·8	91·2	
				88·6		89·8	92·2	
	♀ 87·1	86·0	89·4				91·7	
„ 18 ……	♂ 82·2	86·0	89·2	85·1	88·0	86·2	88·0	
				84·5	87·4	85·7	86·6	
	♀ 80·0	82·8	86·8	85·4	86·2	84·3	88·8	

P. Z. S. 1881, p. 967.

Table II.

Showing the Averages of the Observations recorded in Table I., and the Differences in Temperature between the two sexes.

Date.	Male.		Female.		Difference.	
	On surface.	Between folds.	On surface.	Between folds.	On surface.	Between folds.
	°	°	°	°	°	°
June 14	...	87·1	...	88·9	...	1·8
„ 16	84·9	87·4	84·6	90·0	**·3**	2·6
„ 18	83·2	85·5	84·6	91·0	1·4	5·5
„ 20	84·3	88·5	83·5	90·4	**·8**	1·9
„ 22	79·0	83·7	83·4	89·5	4·4	5·8
„ 24	79·5	84·4	80·2	88·7	·7	4·3
„ 27	79·4	85·5	80·4	87·9	1·0	2·4
„ 29	77·6	80·6	82·6	88·2	5·0	7·6
July 1	86·0	87·9	86·9	91·5	·9	3·6
„ 4	88·8	89·9	86·9	90·4	**1·9**	·5
„ 6	80·9	84·7	82·7	88·1	1·8	3·4
„ 8	79·4	82·5	79·2	85·5	**·2**	3·0
„ 11	84·8	86·5	81·9	86·5	**2·9**	
„ 13	83·7	85·5	86·2	89·3	2·5	3·8
„ 15	88·3	89·8	88·2	91·5	**·1**	1·7
„ 18	85·0	87·1	85·4	87·8	**·4**	·7
Average	82·98	86·03	84·38	89·07		

N.B. The figures in black type point out when the difference of temperature is in favour of the male. Such cases, it is to be observed, only occur when the surface-temperature is observed.

Rep. B. Assoc. 1881, p. 723.

48. OBSERVATIONS ON THE INCUBATION OF THE INDIAN PYTHON (*PYTHON MOLURUS*).*

The only two previously recorded instances of the incubation of their eggs by female Pythons in captivity are those recorded by Valenciennes (' Comptes Rendus,' 1841, xiii. pp. 126–133) and Sclater (P. Z. S. 1862, pp. 365–368), for *P. bivittatus* and *P. sebæ* respectively. During the summer of 1881 a female of the *Python molurus*, about 12 feet long, which was kept in the same cage in the Reptile-house in the Zoological Society's Gardens as two other Pythons of the opposite sex, one being of the same species, the other *P. bivittatus*, laid about fifteen eggs, on

* Rep. Brit. Assoc. 1881, p. 723.

which she sat steadily for about six weeks, in exactly the same manner as in the two instances mentioned above. At the termination of that period, as the eggs were decomposing and obviously bad, they were removed; some at least were fertilized, an embryo about 11½ inches long having been extracted from one.

With the kind aid of Mr. Zambra, of the well-known firm of Negretti and Zambra, who not only had special thermometers of the most approved kind constructed for this occasion, but also regularly attended himself to help in the observations, a series of observations, about two hundred in number, were taken at regular intervals of 48 or 72 hours, to ascertain the temperature of the sitting female, as compared with that of the non-incubating male, kept next door under nearly identical conditions of temperature and moisture. The result of these shows that, whereas the temperature of the male, whether taken on the surface or between the folds of the coiled-up body, varied very much as the temperature of the air in the cage, the curves falling or rising with it, that of the female, taken in the same way, was much more constant, particularly of the body between the folds. Not only so, but the average temperature of the female was much higher, the temperature of the two sexes being respectively 86°·7 F. and 89°·75 F. between the folds, and on the surface 82°·5 F. and 84°·4 F., giving differences of 3°·05 and 1°·9 in favour of the female. In no case did the temperature of the male, taken between the folds, exceed that of the female; and in most cases there was a marked excess in that of the female, the average in one set of observations being as much as 7°·6. In no case was any such difference as 20°·0, like that recorded by Sclater, found. The highest temperature observed in the female was 92°·8; the highest observed by Valenciennes was 106°·7, or 14°·0 higher. The greatest difference between the surface of the snake and that of the air in the cage observed was 9°·6 F.

No such decline in temperature from the commencement to the end of incubation as was observed by Valenciennes could be made out in the present case. The maxima were attained when the temperature of the surrounding air was also at its highest, the range of the between-folds temperature being 6° (85°·5 to 91°·5).

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49. THE INSECTARIUM AT THE ZOOLOGICAL GARDENS.*

Ent.M.M.xviii. p. 15 (1881).

WITHIN the last few weeks a new house in the Zoological Society's Gardens has been opened, which promises to be of great interest to the

* Ent. Month. Mag. xviii. pp. 15, 16 (1881).

public generally, and to entomologists in particular. This is an "Insectarium," or house devoted to the exhibition of living specimens, in their various stages, of the class of Insects. Such an exhibition is not absolutely new, it is true, for something of the kind has been tried already in this country at the Westminster Aquarium, as well as on the continent at the Hamburg Zoological Gardens. In neither case, however, was the experiment made on any large scale, and in the first instance, at least, it has not proved, hitherto, a great success. The "Insectarium" stands in what is known as the "North Garden"—as the slip of land lying on the northern bank of the Regent's Canal is called—not far from the northern entrance to the gardens. It is of an oblong shape, with a glass roof, and with three of its sides, including the south one, also consisting largely of glass. The remaining or northern side is of cement and brick. The floor is paved with tiles, and beneath it hot-water pipes run round the house, which admit of its being kept up to any necessary temperature.

The larger insects are exhibited in glass cages, provided with tops of perforated zinc, and with metal floors in which can be inserted, if necessary, a flower-pot with growing plants for the larvæ to feed on. These cages, which are rather larger than an ordinary Wardian case, are arranged along two sides of the house, those on the south side being at present chiefly occupied by various exotic silk-producing Bombyces, whilst the smaller ones on the north are devoted to English Lepidoptera of various species. On tables in the middle of the room are bell-glasses with various aquatic insects, as well as other cages containing smaller species, or very young larvæ of Lepidoptera, together with a few insects of other groups.

At the present time, the Lepidoptera are best represented. There is a good collection of the cocoons of the Bombyces exhibited, and many of these have come out, and produced beautiful imagos. Amongst others, *Samia gloveri* and *S. cecropia*, *Attacus atlas* and *Actias luna* may be mentioned as having been exhibited alive during the past few weeks. Eggs of most of these have also been obtained, so that no doubt before long, larvæ of them will be visible, though at present the only silk-moth larvæ shown are those of *A. yama-mai.*

Of European Lepidoptera, imagos of *Papilio machaon*, *Melitæa cinxia*, and *Nemeobius lucina* may be seen, whilst there are larvæ in various stages, or pupæ, of many others, amongst which those of *Melitæa maturna*, *Apatura ilia* and *iris*, *Limenitis populi* and *sibylla*, and *Catocala fraxini* are, just now, perhaps the most interesting.

The other Orders are represented chiefly by aquatic forms at present, in the shape of sundry *Hydradephaga* and *Philhydrida* from amongst the Coleoptera, by larvæ of *Agrion*, *Libellula*, and *Ephemera*, together with *Phryganidæ* in their cases, *Nepa*, *Notonecta*, and a few others. The Hymenoptera are, as yet, hardly represented, though in time there seems no reason why the visitors to Regent's Park should not be able to study for themselves the habits of the ant and the economy of the hive-bee. Perhaps Sir John Lubbock could help here?

As yet, of course, only a beginning has been made, but enough has even now, we think, been done to prove the success of the experiment, which is of course capable of development to almost any extent. As the season advances, the number of insects exhibited will no doubt become much increased, whilst constant changes, both as regards the condition of the specimens and the various forms exhibited, will always give the charm of novelty to a visit to this house. It is to be hoped, indeed, that at no distant period the Londoner may be able to contemplate at leisure the charms of a live *Morpho* or *Urania*, without going further from his home than the Regent's Park. Ent.M.M.xviii. p. 16 (1881).

The Insectarium is under the charge of Mr. W. Watkins, already well known to many readers of this magazine, and under him will no doubt daily increase in efficiency and attraction, and so perform its main mission of instructing and amusing the public. When more experience in the working of the Insectarium has been gained, it may also be possible to utilize some of the opportunities now afforded for experiments in such matters as the effect of increased temperature or moisture in producing variation in insects. It would also be interesting to experiment further on the reproduction of *Aphides*, with the object of discovering how many generations in succession of agamo-genetic individuals (if the term may be thus used) could be produced under circumstances favourable for their propagation presented in the Insectarium.

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50. REMARKS UPON THE HORNS OF THE PRONGBUCK.*

P. Z. S. 1882, p. 1.

Mr. W. A. Forbes exhibited and made remarks on the horns shed by the male Prongbuck (*Antilocapra americana*) living in the Society's Gardens since December 1879, which had been dropped, one on November 15 and the other on November 24, of 1881. This, it was believed, was the first instance on record of one and the same individual of this species having shed its horns in consecutive years, though that this event took place periodically had been rendered nearly certain from previous observations †.

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* Proc. Zool. Soc. 1882, p. 1.

† See P. Z. S. 1880, p. 540.

P. Z. S. 1882, p. 287.

51. ON SOME POINTS IN THE ANATOMY OF THE GREAT ANTEATER (*MYRMECOPHAGA JUBATA*).*

(Plate VIII.)

THE literature relating to the anatomical structure of the Edentata, though very considerable, is unfortunately much scattered, and with many blanks as regards special points. The genus *Myrmecophaga* may be considered—thanks chiefly to the labours of Owen † and Pouchet ‡, who have elaborately described many parts of its organization—to be the best known, as regards anatomical structure, of all the existing Anteaters. Two adult female specimens of this animal having lately § passed through my hands in my prosectorial capacity, I have had the opportunity of confirming a large part of the already published accounts of its anatomy, as well as of correcting, or adding, certain details, which I now lay before the Society.

1. *Alimentary Canal and Appendages.*—The palate (fig. 1, p. 297) is not absolutely smooth, but presents anteriorly a series of irregular transverse ridges notched along their margin, best developed and nearly meeting mesially anteriorly, posteriorly becoming much more oblique backwards and less regular, the ridges not being opposite each other but more or less alternating. In all there are about seven of these ridges.

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* Proc. Zool. Soc. 1882, pp. 287–302. Read March 7, 1882.

† "On the Anatomy of the Great Anteater," Part I., Trans. Zool. Soc. iv. pp. 117–140, pls. xxxvii.–xl.; Part II., *l. c.* pp. 179–181, pls. li.–liii.

‡ Mémoires sur le Grand Fourmilier: Paris, 1874.

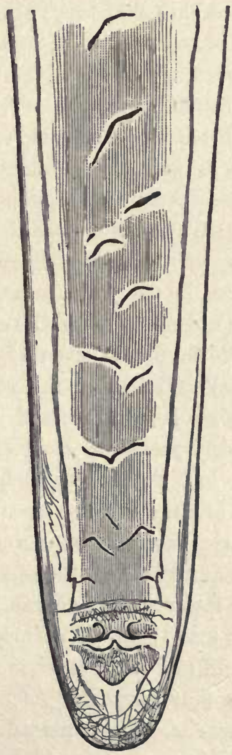
In addition to these, there are brief references to *Myrmecophaga jubata* in Rapp's 'Edentaten' (2e Aufl., Tübingen, 1852), and Prof. Flower's Hunterian Lectures (Med. Times and Gazette, Nov. 30, 1872, p. 591). The submaxillary glands have been described by Gervais (C. R. lxix. pp. 1110, 1111 [1869]); and the brain by the same author ("Mémoire sur les formes cérébrales propres aux Edentés vivants et fossiles," Nouv. Arch. Mus. v. pp. 1–56, pls. i.–v.), and by G. Pouchet ("Mémoire sur l'encephale des Edentés," Robin's Journal de l'Anatomie, 1868, pp. 658–675, and 1869, pp. 1–18, &c.).

§ The first of these, from Buenos Ayres (spec. *d* of the List of Vertebrates), was presented to the Society by the Hon. L. S. Sackville West (now H. B. M.'s Minister at Washington) on Sept. 7, 1877. It died Nov. 29, 1881, from severe inflammation of the connective tissues lying in and around the submaxillary glands.

The second (specimen *a*) was presented so long ago as October 4, 1867, by Dr. J. A. Palin, C.M.Z.S., and, after living for more than fourteen years in the Society's Gardens, died on the 5th of February of the present year. The only disease detected in it, on *post-mortem* examination, was a considerable enlargement of the thymus gland, and acute inflammation of the laryngeal mucous membrane. This second specimen, though an aged animal, was by no means so large as the first, having a total length of 6 ft. 1½ in. (from the tip of the nose to the end of the tail, which was 2 ft. 4 in. long), as against 7 ft. 5¼ in. in the other.

The floor of the mouth to about 2 inches beyond the most posterior opening of the submaxillary glands, the gums over the tip of the lower jaw, and the lateral callous pads which are present as in *Tamandua*, are all covered with minute, retroverted, closely-set papillæ. The tip of the tongue is quite glabrous and globular; but the greater part of the rest of its extent, anterior to the pair of circumvallate papillæ, is dorsally and laterally covered with similar, but smaller, retroverted papillæ, best developed towards the tip of the organ, and gradually getting smaller and smaller towards its base, till they are scarcely visible to the unaided eye except in certain lights. There is a median glabrous line, or shallow **P. Z. S. 1882, p. 288.**

Fig. 1.



Palate of *Myrmecophaga jubata*; from a preparation in the Museum of the Royal College of Surgeons, prepared from specimen *a*.

groove running along the tongue till near its apex; but this is ventral in position. According to Owen there is a similar dorsal one; but if so, it is not very evident (*l. c.* p. 129). The dorsal surface, however, is slightly fluted towards the apex. In front of the circumvallate papillæ a slightly raised median longitudinal ridge extends for some 5 inches.

P. Z. S. 1882, p. 289. My observations on the salivary glands agree well in most points with those of my predecessors, except as regards the number and openings of the ducts to the submaxillary glands, regarding which very different statements have been made at various times. Of these, Gervais's description, as given in some remarks accompanying the exhibition before the French Academy of Sciences of some models of these glands (C. R. *s. c.*), agrees best with my observations. He says:—"*Deux paires* des canaux dont il s'agit viennent aboutir séparément dans la bouche en se rendant à deux poches situées auprès de la symphyse mentonnière; la *troisième* paire verse un peu en arrière, également dans une petite dilatation terminale."

A similar arrangement is described by J. Chatin in the genus *Tamandua**, except that he says that there are *two* openings on *each side* at the symphysis. Pouchet, on the other hand, maintains ('Mémoires' &c. pp. v and 88) that there are only *two* ducts on each side, one of these being formed by the confluence of two of the three primary ducts coming from the corresponding three lobes of which each gland is composed. He only describes a single pair of openings close to the symphysis. Owen, finally, describes the three ducts of each side as eventually uniting, and opening, also by a single aperture, close to the symphysis.

An examination, however, of his specimen (now preserved in the Hunterian Museum, where, by the kind permission of Prof. Flower, I was allowed to examine it) demonstrates the existence of a second pair of apertures in the floor of the mouth situated some 2 inches behind the first pair, which lie immediately behind the symphysis, in this respect quite agreeing with Gervais's description, and with my own observations on the second of my (fresh) specimens (*vide* Plate VIII. fig. 3 *c*). This second pair of apertures, which lie close to each other on each side of the median line and are very minute, are the openings of the deeper ducts, which, one on each side, arise from the more anterior (*cervical*) portion of the gland†. As these lie quite behind the other pair of apertures, any injection passed into the latter can of course only fill the two pairs of ducts (*a*, *b*) which debouch into them. This may easily explain, therefore, Pouchet's only having found *two* ducts on each side, though it is possible that individual specimens may vary in this respect. I must at least notice that in the first specimen that passed through my hands (the submaxillary ducts of which were injected from the anterior pair of

* Ann. Sci. Nat. 5, (Zool.) xiii. art. no. 9.

† Such was, at least, the condition in the only specimen of *Myrmecophaga* in which these ducts had been satisfactorily injected examined by me. In *Tamandua*, according to Chatin's figure (*op. cit.* pl. 14), it is the ducts from the posterior (*sternal*) part of the gland that open here. This point requires reexamination, as also the number of apertures anteriorly.

apertures alone), I found on the left side a *single* duct only, and on the right *two*, which united together at about the level of the articulation of the lower jaw. This specimen, however, had, it is to be remembered, extensive inflammation in these parts, which may possibly have effected an alteration in the relations and number of the ducts. It is pretty clear, however, that three pairs all together is the ordinary number of these ducts, that having been found in Gervais's specimen (perhaps in two), in Owen's, and in one of mine for certain. **P. Z. S. 1882, p. 290.**

I found the opening of the two other ducts exactly as described by Pouchet (*l. c.* p. 89) and Gervais, one of these being dilated terminally, the dilatation receiving the other duct and opening by a *single* aperture into the mouth (*vide* Plate VIII. fig. 3).

At the point where the three submaxillary ducts of each side, coming from the three lobes of the gland, converge, and become united intimately by their walls to each other, they become surrounded by a bulb-like mass of muscular tissue, the exact relations of which I shall describe below. But I could not perceive that this structure, which externally looks like a bulbous reservoir surrounded by a muscular coat, corresponded to any dilatation of the ducts which pass through it; on the contrary, these seem to preserve a nearly uniform diameter throughout this part of their course, a condition corresponding to that described by Chatin in *Tamandua*.

The terminal reservoirs, I may add, of the two pairs of submaxillary ducts lie just above the long thin median tendon of the genio-hyoid, the contraction of which muscle may possibly, by compressing the floors of these reservoirs, aid in the ejaculation of the fluid contained in them.

The stomach of *Myrmecophaga* generally resembles Prof. Owen's figures and description; but the thick pyloric pads are softer and more vascular, and the whole less gizzard-like, than I had been led to anticipate from his account. The gyriform folds of the mucous membrane of the cardiac part of the stomach, which quite resemble those of the stomach in many other animals, are, in particular, not happily represented in his fig. 1, pl. lii.

The liver of both specimens agrees very well with Prof. Flower's description of this viscus. Both caudate and Spigelian lobes are practically absent.

As accurately described by Pouchet ('Mémoires,' pp. 191, 192), the pancreatic duct ends in a vesicle, in the walls of which the hepatic duct runs for a little way and then opens into it, the vesicle then opening by a separate aperture into the duodenum.

In the first (larger) specimen examined by me the intestines measured as follows:—small intestine 24 ft. 10 in., large intestine 2 ft. 3½ inches. The cæcum can hardly be said to exist as a separate part. The median longitudinal ridge of mucous membrane was continuous for the posterior

15 feet 3 inches of the small intestine, and reappeared above this at intervals in a less regular and less developed way.

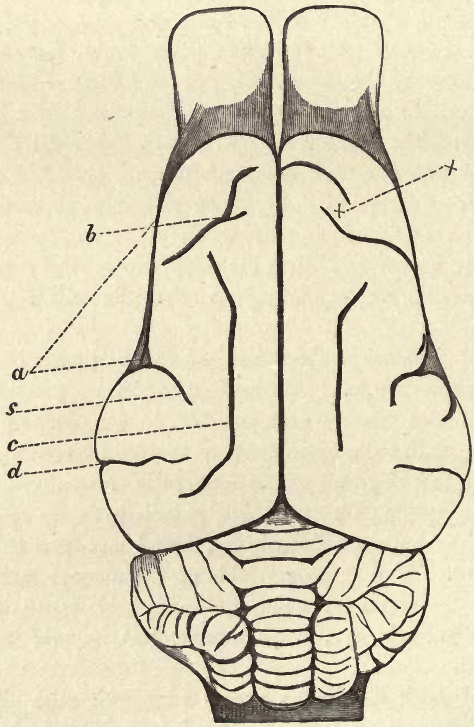
I could see no *longitudinal* folds of mucous membrane, such as are described by Owen, in the rectum, which, however, had distinctly *transverse* ones, irregularly disposed in a gyriform way, well marked.

The right lung is trilobed, with an azygos lobe superadded; the left lung is bilobed, the lowest lobe in each lung being biggest.

The kidneys are quite smooth externally: there are no distinct Malpighian pyramids, the tubules opening internally on a single slightly-

P. Z. S. 1882, p. 292.

Fig. 2.



Brain of *Myrmecophaga jubata* (specimen *a*) from above.

P. Z. S. 1882, p. 291. elevated ridge, which in one specimen is divided into three or four slightly-marked papillæ.

2. *Brain.*—The late Prof. Gervais has given, in his memoir on the brain of Edentata, figures of the superior, inferior, and lateral aspects of the brain of *Myrmecophaga jubata*, as well as of the cranial casts of that and the other species of Anteater *. Pouchet, in his 'Mémoires,' also gives

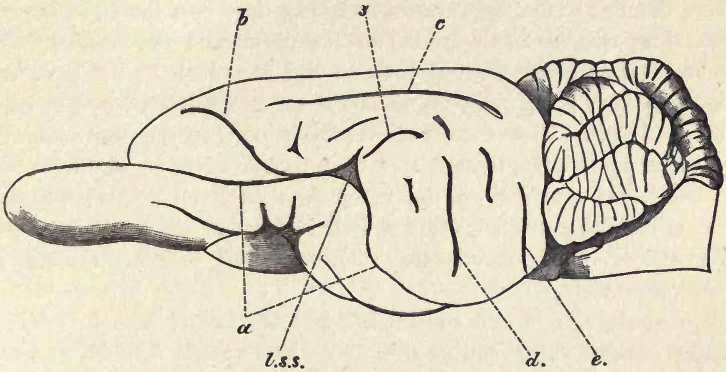
* Nouv. Arch. v. pl. i. figs. 3, 3 *a*, 3 *b*, pl. ii. figs. 1–3.

figures of the cranial casts of *Myrmecophaga*, and, in the article in the 'Journal de l'Anatomie' above cited, representations of the brain itself of *Tamandua* and *Cycloturus*, that organ having been previously figured in the latter species by Tiedemann *.

As I find Gervais's figures of the brain in some respects unsatisfactory, I have taken this opportunity of giving representations of the brains ex-

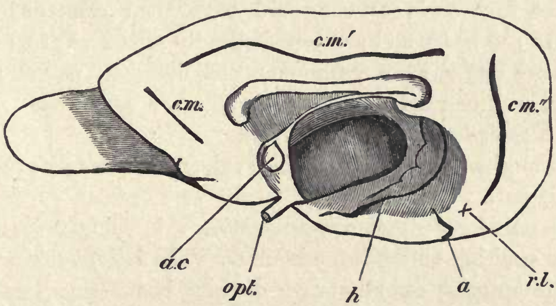
Fig. 3.

P. Z. S. 1882, p. 293.



Brain, from the side, of specimen *d.*

Fig. 4.



The same, from the inside. All these figures are of the natural size.

a, Limbic fissure (inferior arc of Broca); *b*, fissure of Rolando (Broca); *c*, primary parietal sulcus; *d*, *e*, additional sulci of circumsylvian gyrus; *s*, fissure of Sylvius; *l.s.s*, island of Reil (*lobule sous-sylvien*, Broca); *c.m*, *c.m′*, *c.m″*, calloso-marginal sulcus (superior arc of limbic fissure, Broca); *h*, hippocampal sulcus; *a.c*, anterior commissure; *opt*, optic nerve; *r.l* (fig. 4), "Pli de passage rétro-limbique" (Broca); + (fig. 2), bridging convolution between frontal and parietal lobes.

tracted from my two specimens, including one showing the disposition of the deeper parts (figs. 2, 3, 4). P. Z. S. 1882, p. 291.

The olfactory lobes are very large, projecting forwards for ·7 inch in

* Icones cerebri Simiarum, pl. v. fig. 8.

front of the cerebral hemispheres: in the lateral view of the brain they occupy, at least anteriorly, almost the lower half of the parts there exposed. They are continuous basally with the well-developed "hippocampal lobe," in front of which appears a large oval swelling of grey matter, on the middle root of the olfactory lobe, of an antero-posterior extent of more than half an inch. Towards their base, the olfactory tracts are curiously marked by slight transverse impressions (fig. 3) giving them a striated appearance, which may also be observed in the corresponding regions in the brains of *Tamandua* and *Orycteropus*. The cerebral hemispheres are but little arched superiorly *; but the *vermis cerebelli* is very prominent, rising above the general level of the hemispheres (fig. 2). Viewed from above, the hemispheres appear somewhat truncated posteriorly, though they here completely conceal the *corpora quadrigemina*, abutting on the cerebellum (fig. 2). Attaining their greatest breadth anterior to this, a little in front of the level of the posterior end of the median fissure (1·95 inch long), they taper somewhat rapidly anteriorly.

The cerebellum is well convoluted, with its lateral extent (1·5 inch) greater than its antero-posterior (1·15). The vermis is much narrower than the lateral lobes; it is prominent, and in one specimen (the larger) considerably twisted on itself. The flocculi are distinct.

The nates are much larger than the testes: the latter are very narrow from before backwards as compared with their combined transverse extent (·075 : ·6 inch), and are not distinctly separated from each other. The nates are larger, more prominent, and distinctly paired, being separated by a well-marked constriction; they are somewhat triangular in shape, with their longer axis transverse.

P. Z. S. 1882, p. 292.

The pineal gland has a distinct hard mineral deposit; its peduncles are easily made out.

There is no very distinct *corpus mamillare*, it being only represented by a white swelling on the infundibulum. The *hypophysis cerebri* is very large. The anterior commissure is distinct, but not particularly large, its antero-posterior extent being ·15 inch. The soft commissure is very large (·25 inch long); the posterior distinct. The third nerves are small, the optic not large.

There is a good septum lucidum (·25 inch deep anteriorly), with a contained fifth ventricle. The fornix is very well developed, with but few precommissural fibres. The corpus callosum is very well developed, more than an inch long, and nearly horizontal in position, with but a slight *genu* anteriorly. Posteriorly it forms, with the fornix, a prominent pad (*bourrelet*).

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* Gervais's figure, *l. c.* fig. 3 *a*, makes their outline much too convex antero-posteriorly.

The cerebral sulci are not exactly alike in my two specimens, the brain of the bigger of the two animals, though of the same dimensions as its fellow, being more richly convoluted by the development in it of minor fissures and impressions not present in the other. It is that of which the lateral and internal views are here figured (figs. 3 & 4, p. 301): the description of the main sulci is taken from the simpler specimen (represented in fig. 2), but applies in all essential respects to both. P. Z. S. 1882, p. 293.

The olfactory lobe is separated from the cerebral hemispheres above by a shallow fissure (a), which, at the level of the anterior extremity of the prominent "hippocampal lobe," turns downwards, and runs along the external and inferior face of that lobe till it terminates on its inner face (fig. 4, a), not, however, reaching the hippocampal sulcus (h). At the point where its downward course commences there is a small triangular area (*l.s.s.*) exposed on the lateral surface of the brain, from which a short curved shallow sulcus (s) runs a short way upwards, forming with the descending part of a a forwardly-convex curve. In the larger specimen figured (fig. 3) this short upwardly-running sulcus (s) is separated, as will be seen, by a narrow bridging fold from the triangular depression and its posterior continuation (a). From the antero-inferior angle of this triangular space, but separated by a very narrow, more or less deep, bridging convolution from a, another sinuous fissure (b) runs forwards and upwards to terminate near the anterior angle of the hemisphere *. Above, on the supero-lateral aspect of the brain, and nearly parallel with the median longitudinal fissure, is a distinct longitudinal sulcus (c), convex upwards, which runs in an antero-posterior direction for a space of 1·2 inch. P. Z. S. 1882, p. 294.

Finally, parallel with the posterior edge of the hemisphere, dividing the external surface of this "temporal lobe," is a vertically-directed sulcus (d) about ·75 inch in extent.

On the internal aspect of the brain (fig. 4) runs a well-marked "calloso-marginal" sulcus (*c.m*), broken up into three or more parts, the most posterior being nearly vertical in position, and separated by but a little space from the posterior extremity of fissure a. In its usual position is a well-marked hippocampal sulcus (h), with a broad "*fascia dentata*" between it and the *corpus fimbriatum*, the *fascia dentata* being continued, as described by Prof. Turner in *Dasypus* †, as a thin layer of longitudinally-disposed fibres over the *corpus callosum* to near its *genu*. The hippocampal sulcus does not extend as high as the *corpus callosum*. The lateral ventricle is fair-sized: I can see not a trace of any posterior cornu. The *hippocampus major* is strongly convex. The "hippocampal

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* In the smaller specimen (fig. 2), this fissure is, on the right-hand side only, broken up into two by a narrow bridging convolution (+).

† Journ. Anat. Phys. i. (1867), p. 314.

lobe" has, on its inferior aspect, a few irregular dentations developed near its antero-internal angle.

In the smaller and simpler brain of *Tamandua* (represented diagrammatically in fig. 5), the only sulci present are those corresponding to *a*, *b*, *c* in the larger species, with some slight representatives of *d*.

Adopting the late Prof. Broca's ideas * as to the nature and composition of the "*scissure limbique*," the inferior arc of this is clearly represented by the fissure *a*, which is separated by a narrow "*pli de passage* P. Z. S. 1882, p. 295. *rétro-limbique*" (fig. 4, *r.l*) from its superior arc, represented by what we commonly call the "calloso-marginal sulcus" (*c.m*, &c.). The slight sulcus at *s*, developed above the triangular depression, will accordingly be the Sylvian fissure. *b* is then, following Broca's identifications, the fissure of Rolando, the gyrus lying anterior to and below it being the reduced equivalent of the frontal lobe. As has already been pointed out, this gyrus is connected posteriorly by a small, sometimes deep, bridging fold with the triangular space (*l.s.s.*) below the Sylvian fissure. This triangular space is Broca's "*lobule sous-sylvien*," its equivalent in the Primates being the lobe of the island of Reil (*l. c.* p. 430).

The longitudinal sulcus *c* corresponds probably to Broca's "*sillon pariëtal primaire*;" the gyrus above and internal to it will thus be the "*circonvolution sagittale*," that below it the "*circonvolution sylvienne*," which in the more-convoluted of the brains (fig. 3) becomes divided up by smaller sulci (*d*, *e*, &c.) into a number of imperfect gyri.

Fig. 5.

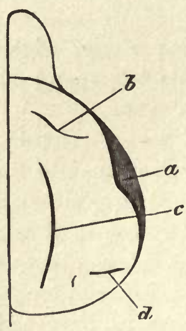


Diagram of right cerebral hemisphere of *Tamandua tetradactyla*, from above.

From my study of the brains of the remaining genera of Edentata, I have little doubt that the sulci *a*, *b*, and *c*, here described, can be traced,

* "Anatomie comparée des circonvolutions cérébrales. Le grand lobe limbique et la scissure limbique dans la série des Mammifères," Revue d'Anthropologie, vii. pp. 385–498.

with various modifications, in nearly all the members of this group. *Orycteropus* in its cerebral characters seems to approach *Myrmecophaga* more nearly than any other form, the sulci and gyri of the brains of the two forms, as well as their general conformation, being very similar; *Manis* seems to possess the three typical sulci well developed; and these are also present in the larger Dasypodidæ, though apparently much reduced in the smaller forms of that group. The Sloths conform to the same general type. But, in the absence of a larger series of brains of this group than is at present available for comparison, satisfactory generalization on this subject is impossible, most of the published figures of Edentate brains being very unsatisfactory in detail, whilst nothing of importance is known as regards the development of the sulci in any member of this group.

3. *Female Generative Organs* (fig. 6, p. 306).—These have been briefly described by Pouchet *, as well as by Rapp; but their accounts will, in some respects, bear supplementing. P. Z. S. 1882, p. 296.

A cloaca, in the true sense of the word, is not present in the Great Anteater. The *labia majora*, which bound the vertical urino-genital fissure, are very prominent and hirsute. Above them, but separated by a distinct perineal space, slightly hair-clad, is the transverse anal aperture, the mucous membrane lining which is pink, quite different from that of the lower passage and its boundaries, which is grey. Slightly inclosing these two apertures above is a widely-open V-shaped tegumentary fold, with its apex situated superiorly towards the root of the tail.

There are no *labia minora* visible; and no clitoris is present as a free organ, though the *corpora cavernosa* can be felt as tough bodies lying in the walls of the vulva.

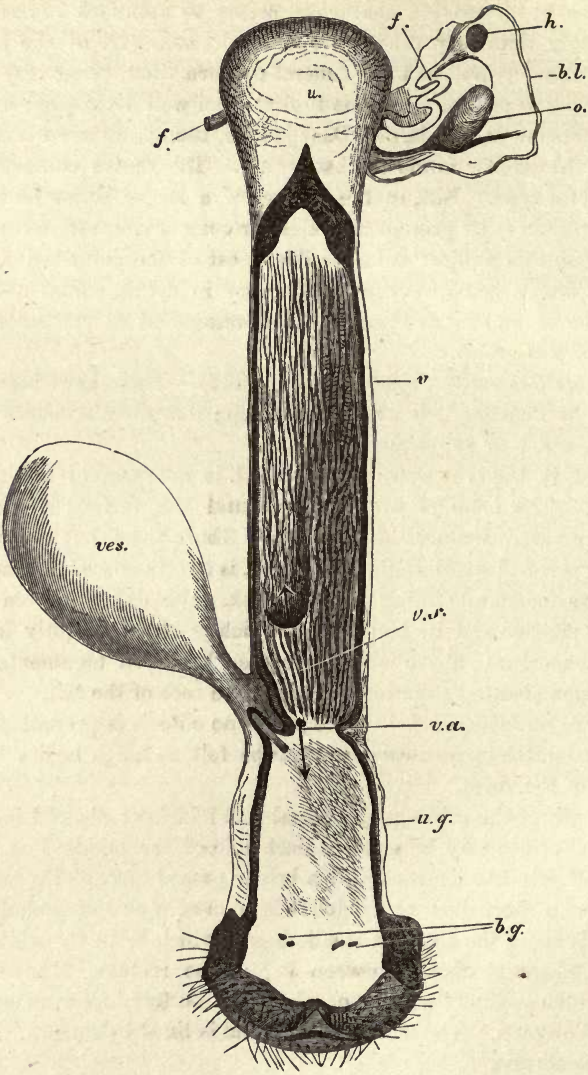
The length of the urino-genital canal is 2·7 inches: about 1 inch from its external orifice may be seen, on each side of the middle line, two or three small pore-like depressions; a bristle passed through the largest of these enters a short duct, connected with one of a pair of globular compact glands about the size of a small cherry, which lie in the walls of the urino-genital canal above, between it and the rectum. They are, no doubt, "vulvo-vaginal" glands, or glands of Bertolini, corresponding to the male Cowper's. The urino-genital canal is lined by smooth, vascular, mucous membrane.

Communication between this and the next section of these organs is effected by means of two small apertures, each admitting readily enough the passage into the vagina, through the here constricted walls of the common tube, of a probe. From between these apertures is prolonged downwards, for a slight distance along the dorsal wall of the urino-genital canal, a slight ridge of mucous membrane, on each side of which are

* Mém. p. 194.

P. Z. S. 1882.
p. 297.

Fig. 6.



Female generative organs of *Myrmecophaga jubata*, from before, reduced, and somewhat diagrammatic. The walls of the tube have been laid open anteriorly to show the vaginal septum (*v. s*), beneath which an arrow is passed, appearing above in the vagina (*v*), and below emerging by the vaginal aperture of that side (*v. a*) into the urino-genital canal (*u.g*). The opening of the vagina into this on the other side is laid open.

b. g, openings of Bertolini's glands; *ves*, bladder, turned to one side; *u*, uterus; *f, f*, Fallopian tubes (cut short, with the rest of the uterine appendages on the left side); *o*, ovary; *h*, hydatid of Morgagni; *b. l*, broad ligament of the uterus, cut short.

visible numerous small pore-like apertures, arranged in series in lines running outwards from the middle line. P. Z. S. 1882, p. 296.

On laying open the vagina along its anterior wall, it is seen to pass above with no marked constriction or "*os uteri*" into the pyriform simple uterus, the only distinction between the two parts being afforded by the thicker and more muscular walls of the uterus, and by the difference in the character of the mucous membrane, this being quite smooth and spongy in the uterus, whilst that of the vagina is thrown into a close-set series of thick, more or less longitudinal, somewhat foliaceous plaits. For about the lower inch of the vagina there extends a complete median septum, attached to both dorsal and ventral walls of the tube, extending a little further along the dorsal wall, and terminating superiorly by a free semilunar margin, concave upwards. Hence the terminal part of the vagina consists of two quite separate tubes, fused together above, but each opening into the urino-genital sinus by a single aperture of its own below.

The vagina proper measures about 4 inches in length. The pyriform uterus is not more than 2 inches long: it presents not the slightest sign of being double. Its walls are very thick and muscular; but there is no constriction or valve at all at its junction with the vagina. It receives the Fallopian tubes, not at its supero-external angles as in *Homo* &c., but at a point about one third down its total length. These are not particularly long, nor much convoluted, and lie along the anterior edge of the broad ligament. The ovaries are completely covered by a peritoneal coat superiorly, but by their ventral faces open into a spacious peritoneal pouch, open anteriorly, in the floor of which is the very considerable aperture of the *morsus diaboli*, surrounded by the expanded extremity of the Fallopian tube. This is not much fimbriated, and is externally prolonged to meet the external border of the ovary of the same side. On this surface of the ovary may be seen a few scars, probably due to the eruption of Graafian follicles, as well as a couple of small clavate processes which depend freely from it into the cavity of the pouch. Towards the outer part of the broad ligament, and lying anteriorly to the ovary and round ligament, is a large "hydatid of Morgagni" nearly the size of a pea. P. Z. S. 1832, p. 298.

The opening of the vagina into the urino-genital sinus by *two* distinct apertures seems to be characteristic (according to the statements by Owen* and Rapp †) both of the Anteaters and the Sloths, though Pouchet considered it in his specimen as "sans doute une anomalie" (*l. c.* p. 195). The latter author describes as the "uterus" what I have here considered to represent both uterus and vagina, whilst what he calls "vagina" is only so in a functional sense, being morphologically the urino-genital canal. Rapp also describes these animals as having a single uterus with

* Anat. Vert. iii. p. 690.

† *L. c.* p. 102.

two *ora* ("*einfache Gebärmutter mit doppeltem* (*rechten und linken*) *Muttermund*," *l. c.* p. 104). Nevertheless I see no reason for doubting the view adopted by Prof. Owen, that the genital tube above the urethral opening represents in reality both uterus and vagina.

The presence of a vaginal septum, a remnant of the coalescence of the primitively paired Müllerian ducts, in *Myrmecophaga* is a peculiarity shared, judging from Owen's account, by the genus *Cholœpus* * only amongst other families of Edentates.

In the Indian Elephant there is, at least sometimes, a similar but more perfect septum dividing into lateral halves not only the vagina, but the uterus (here provided with a distinct *os uteri*) also †. In other cases this disappears completely, except externally, forming then the so-called "hymen" of Miall and Greenwood.

In the genus *Lagostomus*, on the other hand, as first described by Prof. Owen ‡, the accuracy of whose statement I have lately had an opportunity of verifying, this median septum is developed along the proximal (uterine) part of the vagina, instead of the distal (external) as in *Myrmecophaga* §.

P. Z. S. 1882, p. 299.

As Pouchet, though describing the two apertures, does not mention any median septum, it is possible that this vaginal septum may disappear, as there seems to be good reason for supposing that it does in *Elephas indicus*, in the gravid state. The penis in *Myrmecophaga* is so small that during coitus it is, I expect, entirely contained in the urino-genital tube, and does not enter the vagina, as is also the case in *Elephas*; the disappearance of the vaginal septum can therefore hardly be due, in this species at least, to the non-*virgin* condition of any particular female.

4. As regards other points, I may mention that the external and internal iliac arteries come off separately, as in many other mammals ||, there being no common iliac arteries.

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* "In the Unau (*Bradypus didactylus*) the rudiment of a uterine septum appears as a longitudinal ridge from the inner surface of the anterior wall in the unimpregnated state: in this species also [the same condition having been already noted in *Bradypus tridactylus*], the utero-vaginal canal communicates in the virgin animal by two distinct orifices with the short urogenital tract." Anat. Vert. ii. p. 690.

† M. Watson, "On the Anatomy of the Female Organs of the Proboscidea," Trans. Z. S. xi. p. 116 &c. pl. xxii. fig. 1.

‡ P. Z. S. 1839, p. 177; Anat. Vert. iii. p. 686.

§ A similar condition of things to that here described in the genus *Myrmecophaga* occurs sometimes, it may be observed, as a malformation, known as "*vagina duplex et uterus simplex*," in the human female, the vagina being more or less completely divided into two chambers by a median septum, and opening externally by *two* quite separate orifices. *Cf.* a paper by Dr. T. Matthews Duncan, Journ. Anat. Phys. i. pp. 269–274, and Dr. Morrison Watson's paper, "The Homology of the Sexual Organs illustrated by Comparative Anatomy and Pathology," *l. c.* xiv. pp. 60–62.

|| *Cf.* P. Z. S. 1881, p. 188.

As in *Manis tridentata* as described by Rapp *, the chevron bones in the tail contain a curious caudal *rete mirabile*, composed of both venous and arterial elements, which completely surrounds, as in a sheath, a central artery of large size, which is the direct continuation onwards of the abdominal aorta, and gives off here no branches at all to the *rete*. The arterial elements of this *rete* are derived from several small trunks on each side, which arise from the caudal artery beyond the origin of the internal iliacs, and then break up into a number of more or less parallel, rarely anastomosing, branches, mixed up with which are similar venous trunks. A similar *rete* occurs in *Tamandua*, and also, as I am informed by Prof. Flower, in the Spider Monkeys of the genus *Ateles*.

The paired eyelids are very small, and hardly exist as special organs; there are no eyelashes. The third eyelid, on the other hand, is very large and well developed. It contains a large cartilage of concavo-convex shape; on the internal surface of this eyelid, just below the inferior border of the contained cartilage, opens the minute aperture of the Harderian gland, which is very large, almost completely surrounding the orbit, and concealing the much more minute lachrymal gland. As described and figured by Pouchet, it consists of three chief lobes.

As already suggested by Chatin, I have little doubt that it is the Harderian gland that has been described by Cuvier (Anat. Comp. 2me éd. iv. part 1, pp. 430, 431) and Owen (*l. c.* pl. xl. fig. 3 *b*) in *Cycloturus* as a salivary gland opening into the mouth.

Clavicles are frequently supposed to be absent in the Great Anteater, though present as rudiments in *Tamandua*, and well developed in *Cycloturus* †. P. Z. S. 1882, p. 300.

In the larger specimen of the two examined by me I find, however, a distinct one present on each side, lying in the muscles, about an inch long, nearly straight, of flattened form, with one end cylindrical. Similar ones were also present, closely attached to the sternum, but of smaller size, in the second specimen. Rapp (*l. c.* p. 40) found a rudimentary cartilaginous one in *Myrmecophaga*, though he (erroneously) denies one to *Tamandua*. There is also an accessory ossicle developed at the head of the fibula, as in some of the fossil forms.

In the anterior *cornu* of the hyoid bone, I find in both specimens *three* distinct ossifications ‡. The proximal of these is a small nodule of bone, ·3 inch long, articulating below with the basihyal; it is called the

* *L. c.* p. 92.

† 'Osteology of the Mammalia,' by W. H. Flower, p. 235: London, 1876.

‡ The accounts given by different authors of the composition of the hyoid bones in the Anteaters differ considerably *inter se*. *Cf.* Pouchet, 'Mémoires,' pp. 93–95.

"apohyal" by Pouchet, but, according to the nomenclature now ordinarily employed, must really be the cerato-hyal *. The other two long curved ossifications of the anterior *cornu* must therefore be the epi- and stylo-hyals respectively.

Both Rapp (*l. c.* p. 61) and Pouchet ('Mémoires,' p. 95, pl. xii. figs. 1–3) describe the posterior cornu as articulating externally with the anterior one. But in neither of my specimens can I find any evidence of such a joint, as the two *cornua*, when in their undisturbed condition, are separated by a considerable space, in part occupied by a muscle (the *intercornualis*, Owen, *l. c.* p. 127); and in the cleaned bones I also find it impossible, without violence, to bring the two arches into such contact together. In *Tamandua*, though there is a distinct ligament between the two arches, they are nevertheless similarly separated; and neither Duvernoy †, who dissected this species, nor Owen, in his account of *Myrmecophaga*, allude to any such interarticulation existing; Owen's figure (pl. xxxix. fig. 2) indeed clearly shows the two cornua separated by the *intercornualis* muscle, as also observed by me (*cf.* Plate VIII. fig. 1, *int*).

At the place where the three main ducts of the submaxillary glands of each side converge to become intimately connected together by their walls, though they still remain quite separate tubes, they are covered by a mass of muscle which forms a bulb-like swelling for an extent of $1\frac{3}{4}$ inch on the inferior aspect of the conjoined ducts (Plate VIII. fig. 1). It is this mass of muscles that has been described by Owen (*l. c.* p. 126) as the "*constrictor salivaris*," a name adopted by Pouchet subsequently.

The external aspect of the ducts is also, for the posterior half inch of this space, covered by a thick muscular coating, so that in this portion the three ducts are encircled by a broad ring of muscular fibres. These fibres arise from the anterior edge of the anterior hyoid cornu, on each
P.Z.S. 1882, p. 301. side of the junction of the stylo- and epihyal bones; running then forwards and outwards, they pass *beneath* and to the outside of (in a sternal view) the conjoined ducts, and then ascend to fan out and form the muscular bulb. The more anterior of these fibres are inserted into the internal and upper part of the combined ducts, and cease there. The most posterior, on the contrary, completely encircle the ducts, running inwards over the ducts, and then, recurving on themselves, ascend on the deep aspect of the ducts, to be inserted on the stylohyal

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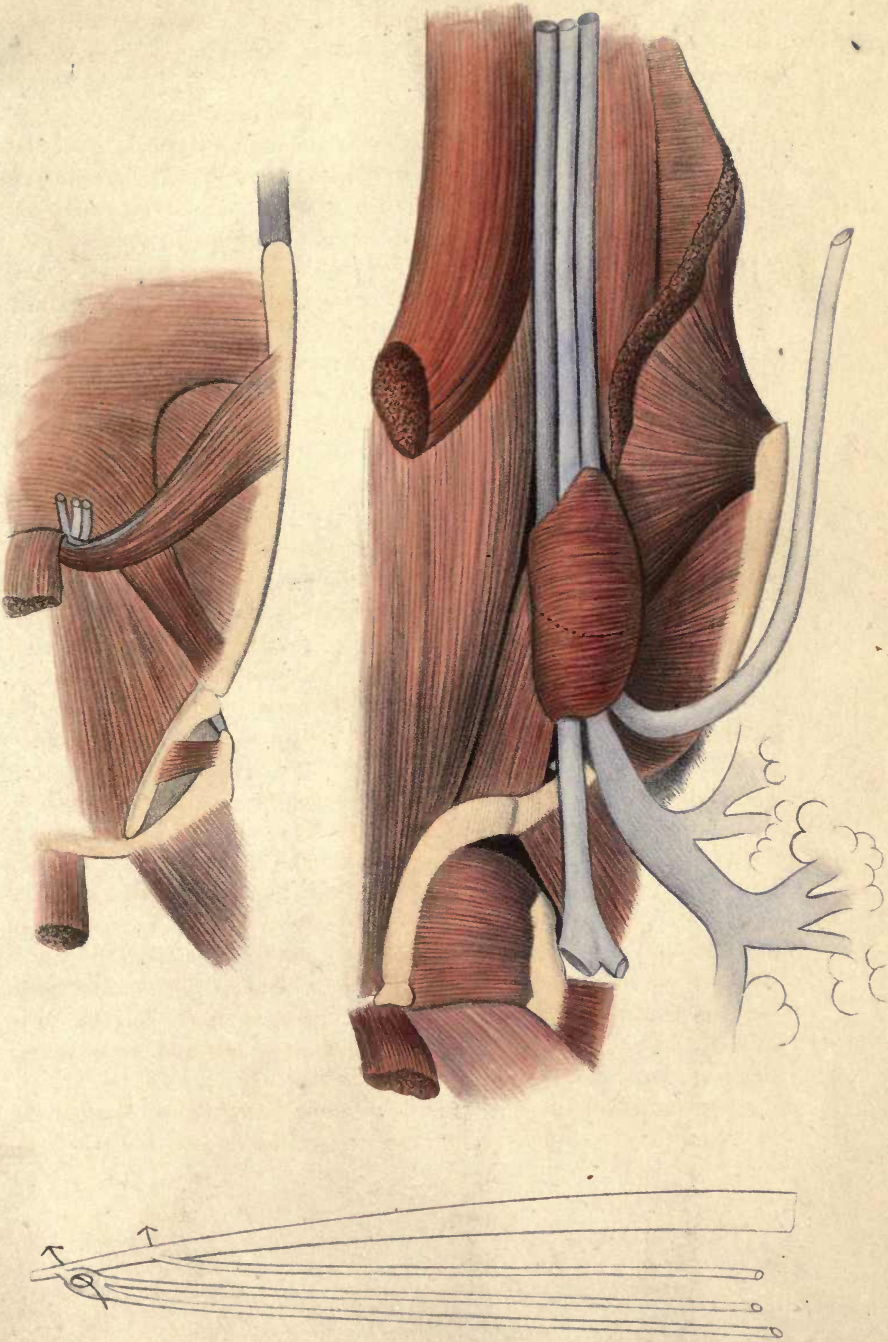
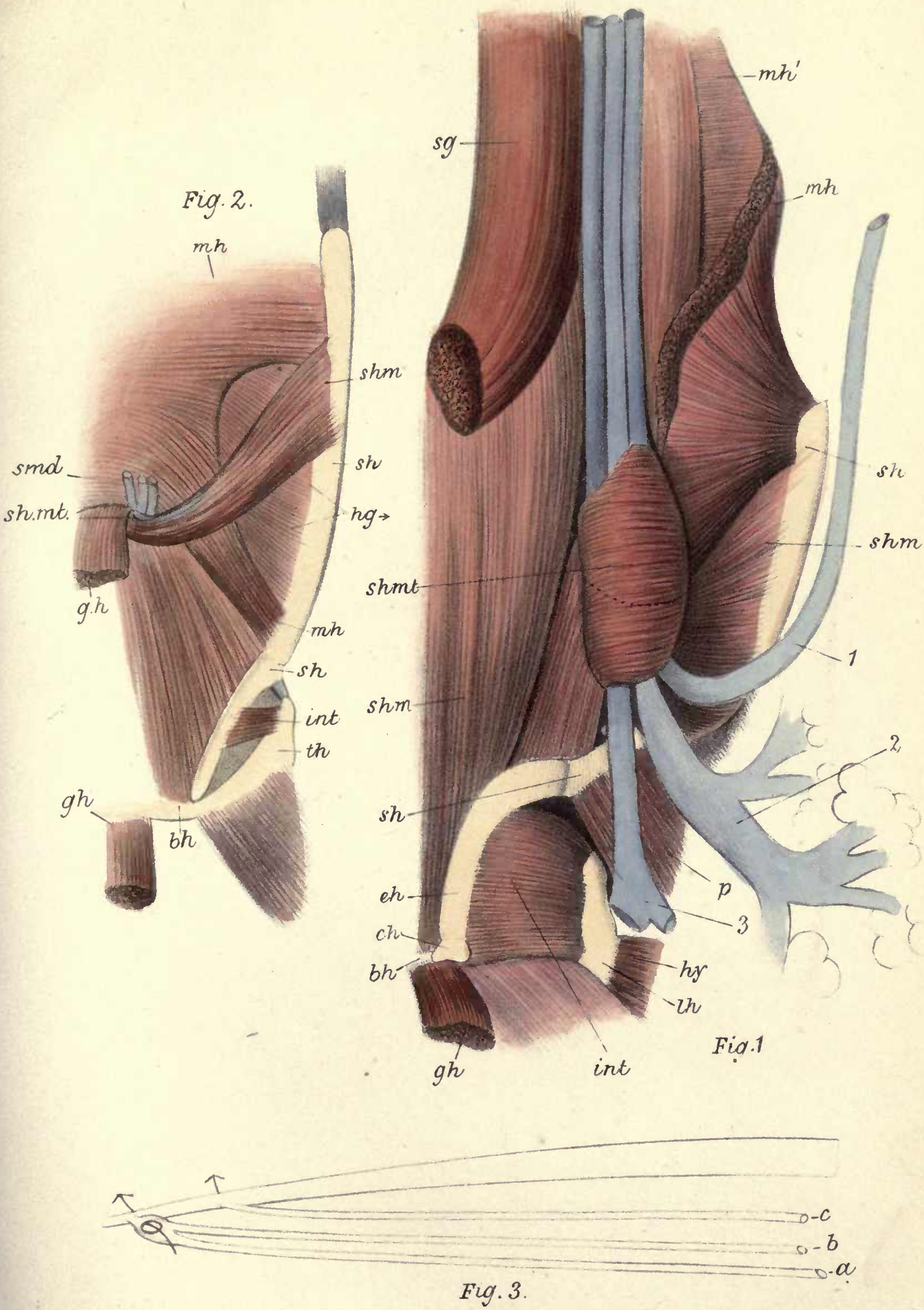
* In *Tamandua* I am unable to find any corresponding ossification, though both the epi- and stylo-hyals are well developed.

† Mém. Soc. Hist. Nat. Strasbourg, 1830; and Cuvier's Anat. Comp. 2me éd. iv. part 1, p. 476.





J. Smit lith. Hanhart imp.

ANATOMY OF MYRMECOPHAGA.

bone for the greater part of its length, not, however, extending to either of its extremities. Along the anterior (free) border of the ascending part, at the point where it is in contact with the ducts and the deep part of their muscular ring, is developed a strong tendinous edge (*s.h.m.t.*), the "commissural tendon" of Owen.

The muscular fibres inserted on this and attached to the stylohyal (ceratohyal of Owen's nomenclature) are described by that author as the "*cerato-hyoideus,*" whilst Pouchet more correctly applies to it the name of "*stylo-hyoideus,*" the rest of the muscular arrangement here described forming, as already stated, the "*constrictor salivaris*" of both authors.

It appears to me that the whole muscle may be more correctly considered as the *stylo-hyoideus*, which has developed this remarkable course round the submaxillary ducts in order to aid the ejaculation of the saliva therein contained by the constriction, on contraction of the muscle, of their walls between the circularly-disposed fibres surrounding them and the tendon developed on its anterior margin.

In the genus *Tamandua** (Plate VIII. fig. 2) there is no special muscular envelope developed round the ducts in this position. The most posterior fibres of the *mylo-hyoideus* (*m.h'*) arise from the posterior end of the stylo-hyal bone, running inwards and forwards, and blending internally with the genio-hyoid. To this point also run *backwards* and inwards the fibres of a narrow flattened muscle (*s.h. m*), which crosses the hyoid origin of the mylo-hyoid superficially, and, as it arises from the stylo-hyal bone, must be considered to represent a *stylo-hyoideus.* At the point where it meets the genio-hyoid and mylo-hyoid, all three muscles become closely connected together, the stylo-hyoid developing here an anterior tendinous edge (*s.h.m.t*). Between this tendon and the conjoined mylo-hyoid and genio-hyoid run the three ducts of the submaxillary gland, so that contraction of these muscles here also serves a purpose similar to that produced by the more specialized arrangement found in the larger species.

[P.S. July 13, 1882.—I have found the disposition of the salivary ducts and the arrangement of the *stylo-hyoideus* muscles exactly the same as those here described in a third specimen of *Myrmecophaga* just dead.—W. A. F.]

EXPLANATION OF PLATE VIII.

Fig. 1. Dissection of the left suprahyoidean region of *Myrmecophaga jubata*, to show the course and relations of the *stylo-hyoideus* muscle. *s.h*, stylohyal; *e.p*, epihyal; *c.h*, cerato-hyal; *b.h*, basihyal; *t.h*, thyro-hyal; *s.h. m'*,

P. Z. S. 1882, p. 302.

* *Cf.* Duvernoy, Mém. Strasb. 1830, "Mémoire sur la langue" &c., p. 3.

origin of the *stylo-hyoideus*; *s.h. m*, its insertion; *s.h. m. t*, its tendinous edge (this, being deep of the muscle and ducts, is diagrammatically represented by a dotted line); *m.h*, *m.h'*, *mylo-hyoideus*, cut and reflected; *s.g*, *sterno-glossus* (cut short); *g.h'*, *genio-hyoideus*, at its origin, cut short and reflected; *h.g*, *hyo-glossi*; *ep*, *epipharyngeus* (Owen); *hy*, *hyopharyngeus* (Owen); *int*, *intercornualis*; 1, 2, 3, the three ducts of the submaxillary gland, converging to be surrounded by the *stylo-hyoideus*.

Fig. 2. The same parts in *Tamandua tetradactyla*, enlarged. The letters as before, except *s.h.m*, *stylo-hyoideus* muscle, with its anterior tendinous edge (*s.h.m.t*), blending here with the mylo- (*m.h.*) and genio-hyoid (*g.h*) muscles, and surrounding the three submaxillary ducts (*s.m.d*), which are cut short and reflected; *m.h'*, hyoid origin of the mylo-hyoid.

3. Diagram to show the openings into the mouth of the three ducts of the submaxillary gland in *Myrmecophaga*. *a*, *b*, the two ducts from the more posterior parts of the gland, opening together; *c*, the third duct, from the cervical part, opening posteriorly to the other two ducts.

P. Z. S. 1882, p. 442.

52. NOTE ON AN ABNORMAL SPECIMEN OF *PITHECIA SATANAS*.*

A young male specimen of *Pithecia satanas*, which was lately forwarded to the Society's Gardens, and died shortly after its arrival, presented an abnormal condition that is perhaps worth recording in the Society's 'Proceedings.'

The peculiarity consists in the completely "webbed" condition of the third and fourth digits of the manus on each side, these two fingers being completely connected together down to their tips by a fold of nude skin, and with their nails closely apposed, though not connected, along their contiguous margins. The other digits of the hands, as well as all of those of the feet, are quite normal, the webbing of them not extending beyond the middle of the first phalanx.

The case is interesting, partly as affording an excellent instance of an abnormal condition affecting homologous parts of opposite sides in an exactly similar way, and partly as showing that the lower Primates are subject, occasionally, to a condition of things which, as is well known, also occurs not at all rarely in Man.

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* Proc. Zool. Soc. 1882, p. 442. Read May 16, 1882.

53. SUPPLEMENTARY NOTES ON THE ANATOMY OF THE CHINESE WATER-DEER (*HYDROPOTES INERMIS*).* P. Z. S. 1882, p. 636.

An adult male of this curious Deer having lately passed through my hands, it may be advisable to record my notes on certain of its soft parts, on the condition of which the late Prof. Garrod laid considerable stress in the classification of the Ruminants, but some of which were, I believe, unknown to him, the specimen of *Hydropotes* described by him † having been a young (in fact still-born) example of the opposite sex.

As regards the male organs of generation, the *glans penis* is an elongated tapering compressed cone, with the urethral opening subterminal, thus closely resembling those of *Capreolus*, *Cervulus*, and *Elaphodus*. There are no traces of Cowper's glands, as is also the case in the first and last of the three genera just named. In these respects, then, *Hydropotes* resembles most closely *Capreolus* and *Elaphodus*, and differs from the Rusine Deer, with which, according to the views of Sir Victor Brooke at one time ‡, in part indorsed by Garrod §, it was supposed to have perhaps its closest relations. The large "rusiform" Spigelian liver-lobe, which was found by the last-named anatomist in the young of *Hydropotes*, and the presence of which he adduced as supporting those views, is, however, quite absent in the liver of the present specimen. There is a similarly situated "spurious cystic fossa," containing, however, no gall-bladder, only a minute almost atrophied cord, of apparently vascular nature. The caudate lobe is well developed.

In the rumen of the stomach the villi, where best developed, are pretty uniformly filiform, slightly flattened, but not clavate. The reticulum-cells are rather shallow. The psalterium has, as I count, nine primary laminæ, and is quadruplicate. P. Z. S. 1882, p. 638.

The length of the intestines in the present specimen (the body of which had a total length of 33 inches, including the three-inch-long tail) was 29 feet 2 inches, 21 feet 7 inches being small intestine, the remainder (7 feet 7 inches) colon and rectum. The relative lengths, therefore, of these parts were not very different from those that obtained in the younger individual already described. The cæcum was three inches long. There were $2\frac{1}{2}$ coils in the colic spiral; and at the junction of the ileum and cæcum is a distinct glandular patch, like a largish "Peyer's patch,"

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* Proc. Zool. Soc. 1882, pp. 636–638. Read Nov. 14, 1882.

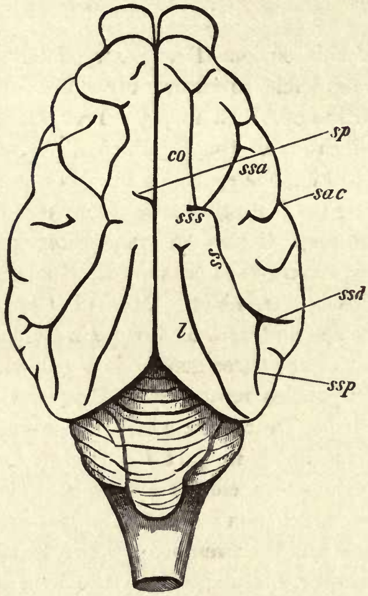
† *Cf.* P. Z. S. 1877, p. 789, and Coll. Papers, pp. 422–425.

‡ P. Z. S. 1872, p. 525.

§ Coll. Pap. p. 425.

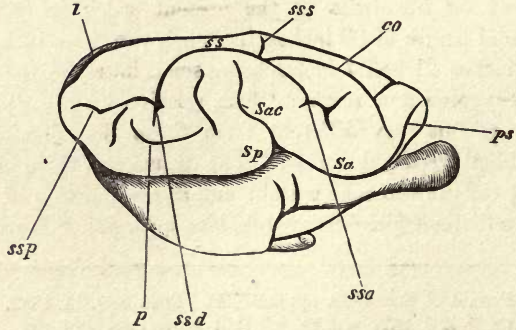
P. Z. S. 1882,
p. 637.

Fig. 1.



Upper surface of brain of Chinese Water-Deer.

Fig. 2.



Side view of brain of Chinese Water-Deer.

though not having the complex structure of the ileo-cæcal gland met with in *Moschus*, *Cervus*, *Camelopardalis*, &c. P. Z. S. 1882, p. 638.

The only figure hitherto extant (that given by Prof. Garrod in his paper already quoted) of the brain of *Hydropotes* having been taken from a very young specimen, it may be worth while to give figures of the superior and lateral aspects of that removed from this adult specimen, which will be useful for comparison with Garrod's earlier one, as well as with those given by that author and Prof. Flower of the brain in *Elaphodus*, *Moschus*, and *Pudua*, and with the series of semidiagrammatic sketches illustrating Dr. Krueg's valuable paper on the cerebral convolutions of the Ungulata generally *, whose nomenclature on the subject I have also adopted.

In its cerebral organization *Hydropotes* approaches the genus *Capreolus* more nearly than any other Cervine form known to me, the similarity of the two being obvious on comparison of the figures now exhibited (see p. 314) with those of Leuret and Gratiolet † and of Krueg ‡ of the Roe. From *Elaphodus* and *Pudua* these two forms differ in the entire disappearance (save very slightly anteriorly) of the calloso-marginal ("splenial") sulcus from the superior aspect of the hemispheres, owing to the greater "pronation" of their brain generally.

Sir Victor Brooke has been led, from a consideration of other points §, to associate *Hydropotes* and *Capreolus* with *Alces*, as a group *per se*, with affinities in some points in the direction of the Old-World (Plesiometacarpal), in others in that of the New-World (Idiometacarpal) forms. It appears to me that the additional evidence in this paper, especially that derived from the resemblance of the generative organs, is strongly in favour of this association, so far, at least, as *Hydropotes* and *Capreolus* are concerned. The general similarity in *facies* of *Capreolus* to *Hydropotes* has often struck me, and has even, I believe, led others into the error of mistaking one for the other!

That *Hydropotes* is in no way intimately related to *Moschus* was already amply demonstrated; and the latter form also differs, as we now know, in the conformation of its glans penis and in the possession of Cowper's glands.

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* Zeitschr. f. wissenschaftl. Zool. xxxi. pp. 297–344. *Cf.* also Garrod, Coll. Papers, pp. 512–517.

† Anat. Syst. Nerveux, Atlas, pl. x.

‡ *L. c.* pl. xxi.

§ P. Z. S. 1878, p. 889.

T. Z. S. 1882, xi. p. 225.

54. NOTES ON THE EXTERNAL CHARACTERS AND ANATOMY OF THE CALIFORNIAN SEA-LION (*OTARIA GILLESPII*).*

(Plates IX.–XI.)

Of late years numerous specimens of the Californian Sea-lion (*Otaria gillespii*) † have been brought alive to Europe and exhibited in the Zoological Gardens and Aquaria of England and the Continent. A pair, the male of which has lately died, lived long at the Brighton Aquarium, and on two occasions bred, one of the cubs being now a fine adolescent male. Another pair were received in the year 1877 at the Southport Aquarium. Of these the female was killed accidentally some fifteen months ago, as already noticed in the Society's 'Proceedings' (1879, p. 460). Unfortunately no further use seems to have been made of her body, though the skull was exhibited at one of the Society's meetings, and determined by Prof. Flower as belonging to this species (*l. c.* p. 551). The male did not long survive his partner, but, gradually pining away, died last spring. Mr. C. L. Jackson, the Superintendent of the Aquarium, having forwarded this animal after its death to Prof. Flower, our President, being at that time much occupied with other duties, was kind enough to hand it over to me for examination and dissection.

Till within a few weeks ago our knowledge of the Californian Sea-lion was extremely limited, all that was known about it being contained in Mr. J. A. Allen's account of the species in his article on the "Eared Seals" (Bull. Mus. Comp. Zool. ii. pp. 69–73, 1870–71). At that time his only materials, as regards the present animal, were two skulls and a skeleton; and for his description of the skin he had to depend upon Schlegel's (*i. e.* Temminck's) account of *Otaria stelleri* in the 'Fauna Japonica,' which at that time, following Dr. Peters's identification, he regarded as being in reality *O. gillespii.*

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* Trans. Zool. Soc. vol. xi. part vii. pp. 225–231, Pls. XLVIII.–L. (1882). Read April 5, 1881.

† Mr. J. A. Allen, in the second of his valuable memoirs mentioned below, uses the name *Zalophus californianus* for the present species. I am not yet prepared to split up the, in many ways, very natural genus *Otaria* into several genera, founded, as these are, almost entirely upon cranial characters. As regards the genus *Zalophus*, it may be noted that Mr. O. Thomas has lately noticed a skull of *Otaria jubata* with the same number of molars as are supposed to characterize that genus (P. Z. S. 1881, p. 4).

As regards the specific name, the *Otaria californiana* of Lesson was based, as Mr. Allen states, on a drawing published by Choris in 1822, which is called by Mr. Allen himself "a rather poor figure," and has hitherto been referred to *O. stelleri*. As there can be no doubt as to the species intended by MacBain's name *gillespii*, and as that name, too, has hitherto been used by nearly all writers on the subject, I think it will be better to retain it.

Since the subject of the present paper passed through my hands Mr. Allen's elaborate 'History of North-American Pinnipeds' (Washington, 1880) has been published, and our knowledge of *Otaria gillespii* much increased thereby, Mr. Allen having been able to examine many skins and skeletons of the species, as well as to give full details of its habits in a state of nature. A good figure, however, of this species still remains a desideratum. The drawings accompanying this paper having been made from the fresh animal by Mr. Smit (under my own supervision), their publication will, by filling up this blank, tend to still further complete our knowledge of this animal. The detailed measurements and description of the adult male examined will also still further supplement Mr. Allen's account, whilst the notes on the anatomy of the soft parts, hitherto unknown in this species, will perhaps also be acceptable, as confirming, or adding to, our knowledge of these parts as described in Dr. Murie's elaborate and exhaustive treatise on *Otaria jubata**. T. Z. S. 1882, xi. p. 226.

The animal examined by me was a male, perhaps adult, but by no means aged, as may be seen from the condition of its teeth and skull, now preserved in the College of Surgeons. The Brighton animal, already alluded to, was probably somewhat older, as I am informed by Prof. Flower.

The following measurements were taken, by means of calipers, on the unskinned animal:—

	inches.
Greatest length, from nose to end of hind limbs	92·0
Length from nose to tip of tail	81·5
From nose to prominence in shoulder-joint	23·5
Length of head, to end of the sagittal crest	10·5
Length of tail, from naked skin at base	4·4
Tip ,, from anus	5·4
Length of pectoral limb, from shoulder-joint	30·0
Breadth ,, ,, at axilla	6·25
Length of pelvic limb, from the anterior extremity of ilium	27·0
Breadth of pelvic limb, at base	3·5
Greatest breadth of pelvic limb, when the fin is expanded	7·6
Distance between anus and preputial orifice	8·5
Length of ear	1·75
,, eye	1·15
Distance between eye and ear	3·25
,, ,, nose and eye	4·75
,, from chin to angle of mouth	3·85
Depth of muffle	1·25
Breadth of ditto	1·25

* "Researches on the Anatomy of the Pinnipedia. Descriptive Anatomy of the Sea-lion (*Otaria jubata*)," Trans. Zool. Soc. vii. pp. 527–596; viii. pp. 501–582.

T. Z. S. 1882, xi. p. 227. There are four mammæ, abdominal in position. The posterior pair, situated about 2 inches from the middle line, are 5·75 inches in front of the opening for the penis; the anterior ones, which lie about 3 inches from the middle, are 10·25 inches in front of these.

There is no true scrotum; but a bare patch of dark, rugose skin surrounds the anus for about 4 inches each way. This did not in the least hang down; neither did the testes project into it at all, though possibly at certain times of the year they may descend into this sort of rudimentary scrotum, or the descent may even be regulated by the condition of the animal.

No such distinct, *Balænoptera*-like pectoral plaits of skin as those figured by Dr. Murie in *Otaria jubata* (*l. c.* pl. lxix. fig. 7) could be made out here. There are a few indistinct lines of folding in the region of each axilla; but their presence seems due to the "lie" of the hairs, and not to any real growing or elevation of the skin, their situation probably depending on the position of the body.

No underfur could anywhere be found. The skin itself, where hair-covered, is pale flesh-coloured.

The following description of the pelage was taken from the animal as it lay, after having been thoroughly dried for a day or two.

The general tint is dark umber-brown, darkest and blackest on the neck, brownest on the back, and lightest on the chest. The muzzle is lighter brown. On the chest and pectoral limbs the coat is very glossy; on the pelvic limbs it is less so. The hairs of the head and neck are chiefly deep black-brown, tipped with pale brown; mingled with these are numerous white ones, which are most numerous on the sides of the head, and on the sort of crest along the top of the head, the hairs here being rather longer than elsewhere. The space round the eyelids is slightly reddish; and there is a pale spot above the eyes. Between the eyes the hairs are shorter, and of a reddish-brown colour. The eyebrows are represented by three, or, on the right side, two small curved hairs of pale colour, slightly marked with darker; the median hair is much the longest. Round the nose the hairs are brown and dirty white. The sides of the face below and above the lips, as well as the chin, are pale rufous-brown; but the margins of the lips themselves are everywhere dark. In the region whence the whiskers arise the cheeks are mottled with dark brown and dirty white hairs. The whiskers are about thirty-five in number on each side, arranged pretty regularly in six horizontal rows. The uppermost row of these contains only three whiskers, all small and short; but below and posteriorly they increase in size and number. The longest row has about seven whiskers. The greater part of the whiskers are white, including all the longer ones; but some three or four on each side are blackish.

The ears are covered with shorter, dirty white and grey hairs.

Behind the shoulders, along the back and upper parts, the tips of the hairs get lighter brown; and mixed with them are numerous entirely pale-brown ones; so that in these regions the general colour of the coat becomes much lighter, inclining to a mottled yellowish-brown tint. T. Z. S. 1882, xi. p. 228.

The sides of the neck are darker in colour than any other part of the body, the hairs here being very deep black-brown, with very few pale ones intermixed. These latter hairs increase in number towards the head, whilst posteriorly the hairs get shorter, paler, and more tipped with yellow, so that the dark colour of the neck passes gradually into the greyer tint of the head and the browner hue of the back.

On the flanks, belly, and lips the yellowish-brown hairs and tips disappear, and the general colour in consequence becomes a dark rich brown, with a vinous tinge in some lights, particularly observable on the anterior parts of the pectoral limbs. The tail is rich brown in colour. On the chest and between the pectoral limbs the hairs become much shorter and yellowish-grey in colour; but both the shortness of the hair and the colour are, I believe, accidental, caused by the wearing-away of the hairs here by the animal's position when in repose.

The pectoral fins (Pl. XI. fig. 1) are above covered with closely appressed, short hairs, which are black for the greater part of their length. There are no light-tipped hairs at all on the "fin" below the humerus. The thickened convex radial margin, from halfway down the first metacarpal for a breadth of about an inch, as well as the ulnar side from two inches above the last nail, are naked; the line of hairs runs along some little way proximad of the nails, leaving the rest of the "fin" naked. Below, the flippers are quite naked from a transverse line extending across a little proximad of the carpal joint; the bare skin is marked by numerous, subparallel, wrinkle-like lines.

On the hind limbs (Pl. XI. fig. 2) the hairs extend above along the ridges of bone nearly to the nails; the margins for some way, as well as the skin between and below the nails, are naked. Beneath they are naked from nearly the base of the free part.

The accompanying Plate (IX.) represents to the right the male specimen from the Southport Aquarium, from a drawing by Mr. Smit, taken from the animal when thoroughly dried. The attitude and position, however, are from a sketch made by him of the adult specimen of the same species at the Brighton Aquarium, taken a few weeks before its death. The figure to the left represents the female specimen at Brighton, and is also taken from life; it represents the animal, however, when wet. The smaller size and different coloration of this sex are well shown in it, as well as the difference in the contour of its head, due to the non-development of the great sagittal crest, which is such a conspicuous feature of the male. The small distant figure in the same Plate represents the male animal with its coat wet. On the second Plate (Pl. X.)

the head of the male Southport specimen is represented of half the natural size*.

As regards the visceral anatomy, it, as might have been expected, conforms closely to that of *Otaria jubata*, with some few minor differences. I did not examine the brain, which is now mounted in the College of Surgeons' Museum.

T. Z. S. 1882, xi. p. 229. The tongue is bifid at the apex. There are only three large, pitted, circumvallate papillæ, arranged in the usual reversed V; the *radix linguæ* behind these is covered with many free papillæ or processes. The stomach is much like that of *Otaria jubata,* as depicted by Murie (*l. c.* pl. lxxxi. fig. 65), but is less globular and more elongated. Internally the mucous membrane is soft, and raised up into numerous well-defined rounded rugæ, which are very irregular in disposition, curving about in all directions. In the pyloric part these folds quite disappear. When undistended, the greatest transverse length of the stomach is 16·5 inches, and its depth, opposite the pylorus, 8·75 inches. Along the greater curvature it is 29 inches. The pyloric part, which is bent back towards the cardiac part, is 4·5 inches long, measured from the angle it makes with the rest of the organ. At the pylorus the stomach is about 2 inches across. All these dimensions, except the extreme length, are a little smaller than Dr. Murie's corresponding figures (*l. c.* pp. 560, 561).

The small intestine is quite without rugæ of any kind, but is covered with very minute villi. The large intestine has only a few slight longitudinal rugæ, but is otherwise smooth. The cæcum is,—as in *Otaria jubata*, a short, simple, conical prominence, projecting backwards for ½ inch. The length of the small intestines is 106 feet 11 inches; of the large, 6 feet 7 inches. In the *Otaria jubata* dissected by Murie the total length of the intestines was only 65 feet 2 inches.

The great size of the *vena cava* and hepatic vein causes the comparatively small liver-lobes to be, as it were, developed round them. All the six lobes of the typical mammalian liver can be clearly made out, they being much separated from each other by the great development of all the chief fissures. Thus the umbilical fissure extends for at least three fourths of the depth of the liver; and the cystic fissure is nearly as well developed, almost completely dividing the right central lobe into two. The lateral lobes are not united by any hepatic tissue at all to the central lobes, but are simply connected to them by means of the great vessels and connective tissue. The right lateral, the two parts of the right central, and the left central lobe are all comparatively long and narrow, the last particularly so; the left lateral, on the other hand, is of an irregularly square shape. The caudate and Spigelian lobes are small compared with the others, and are very freely attached. Both are of irregular shape, the caudate being somewhat forked externally; they

* [The Plate as here given is *one-fourth* of the original.]

are nearly, though not quite, united by a very thin bridge of hepatic tissue developed between them over the broad *vena cava.* The round and suspensory ligaments are well developed. The gall-bladder is elongated, and appears on the superior aspect of the liver. As compared with Dr. Murie's figure (*l. c.* pl. lxxxii. fig. 72) of the liver in *Otaria jubata,* that of the present species differs chiefly in the more regular outlines of its lobes, and the much smaller development of additional sulci on its inferior aspect, in these respects more resembling the liver of ordinary Mammalia, and presenting less approximation to the greatly complicated liver of the Seals.

The pancreas is compact, and of a creamy-red colour. From its extremity it measures 9·75 inches to its "head," and 11·75 inches to its "tail." The duct, as far as could be ascertained, opened into the *ductus choledochus* as the latter perforated, in a very oblique direction, the wall of the small intestine. T. Z. S. 1882, xi. p. 230.

As regards the vascular system, the aorta gives off the great vessels in a way different from that described and figured by Murie in *Otaria jubata.* In the latter species the aorta gives rise successively to a right innominate, a left carotid, and a left subclavian, as in Man and many other animals. In *Otaria gillespii* an innominate gives off both left and right carotids close together, continuing on as the right subclavian, which then gives off two smaller trunks, which are apparently the right internal mammary and vertebral arteries; the left subclavian arises independently from the aortic arch, just beyond the origin of the innominate, and also gives off, not far from its origin, two corresponding branches. The ductus arteriosus is conspicuous.

The trachea is very wide, measuring about 2½ inches transversely, and is somewhat dilated at the bronchial bifurcation, being here about 3 inches across. From the right main bronchus, 4 inches below its origin, is given off an extra third bronchus to the uppermost lobe of the lung on that side. Each lung is divided into three distinct lobes, of which the lowermost of each side is the biggest, whilst the middle ones are the smallest. The left upper lobe is deeply divided anteriorly. There is a distinct azygos lobe in addition, of subtriangular shape. The epiglottis hardly exists as a free organ; it has tumid margins, and a median sulcus. The arytenoid and thyroid cartilages are much produced superiorly *.

The spleen is flattened and elongated, with one end slightly broader than the other. It measures 13¾ inches in length, and 3 inches across. The thyroid glands are the size of Brazil nuts, and are quite separate from each other.

* Not having been able to dissect the larynx, which is now mounted in the College of Surgeons, I am unable to describe its internal structure. There are, however, small laryngeal pouches, connected with the lateral ventricles, and opening in the same position as those described by Murie in *O. jubata* (*l. c.* pl. lxxx. fig. 59).

The kidneys are compound, and are composed of about forty quite distinct papillæ, in each of which the cortical and medullary parts are as distinct as in Murie's beautiful figure of the same organs in *Otaria jubata* (*l. c.* pl. lxxxi. fig. 70).

The male generative organs have been preserved as a preparation in the College of Surgeons; so I have not been able to examine them thoroughly. The testes, as already stated, did not lie in any distinct pedunculated scrotum, but were situated in the groin, close to the naked skin round the anus. There is apparently a small prostate, like that in *O. jubata* (*l. c.* pl. lxxxii. fig. 73); but both *vesiculæ seminales* and Cowper's glands are absent. The penis (Pl. XI. fig. 3) has a large *os*, which is bifurcated at the apex. This bone in the glans is only covered by a thin coating of pale mucous membrane, which is continued also onto the prepuce. The length of the glans, from the reflected prepuce to the apex, is 2·8 inches; the notch between the superior and inferior ends of the bifurcated *os* is slightly filled up by the coating of mucous membrane, the urethra opening just behind the *lower* end of the *os*, on the inferior aspect of the glans. About an inch from the apex of the penis the mucous membrane is developed into a sort of reflected corona of loose skin; if this is expanded it forms on each side a sort of triangular flap, attached dorsally and ventrally to the median lines of the penis (*vide* fig. 3 *a*, Pl. XI.). This description differs in several particulars from that given by Dr. Murie; but his specimen had sustained a fracture of the penis, and consequent damage to the glans, so that the decrepancies of the two may be due to accidental causes.

T. Z. S. 1882, xi. p. 231.

Until examples of other species and more specimens of these animals have been dissected, it will be impossible to say how much taxonomic importance ought to be attached to certain differences between *Otaria jubata* and *O. gillespii*, indicated in the present communication; but at present the anatomical evidence seems to be in favour of retaining the two forms under a common generic title, as is here done.

DESCRIPTION OF THE PLATES.

Plate IX.

Fig. 1. ♂ *Otaria gillespii*, from the specimen lately in the Southport Aquarium (coat dry).

2. ♀ *Otaria gillespii*, from the specimen formerly living in the Brighton Aquarium (coat wet).

Plate X.

Head of ♂ *Otaria gillespii*: ½ natural size.

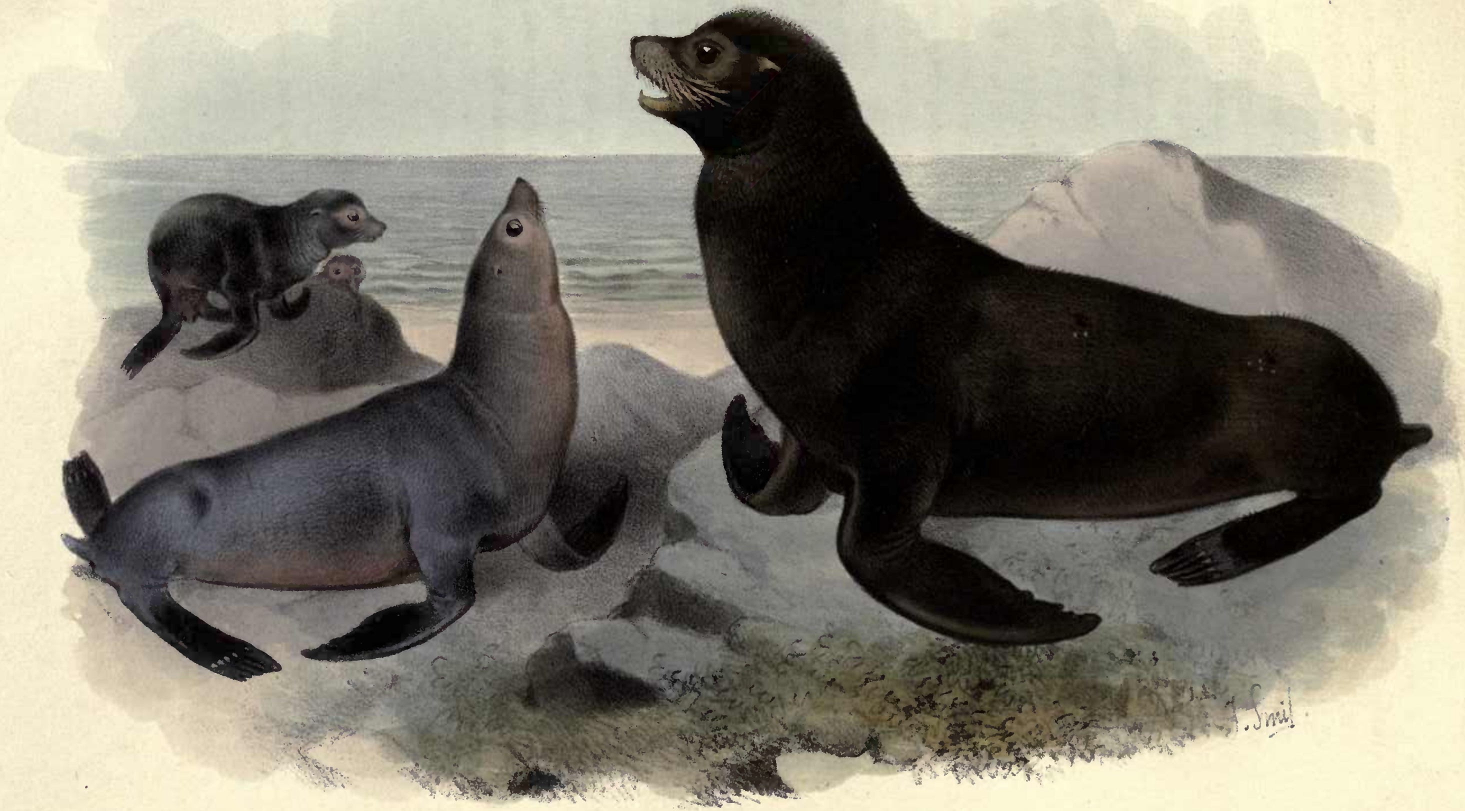
Plate XI.

Fig. 1. Pectoral fin of *O. gillespii*: ½ natural size.

2. Pelvic fin of *O. gillespii*: ½ natural size.

3. Glans penis of *O. gillespii*: about natural size.

3 *a*. The same, viewed from the front.



J. Smit lith.

Hanhart imp.

OTARIA GILLESPII.

J. Smit lith.

Hanhart imp.

OTARIA GILLESPII.

J. Smit lith.

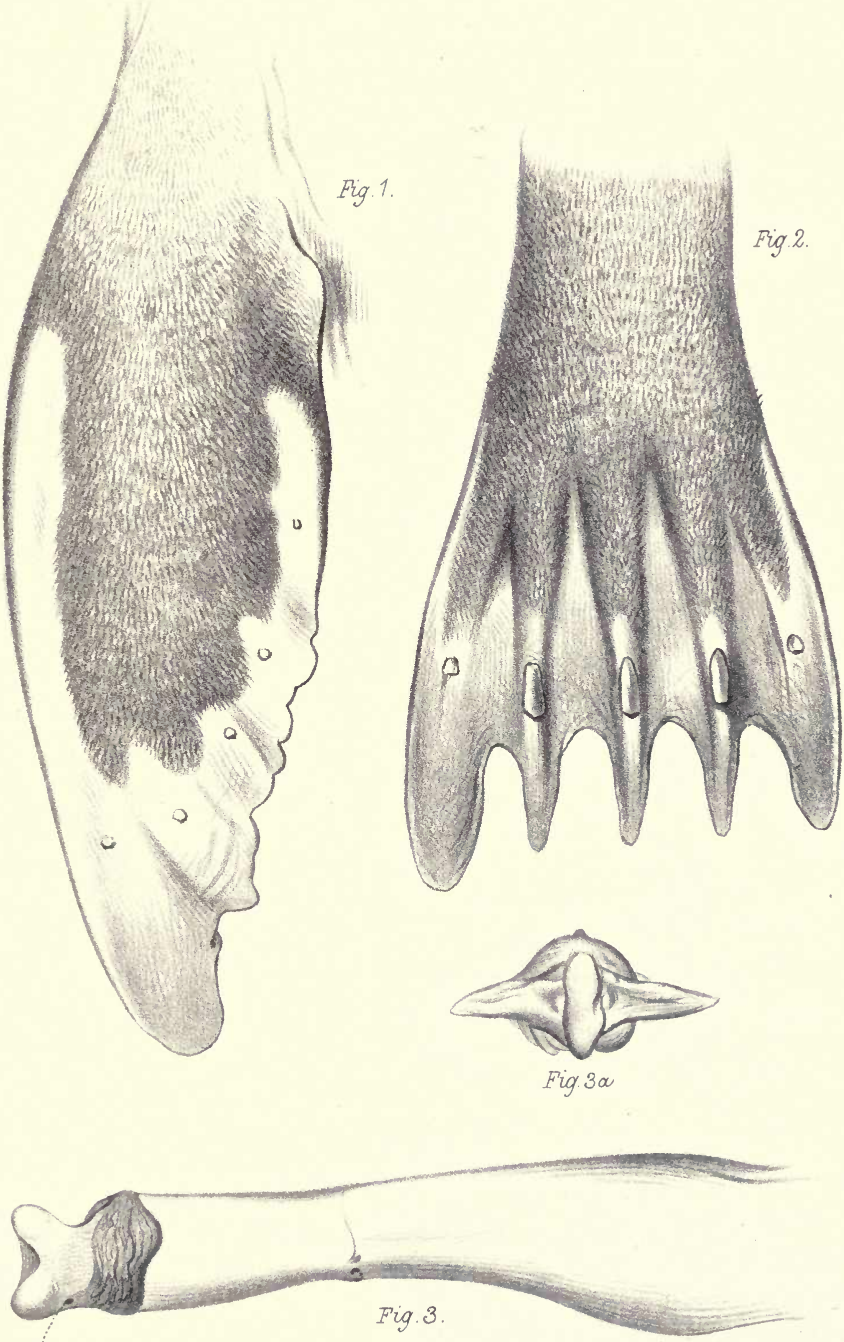
Hanhart imp.

HEAD OF MALE OTARIA GILLESPII.
(One fourth the Size of Nature.)

J. Smit lith.

Hanhart imp.

HEAD OF MALE OTARIA GILLESPII.
(One fourth the Size of Nature.)



J. Smit lith

Hanhart imp.

ANATOMY OF OTARIA GILLESPII.

Trans. Zool. Soc. Vol. XI. Pl. 50.

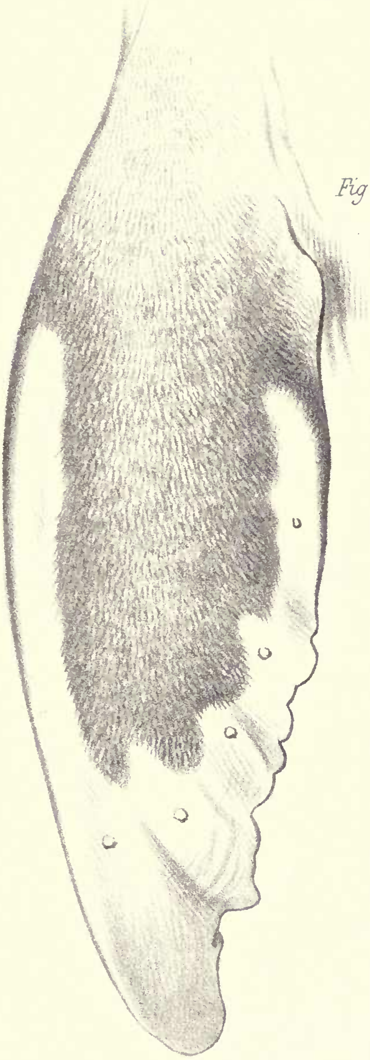


Fig. 1.

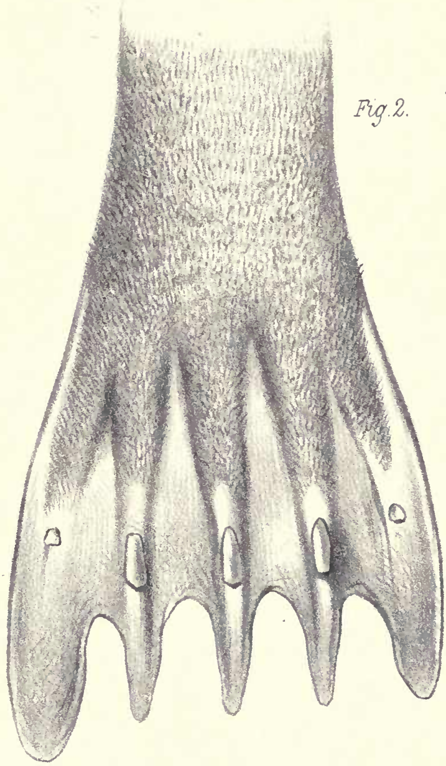


Fig. 2.

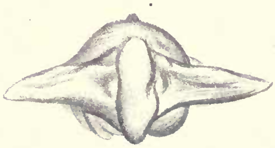


Fig. 3 a

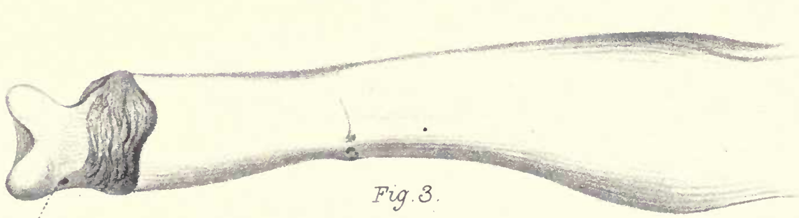


Fig. 3.

J. Smit lith.

Hanhart imp.

ANATOMY OF OTARIA GILLESPII.

55. NOTE ON THE GALL-BLADDER, AND SOME OTHER POINTS IN THE ANATOMY OF THE TOUCANS AND BARBETS (*CAPITONIDÆ*).*

P. Z. S. 1882, p. 94.

THE statement has been made, and copied†, that a gall-bladder is absent in the Toucans. The latest writer on the visceral anatomy of birds, Dr. Hans Gadow ‡, describing the gall-bladder of the "Coccygomorphæ," says:—"*Rhamphastus* compensirt *das Fehlen der Blase* durch einen sehr langen (9 cm.) und weiten Ductus Choledochus" (*l. c.* p. 70).

On dissecting, therefore, some months ago a fresh specimen of *Pteroglossus wiedi*, I was considerably surprised to find a peculiarly long and tubular gall-bladder, which lay superficially, covering the other abdominal viscera and extending far down in the abdominal cavity, its fundus nearly reaching the cloacal region of the intestine.

My attention having been thus called to the point, I have since, whenever opportunity has offered, always looked for this viscus, and have now ascertained its presence in specimens of *Rhamphastos carinatus*, *vitellinus*, and *dicolorus*, *Pteroglossus wiedi* (3), *Selenidera maculirostris*, and *Aulacorhamphus prasinus*. The annexed drawing (fig., p. 324) will show its general form and relations, as seen in a fresh specimen of *Rhamphastos dicolorus*. In the specimen figured the total length of the gall-bladder was not less than 4·15 inches. The cystic duct originated ·85 inch from the liver, and was 1·7 inch long. In other cases the duct arises much nearer the portal fissure. Its presence, therefore, in all Toucans is nearly certain §.

It is also present, of exactly the same general form, and with the same relations, in all the Capitoninæ I have examined as regards this point, namely *Megalæma virens* (a fresh specimen), *M. franklini*, and *Xantholæma rosea*. Its presence in *Indicator* in a similar form is almost certain, from

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* Proc. Zool. Soc. 1882, pp. 94–96. Read Jan. 3, 1882.

† Owen, Anat. Vert. ii. p. 177; Macalister, Morph. Vert. p. 194; Crisp, P. Z. S. 1862, p. 137.

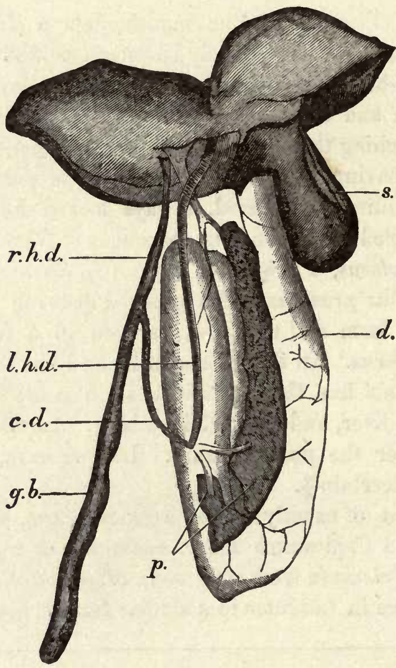
‡ "Versuch ein. vergleich. Anatomie des Verdauungssystemes d. Vögel," Jen. Zeitschr. xiii. n. F. vi.

§ It is but due to the late Prof. Garrod to say that he also had noted this peculiar gall-bladder, aptly characterized by him as "intestiniform," in several Toucans dissected by him, including *R. cuvieri* and *carinatus* and *P. wiedi*. It is also, I find, correctly described by Meckel ('Traité général,' &c., Paris, 1838, t. viii. p. 289), as follows:—"La conformation de la vésicule est extrêmement curieuse chez le toucan (*Ramphastos*). Elle y est d'une longueur si énorme, qu'elle occupe la cavité abdominale toute entière: elle est très rétrécie, et ressemble plutôt à un cæcum qu'à une vésicule." I made my first observations unaware of either of the above facts.

the intimate relationship of that genus to the Barbets and Toucans. Unfortunately I can give no exact information on this point, the only specimen I have of an *Indicator* having been eviscerated.

P. Z. S. 1882, p. 95.

The only other family of birds in which, so far as I am aware, the gall-bladder assumes this peculiar vermiform shape, and lies freely in the abdominal cavity, is that of the Picidæ. Nitzsch * describes the liver of the Woodpeckers (of which he examined *Gecinus viridis* and *canus*, *Dryocopus major, medius*, and *minor*, and *Picus martius*) as being "immer mit ausgezeichnet langer darmförmiger Gallblase;" and I can quite confirm this description as being applicable to the last-named species.



Liver, stomach, duodenum, &c., of *Rhamphastos dicolorus*, from in front, showing the peculiar intestiniform gall-bladder (*g. b*).
St, stomach; *d*, duodenum; *p*, pancreas; *r. h. d*, *l. h. d.*, right and left hepatic ducts; *c. d*, cystic duct.

Garrod also correctly noted, in his MSS., the "long intestiniform gall-bladder" of *Gecinus*. The similarity, therefore, in this respect of the Capitonidæ † to the Picidæ strengthens the many arguments for the

* In Naumann's Orn. Deutschlands, v. p. 252.

† I use this term, with Garrod (Coll. Papers, p. 464), to include the Toucans and *Indicator*, as well as the true Barbets.

intimate relationship of these two groups. And I may take this opportunity to point out some further peculiarities which these birds have in common with each other. These are :—

(1) The great extent of the deltoid muscle, which extends down the entire length, or very nearly so, of the humerus, and is inserted by a tendinous slip into a small tubercle on the external surface of that bone, close to the elbow, and just above the tubercle for the tendon of origin of the *extensor metacarpi radialis longior* muscle. This is common to the Picidæ, *Indicator*, and the Toucans and Barbets. As long ago noticed by Nitzsch *, this peculiarly long deltoid also occurs in the Passeres ; but its similar condition in the Capitonidæ has not, I think, before been observed. But, as showing that the similarity in this respect of the Passeres to the Picidæ and their allies is not *necessarily* a mark of relationship, I may add that in some other birds, as, e. g., *Carpophaga*, *Ptilopus*, and *Cariama*, the deltoid is nearly the same in size and shape, extending down to very near the elbow.

P. Z. S. 1882, p. 96.

(2) The presence of a distinct ossicle, of the nature of a sesamoid, the so-called "*scapula accessoria*," which is developed in the scapulo-humeral ligament of the shoulder-joint, and plays over the posterior angle of the humerus-head. From it arise some of the fibres of the deltoid.

Nitzsch, with his usual accuracy †, had also noticed the existence in the Picidæ of this bone, which, as is well known, occurs also in the Passeres ; but the relationships of the bone in the last are not the same as they are in the Picidæ, *Indicator* and other *Pici* I have examined.

In the Passeres the bone in question becomes connected with the tendon of the *pectoralis secundus* muscle as this courses over the head of the humerus towards its insertion, sending round it a special thin tendinous loop, in which the tendon of that muscle plays. Hence, in the undisturbed position of these parts, the *pectoralis* tendon is seen to be somewhat L-shaped, the angle of the L being at the place where it is connected by this fibrous loop to the sesamoid bone, and so dragged backwards out of a direct course.

In the *Pici* I have been able to find no such connection between the *scapula accessoria* and the *pectoralis secundus* tendon, which remains quite free from it throughout its course.

The additional points of resemblance detailed in the present communication render the near relationship of the Picidæ to the Capitonidæ even more certain than before. Nitzsch, from pterylographical grounds, and Kessler ‡, from osteological ones, long ago pointed out this connection,

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* Zeitschr. f. ges. Naturwiss. 1862, xix. p. 400.

† *Tom. suprà cit.* p. 399.

‡ Bull. Soc. Imp. Nat. Moscou, xvii. pp. 332–334, 340.

which was afterwards remarkably confirmed by Garrod's observations on their myology and visceral anatomy.

The fact that there should be important cranial differences between the two groups (and even amongst the members of one of these) only shows that the cranial structure of a bird may be profoundly changed, in accordance with its conditions of existence, whilst in the rest of its organs no change whatever is effected; and such a fact must of itself tell heavily against the view that the structure of the skull in birds is of itself alone a certain, or even sufficient, index to their systematic classification.

P. Z. S. 1882, p. 208.

56. ON SOME POINTS IN THE ANATOMY OF THE INDIAN DARTER (*PLOTUS MELANOGASTER*), AND ON THE MECHANISM OF THE NECK IN THE DARTERS (*PLOTUS*), IN CONNEXION WITH THEIR HABITS.*

It is to the late Prof. Garrod that we are indebted for our knowledge of the great differences in the anatomy of the digestive organs of the American † (*Plotus anhinga*) and African ‡ (*P. levaillanti*) Darters. The existence of such differences in birds apparently so nearly allied made it very desirable to obtain a knowledge of these parts in the other species of the genus *Plotus*.

On April 8th last, the Society obtained, by exchange from the Zoological Gardens of Calcutta, the first specimen of the Indian Darter
P. Z S. 1882, p. 209. (*Plotus melanogaster*) that it has acquired. The specimen, a male, lived in excellent health till December 21st last, when it died suddenly, its death apparently having been caused by some sudden shock produced by too rapid feeding, as a dozen small fishes, just swallowed, were found in its stomach. No disease whatever could be found. It is this specimen that forms the subject of the present communication.

As regards its stomach, *Plotus melanogaster* closely approaches *P. levaillanti*, the proventriculus being in the form of two quite separate patches, and the pyloric lobe being provided with a similar hair-covered conical and retractile "plug." In *P. anhinga*, it will be remembered, the proventricular glands are collected together into a special diverticulum of the stomach, whilst the pyloric lobe, though hairy internally,

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* Proc. Zool. Soc. 1882, pp. 208–212. Read Feb. 7, 1882.

† P. Z. S. 1876, pp. 335–345; Scient. Papers, pp. 334–346, pls. xviii.–xx.

‡ *L. c.* 1878, pp. 679–681; *t. c.* pp. 346–349.

has no such plug. In *P. melanogaster* the two gland-patches have the form of watch-pockets, which nearly, though not quite, unite with each other superiorly. They measure 1·1 inch transversely and ·8 inch from above downwards, being thus a little larger than the similarly shaped and situated ones of *P. levaillanti* *. There is no trace of the elevated "U-shaped ridge" situated on the anterior wall of the stomach between the two patches, described and figured by Prof. Garrod in the last-named species. The gland-patches are covered, as is the rest of the interior of the stomach, by the usual yellow wrinkled "epithelium." This ceases abruptly above at the level of the upper margins of the glandular areas, where it meets the smooth and pink mucous membrane of the œsophagus. Along this line of junction, the epithelial coat is thicker and jagged, an appearance probably due to several thicknesses of this coat having been "moulted" (as we know happens in the American species) and not come clean away †.

The second, or pyloric, stomach is quite as distinct in *Plotus melanogaster* as it is in the two other species of the genus dissected. Like these, too, its pyloric half is covered internally with the peculiar hairy mat already described in these birds: the cardiac part, on the other hand, is covered by a yellow "epithelium" continuous with that of the rest of the stomach. The hairy covering forms a complete ring, thickest and best developed inferiorly—on the surface corresponding to the "greater curvature" of the Mammalian stomach—and quite surrounding the equally hairy pyloric plug. This "plug" is not a free process: it is rather a well-defined ridge, nearly cylindrical in section, attached superiorly to the wall of the stomach, but ending freely below. It, particularly towards its termination, is thickly covered with hairs of a similar character to those in the rest of the hairy region. When fully retracted, it completely fills up the centre of the hairy ring already described, the communication of the cavities of the stomach and duodenum being reduced to a narrow aperture situated below the plug, and only capable of allowing the passage of a bristle.

It is not unusual in birds to find a small irregular nipple-like projection guarding the entrance to the pylorus; and it is, I am inclined to believe, a greatly developed condition of this structure that forms the hairy "plug" of the Old-World Darters. P. Z. S. 1882, p. 210.

In the rest of its anatomy *Plotus melanogaster* resembles in nearly every respect *P. anhinga* and *P. levaillanti*. As in the latter, there are two cæca, ·2 inch long, whilst in most specimens of *P. anhinga* one only

* In the prventricular glands being limited to distinct areas, which do not unite to form a zone, *Plotus levaillanti* and *P. melanogaster* resemble the genus *Phalacrocorax*.

† *Cf.* Bartlett, P. Z. S. 1881, p. 247.

has been observed *. As in *P. anhinga*, the large intestine is peculiarly long, measuring 5·5 inches; the small intestine has a length of 30 inches. The *bursa fabricii*, I may add, in the present specimen (a ♂) had the ordinary relations of that organ to the cloaca, opening into that chamber by a small pore. There is only one carotid artery, the left, as in the two other species of *Plotus*, the genus *Pelecanus*, and *Sula leucogastra* and *S. piscator*, though not in *S. bassana*, or the other Steganopodes. The patella is only grooved, and not perforated, by the *ambiens* muscle.

The structure of the neck in *P. melanogaster* is almost identical with that of *P. anhinga*, as described and figured by Garrod. "Donitz's bridge," situated, as in the other species, on the 9th cervical vertebra, is well-ossified in the present specimen, as it is also in *P. levaillanti* and *P. novæ-hollandiæ*, though not in *P. anhinga*.

In addition to this, the similarly-situated fibrous bands—formed by a specialized part of the general cervical aponeurosis—on the 11th cervical vertebra, which are correctly figured and described (in the explanation to the plate) by Garrod † in *P. anhinga*, are also ossified, each in its median portion being converted, over a small area about the size of a hemp-seed, into bone. Through the canal thus formed on each side, the *longus colli posterior*, as well as the general mass of posterior neck-muscles, passes. On examination of *P. levaillanti*, I find these bands also ossified in that species; in *P. anhinga*, as already correctly stated by Garrod, they remain fibrous. There is no such ossification of the cervical portion of the *longus colli posterior* tendon in this species, as was observed by Garrod in *P. anhinga*; and in this respect again the African and Indian species agree, and differ from their American relative.

Prof. Garrod, in the first of his papers already referred to, has fully and accurately described the peculiar osteological and myological characters of the neck of the Darter. But, probably from never having observed these birds when feeding, he has not pointed out the connexion between this peculiar neck, with its naturally persistent "kink," of the Darters and their mode of life.

The Darters feed entirely, so far as I have been able to observe, under water. Swimming with its wings half expanded, though locomotion is effected entirely by the feet, the bird pursues his prey (small fishes) with
P. Z. S. 1882, a peculiar "darting" or jerky action of the head and neck, which may
p. 211. be compared to that of a man poising a spear or harpoon before throwing

* In a specimen of *Plotus anhinga* that has passed through my hands since this paper was read there was, in addition to a single cæcum of the ordinary size, a much more rudimentary one developed on the other side of the intestine.

† *L. c.* pl. xviii. fig. 2 *a*.

it. Arrived within striking-distance, the Darter suddenly transfixes, in fact bayonets, the fish on the tip of its beak with marvellous dexterity, and then immediately comes to the surface, where the fish is shaken off the beak by jerking of the head and neck (repeated till successful), thrown upwards, and swallowed, usually head first.

A study of the neck in the recently dead bird leaves little doubt as to

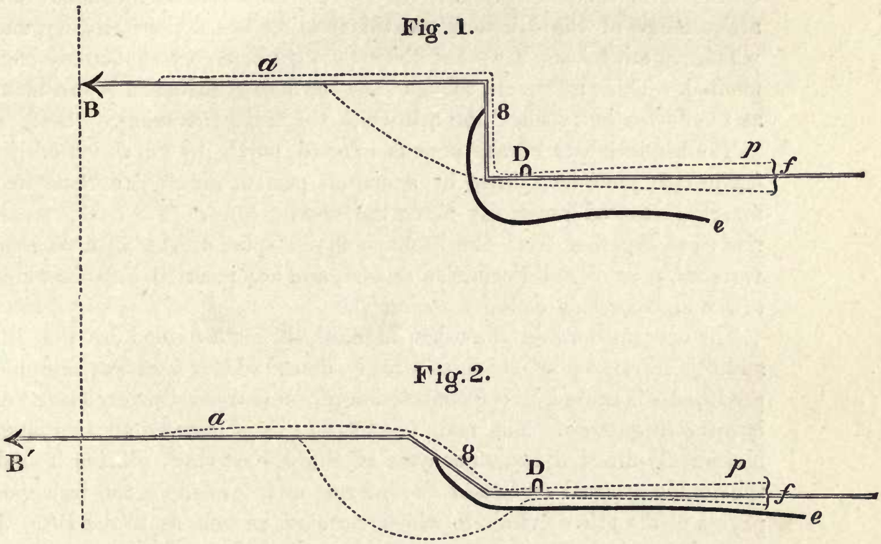

Diagram to show the mechanism of the "kink" of the neck in the Darters.

a, head and anterior moiety of neck (1st to 7th cervical vertebræ); *p*, posterior moiety of neck (from the 9th cervical vertebra to thorax); 8, 8th cervical vertebra; D, "Donitz's bridge," on the 9th cervical; *f*, the two flexor muscles (*vide* text); *e*, the extensor muscle (the *longus colli anterior*). In fig. 1 the flexor muscles are supposed to be acting, bending back the anterior part of the neck on the 8th cervical; in fig. 2 the extensor muscle has opened out the anterior genu formed by the 8th cervical, thereby protruding the apex of the beak (marked B in fig. 1) to B′.

the mechanism by which this peculiar impaling of the prey is effected. The 8th cervical vertebra is articulated, as has already been described, with the 7th in such a way that the two cannot naturally be got to lie in the same line, but form an angle, open forwards, of about 145°, when the two bones are stretched as far as is possible in that direction. Behind, its articulation with the 9th cervical is such as to permit it to be bent back at an angle a little greater than 90° with that vertebra, beyond which extent, however, no further flexion is possible. The 8th vertebra is thus so articulated with the 7th anteriorly and the 9th posteriorly as to allow it, when the neck is flexed, to be nearly at right angles to the rest of the neck, the two portions of which, though parallel, are then at

P. Z. S. 1882, p. 212.

different horizons, something like the two bars of a parallel ruler (*vide* diagram, fig. 1, p. 329). When the neck is bent in this Z-shaped form, any opening out of the anterior angular bend by the action of the anterior neck-muscles causes the anterior moiety of the neck to suddenly shoot out, thus causing a corresponding protrusion of the head and beak (diagram, fig. 2). By the flexion of the 6th on the 7th, and of the 9th on the 10th, cervical vertebræ, the curve of the neck is increased—the articulations of the 8th vertebra still forming the double hinge round which motion takes place—and the impaling action correspondingly augmented. This protrusion, though only for a short distance, is so violent as to effectually "strike" the fish which the bird is pursuing.

The bending-back of the neck is effected, partly by the action of the *longus colli posterior*, partly by a special pair of closely approximated muscles, situated anteriorly along the middle line of the neck, which rise close together from the hæmapophysial spine of the 11th cervical vertebra, near its anterior articular end, and are inserted into the sides of the anterior half of the 6th cervical.

The opening-out, on the other hand, of the genu formed by the 7th and 8th cervicals—by which, as already described, the impaling action is produced—is caused by the contraction of the thoracically very powerful *longus colli anterior*. The main tendon of this is inserted on the long, backwardly-directed hæmapophysis of the 8th cervical, playing round the doubly-grooved surface of the inferior arch formed by the hæmapophyses of the 9th cervical, to which vertebra, as well as to the 10th, it gives off much smaller tendinous slips.

It is obvious that considerable advantage is gained by the action in question, the rapid protrusion of the narrow neck and head over a small space by this mechanism necessitating a less amount of exertion than would a similar movement of the whole bird over the same space, and being equally efficacious in striking the prey. The whole mechanism, it may be observed, exists in a less developed form in the neck of the Herons, Cormorants, &c.; and it requires but a slight modification of the arrangement of these parts in those birds—none of which, so far as I know, impale their prey like the Darters—to bring about the perfect adaptation of these structures to a newly acquired mode of feeding.

57. DESCRIPTION OF THE PTERYLOSIS OF *MESITES*, WITH REMARKS ON THE POSITION OF THAT GENUS.*

P. Z. S. 1882, p. 267.

WHEN making some observations on the pterylographical and other peculiarities of *Eupetes macrocercus* †, I expressed regret at not having been able to obtain any specimen of *Mesites*, which in external appearance somewhat approaches *Eupetes macrocercus*, to study its pterylosis also.

Since then, having obtained through Herr G. Schneider, of Basel, a skin of *Mesites variegatus*, I have been able, from an examination of it, to complete our knowledge of this most peculiar form as regards the distribution of its feathers. All that was previously known of this part of the structure of *Mesites* was the existence in that bird of five pairs of powder-down patches ‡, M. A. Milne-Edwards in his paper on it § having confined his observations to its osseous and internal structure ||. Those interested in the various opinions which have been held by naturalists as to the exact systematic position of *Mesites*, I will refer to M. Milne-Edwards's paper just quoted, only adding Mr. E. Bartlett's suggestion "that the genus *Mesites* should be arranged in the Natural System next to *Eurypyga* and its near ally *Rhinochetus*." P. Z. S. 1882, p. 268.

The nostrils of *Mesites* are long, linear concave-upward slits, extending for more than half the length of the beak, and covered above by a well-marked membranous valvular operculum, being in this respect very unlike the ordinary form of nostril in the Rails.

The tarsi have about 10 or 11 distinct transverse scutella anteriorly, best developed internally, and there nearly meeting, along the lateral surface, a similar but somewhat more numerous series of smaller scutella, which are developed along the posterior aspect of the leg, but become obsolete about $\frac{1}{2}$ inch above the metatarso-phalangeal joint. Externally the two series of scutella are separated by a distinct space covered by smooth, non-scutellated skin. This tarsal scutellation extends upwards above the "knee" for about $\frac{1}{2}$ inch, for which extent therefore the tibia is bare of feathers.

The digits are all free from their bases; the hallux is considerably the smallest of them ¶.

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* Proc. Zool. Soc. 1882, pp. 267–271. Read Feb. 21, 1882.

† P. Z. S. 1881, p. 838.

‡ *Vide* E. Bartlett, P. Z. S. 1877, p. 292.

§ Ann. Sci. Nat. (6) Zool. vii. 1878, art. 6.

|| An imperfect skull, extracted from the present skin, shows that the palate is schizognathous, the recurved maxillo-palatines being free in the middle line, and the vomer small and pointed—points not evident in Milne-Edwards's figure, his specimen, I believe, being somewhat imperfect.

¶ By soaking out the plantar tendons, I have been enabled to ascertain that there is a good *vinculum* between the *flexores longus hallucis* and *profundus digitorum*, the tendons

The number of remiges cannot be counted with certainty; but there are certainly 10 primaries; the wing is much rounded.

There are 16 rectrices, a very non-passerine character *; and both the upper and under tail-coverts are very long, with the last feathers rectriciform and extending along the tail for quite three fourths of its length both above and below.

There is apparently no claw on the pollex; and the contour-feathers have *no* aftershaft—in both these respects differing from the Rallidæ. The tail in my specimen has unfortunately been so cut that I have been unable to ascertain for certain whether the oil-gland is present or not. I can find no tuft, however; and as we know that the gland, though present, is nude both in *Rhinochetus* and *Eurypyga*, such is probably its condition in *Mesites* too †.

The continuous head-feathering extends about halfway down the neck, and then gives off the dorsal and ventral tracts of each side, which are separated by well-marked spaces, of which the dorsal one is considerably the biggest. The feathering of the lower part of the neck is thus quadriserial, separated by as many *apteria*. In the lower part of the neck the two dorsal tracts, which are narrow but strongly feathered, are widely separated, and somewhat divergent, including between them the anterior pair of dorsal powder-down patches, but converge again in the interscapular region. Here they suddenly become much feebler, and are then continued on as the much more weakly-feathered posterior part of the dorsal tract, P. Z. S. 1882, p. 269. this being of a furcate form, with the united part about 1 inch long, and inclosing a fairly broad median space. The limbs of this posterior fork are strongly dilated in the middle part of their extent, being there 6 to 7 feathers broad, and united externally by scattered feathers with the very broad and long lumbar tracts, which are arranged in about six rows of not closely-placed feathers, the posterior row of these being considerably the stronger.

The humeral tracts are not very broad or strong, and are quite distinct, anteriorly, from the inferior tract.

This last, which (as already described) commences on each side about halfway down the neck, springing at once independently from the continuous feathering of the anterior cervical region, ceases altogether at the commencement of the pectoral region (extending as far as the most

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of which are ossified near the bottom of the leg. In all ordinary Passeres, it will be remembered, this *vinculum* is quite absent.

* According to Nitzsch, however, this is the number met with in the male of *Menura superba*.

† In answer to an inquiry on this subject, M. A. Milne-Edwards has been kind enough to inform me that his spirit-specimen of *Mesites* is also unfortunately damaged at the root of the tail, but that on an examination of a skin he finds apparently an oil-gland present with *no* tuft.

anterior of the ventral powder-down patches to be presently described). It recommences, however, a little lower down as a very narrow tract, composed at first of only single feathers, but subsequently becoming stronger and broader (though even here only two feathers broad), in which condition it runs on, as the main inferior tract, to terminate near the vent.

Strange to say, what must be considered the equivalent of the outer pectoral branch of ordinary birds is here *quite free throughout* from the main stem, with which it is not even united anteriorly, where it is separated by the already-mentioned powder-down patch, whilst posteriorly it runs parallel to, but quite free from, the main stem.

The powder-down patches of *Mesites* resemble those of the Ardeidæ, of *Leptosoma*, and *Podargus* in their compactness, as well as in the definiteness of their areas, as opposed to the more scattered and diffused forms they present in *Rhinochetus*, *Eurypyga*, *Crypturus*, and other birds. But in their exact distribution they differ materially from any of these.

As already described by Mr. E. Bartlett, there are five pairs * of powder-patches in *Mesites*. Of these two pairs are dorsal, two ventral, and one lateral in position. All have the form of well-defined more or less oval areas, covered by a dense mat of closely aggregated long powder-down plumes.

The most anterior pair is placed close to the median line, the patches being only slightly separated from each other, at the commencement (apparently) of the interscapular region and inclosed between the two dorsal tracts, a little before these pass into their weaker posterior fork.

The *second* dorsal patch is situated on the rump, close to and just outside the terminal part of the dorsal tract, between that and the posterior termination of the lumbar tracts of each side.

The *third* patch is inferior in position, lying just at the commencement of the pectoral region, between the two halves of the inferior tract internally and the anterior extremity of their separated pectoral branch externally. P. Z. S. 1882 p. 270.

The *fourth* patch is longer and narrower than its fellows, lying on the ventral region just outside the middle part of the inferior tract.

The *fifth* (lateral) patch lies more or less transversely, in the neighbourhood of the axilla, between the posterior ends of the outer pectoral and humeral tracts.

No Ardeine bird has any such lateral pair of patches; and only *Cancroma* has the anterior dorsal pair. These moreover lie *outside*, and not *inside*, the dorsal tracts in that bird. On the other hand, the concen-

* In the Ardeidæ the number varies from one pair (*Balæniceps*) to four pairs (*Cancroma*). Three is the most ordinary number. The presence of a single cæcum in *Balæniceps* (as fortunately demonstrated by a preparation mounted in the Museum of the Royal College of Surgeons), together with these powder-down patches, renders its Ardeine nature nearly certain, as already suggested by Mr. A. D. Bartlett (P. Z. S. 1861, p. 131).

trated patches of *Mesites* may easily be derived from the more diffused arrangement found in *Rhinochetus* * and *Eurypyga*.

A full account of the pterylosis of *Rhinochetus* is still a desideratum, Dr. Murie having unfortunately omitted any account of the systematically more-important contour-feather tracts in his account of the "dermal structures" of the Kagu (*l. c.*).

I have at present insufficient material to describe these thoroughly, though an examination of two imperfectly-feathered specimens in spirit demonstrates considerable agreement between the Kagu and *Mesites*. Of *Eurypyga* we likewise have but imperfect information, due to Nitzsch †, and not to my mind very satisfactory, judging from the material before me.

In *Rhinochetus*, as in *Mesites*, the neck-feathering is quadriserial, though the median dorsal space is much narrower below and the lateral neck-spaces very broad; the two dorsal tracts terminate close together about the level of the anterior end of the scapulæ, and are quite separate from the posterior portion, which is only forked to a slight extent anteriorly, and widely dilated mesially. These differences seem to be due mainly to the greater development of the dorsal powder-down tracts of *Rhinochetus*, these covering most of the dorsal aspect of the trunk, except a narrow median space along the backbone and a reversed heart-shaped area on the pelvis, to which spaces therefore the contour-feathers are nearly confined.

Below, as in *Mesites*, the inferior tract of each side is nearly or quite broken up into two by the interruption of a patch of powder-down feathers; and the *pectoral* branch is likewise quite separated from the main tract, as in no other bird known to me except *Mesites*, powder-downs also intervening between the two. The humeral tract is quite free from the inferior one. On the other hand, in the number of its rectrices (16), and the absence of an aftershaft to the feathers, *Mesites* differs from *Eurypyga* and *Rhinochetus*, both of which have 12 rectrices ‡ and an aftershaft. The number of primaries in all is 10.

P. Z. S. 1882, p. 271.

Mesites, *Rhinochetus*, and *Eurypyga* agree together, but differ from the Rallidæ, in having well-developed and strong rectrices, in the possession of powder-down patches, in the oil-gland being nude (? *Mesites*), and in the interruption of the dorsal tract in the neighbourhood of the scapulæ. Pterylographically, therefore, there is no special reason to unite these forms with the Rails. Judging from M. Milne-Edwards's account and figures of the osteology of *Mesites*, numerous differences between these two forms also exist in the osseous parts of their structure. In particular, the fact of *Mesites* being schizorhinal is a strong point in view of its relationship being, along with *Rhinochetus* and its allies, to the Plu-

* *Cf.* Murie, Trans. Z. S. vii. pl. 56. figs. 1–3.

† 'Pterylography,' Ray Soc. ed. p. 129, pl. viii. fig. 15.

‡ *Rhinochetus* has not 10, as erroneously stated by Murie, loc. cit. p. 468.

vialine group, where I have already * placed it. In spite of M. Milne-Edwards's remarks †, I see no reason for doubting the value of the schizorhinal character of the nasal bones as a mark of the genetic affinities of birds, especially when, as in the present case, other facts point in the same direction.

I should be inclined therefore to consider (1) that *Mesites*, *Eurypyga*, and *Rhinochetus* have all sprung from some common ancestor, which must have been a generalized Pluvialine form provided with powder-down tracts; (2) that of the forms which this common stock gave rise to, all have become extinct save the three in question, which, having become isolated in three widely separated localities, have each acquired certain special characters not found in the others; (3) that, judging at least from the pterylosis, the Malagash *Mesites* is perhaps more nearly related to the New-Caledonian *Rhinochetus* than to the Neotropical *Eurypyga*.

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58. NOTE ON A PECULIARITY IN THE TRACHEA OF THE TWELVE-WIRED BIRD-OF-PARADISE (*SELEUCIDES NIGRA*).‡

P. Z. S. 1882, p. 333.

THE death (from conjestion of the lungs, with resulting hæmorrhage, and thickening of the walls of the intrathoracic air-cells) on Feb. 22nd last of the male *Seleucides nigra*, purchased by the Society on March 19, 1881 §, has given me the opportunity of observing a peculiarity in the construction of its trachea of a nature unlike any thing of the kind yet known to me. The windpipe, for the greater part of its course, has the normal avian structure, the tracheal rings, which are ossified and, as usual, notched both before and behind, being of the ordinary form, and separated by but narrow intervals from each other. For a space, however, of about 1 inch above the largely developed short pair of

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* Ibis, 1881, p. 4, and P. Z. S. 1881, p. 644.

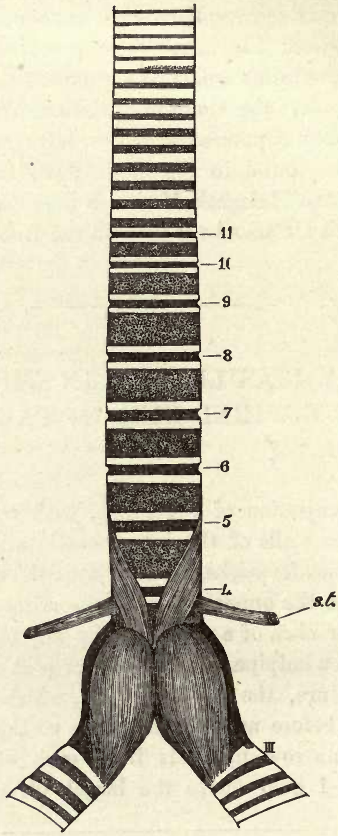
† The greater or lesser size of the beak will *not* account for the schizorhinal or holorhinal character of the nares, as suggested by M. Milne-Edwards. Else why should the big-billed *Plataleæ*, Ibises, *Didunculus*, Laridæ, Alcidæ, be *all* schizorhinal, whilst the slender-billed Rails, Colymbidæ, and such Tubinares as *Puffinus* and *Procellaria*, to say nothing of such forms as the Meropidæ, Dendrocolaptidæ, and Nectariniidæ, are all equally holorhinal? Nor can I admit with M. Milne-Edwards that the Pteroclidæ are related to the Gallinæ, or the Ibididæ to *Tantalus*, there being plenty of collateral evidence to prove the reverse. Hence any argument based on such assumed affinities also fails.

‡ Proc. Zool. Soc. 1882, pp. 333–335. Read Mar. 21, 1882.

§ See P. Z. S. 1881, p. 450.

intrinsic muscles, the interval comprising 8 tracheal rings, it becomes peculiarly modified, the tube itself becoming slightly dilated and flattened antero-posteriorly, whilst the tracheal rings become broader, and ossified along the middle of their depth, the borders only remaining

P. Z. S. 1882, p. 334.



Lower portion of trachea of *Seleucides nigra* ♂, from before. Twice the natural size.

4, 5, 6, 7, 8, 9, 10, 11. Fourth, fifth, &c. (from bottom) tracheal rings, peculiarly modified. III. Third bronchial semiring. *s.t*, *sterno-trachealis* muscle, cut short.

P. Z. S. 1882, p. 333.

cartilaginous. This ossified part of each ring is slightly concave, so that when seen laterally the cartilaginous margins project slightly from it, the whole ring being thus like a fluted table-napkin ring, when seen in section. The intervals between these peculiar rings are very much deeper than those above, and occupied by delicate membrane only, so that all this part of the trachea is highly elastic.

The *sterno-tracheales* are inserted just below the lowest of these peculiar rings, which is the last but three of those composing the trachea —the next two, which are very narrow, and the last, which is broad and bears the pessulus, being concealed from view by the largely developed syringeal muscles, of which there are four pairs, all, except the small anterior long muscle, being inserted on the ends of the very strong third bronchial semirings. The lateral tracheal muscles are weak, extending, however, nearly to the thoracic end of the tube.

Nothing like the modification of the trachea here described obtains in any other allied form of Paradise-bird that I have been able to examine (including *Paradisea papuana* and *rubra*, *Ptilorhis alberti*, *Phonygama gouldi*, *Manucodia atra*, *Ptilorhynchus violaceus* and *smithi*); nor do I know any structure in other birds quite comparable with that now described, which is probably correlated with the very loud harsh note of these birds *.

In all other respects *Seleucides* is, as might have been expected, a typical oscinine Passerine.

I may take this opportunity of remarking that the various published P. Z. S. 1882,
figures of *Seleucides nigra* do not give a very accurate idea of the bird, as p. 334.
they fail to represent the peculiar way in which the leg-feathering ceases altogether some way above the "knee," leaving the large and muscular legs bare for about an inch or so above that joint.

The eyes are brilliant red; the legs, including the bare skin above the "knees," pale red, the claws greyish. The mucous membrane of the mouth and superior surface of the tongue is bright emerald-green, a P. Z. S. 1882,
narrow line of this appearing at the angle of the mouth when the jaws p. 335.
are closed. When the beak is open, the beautiful green of the mouth and tongue is very conspicuous, and, contrasting with the bright red eye and dark velvety plumage of the head, adds greatly to the general appearance of the bird.

It would be interesting to know whether the females of *Seleucides* also have their mouth thus coloured, or whether it is a peculiarity of the male, developed as a sexual ornament †.

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* Mr. Wallace, speaking of this species, says (Malay Archipelago, ii. p. 254, London, 1869):—"It has a loud shrill cry, to be heard a long way, consisting of cáh, cáh, repeated five or six times in a descending scale; and at the last note it generally flies away."

† P.S. (April 7).—A young male Rifle-bird (*Ptilorhis paradisea*) now living in the Society's Gardens has, it is interesting to observe, its mouth and tongue similarly brightly coloured, though of a lemon-yellow colour instead of green.

P. Z. S. 1882, p. 347.

59. ON THE CONVOLUTED TRACHEA OF TWO SPECIES OF MANUCODE (*MANUCODIA ATRA* AND *PHONYGAMA GOULDI*); WITH REMARKS ON SIMILAR STRUCTURES IN OTHER BIRDS.*

THE subcutaneous convolution on the pectoral muscles of the trachea in the Manucodes of the genera (or subgenera) *Manucodia* and *Phonygama*, originally described and figured by Lesson in *Phonygama keraudreni* so long ago as 1826 †, has lately excited considerable attention, Prof. Pavesi ‡ having shown that a similar structure, though less developed, exists in *Manucodia chalybeata*, and Dr. Meyer § having demonstrated the same for its representative form *M. jobiensis*. From their figures and observations it is clear:—

1. That the trachea of *Phonygama* "*keraudreni*" || *may* be convoluted in both sexes, that of the males being most complicated, consisting, when best developed, of a complete spiral of several coils, whilst in younger males, and females, it is reduced to a simple loop with a bend to the right.

Intermediate forms of all kinds are to be found, as shown by Pavesi's interesting series of figures.

2. That in *Manucodia chalybeata* and *M. jobiensis* the adult males possess a trachea provided with a simple loop, extending about two thirds down the surface of the pectoral muscles. This is apparently absent in the females and young males.

The specimen, a male, of *Manucodia atra*, purchased by the Society on March 19, 1881 ¶, having died on March 11th inst., I have now been enabled to examine the condition of the trachea in this species also. As will be seen from the drawing I exhibit (figure, p. 339), representing it *in situ*, it too is convoluted, but to a much smaller extent, only forming a short loop lying on the interclavicular air-cell, between the rami of the furcula, much as in many specimens of the genus *Crax*. This quite confirms D'Albertis's description given by Count Salvadori **. In the female the trachea will probably be found to be quite simple.

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* Proc. Zool. Soc. 1882, pp. 347–353. Read April 4, 1882.

† Voyage de la 'Coquille,' Atlas, pl. xiii. fig. 2.

‡ Ann. Mus. Genova, vi. pp. 313–324, pl. x., and ix. pp. 66–77.

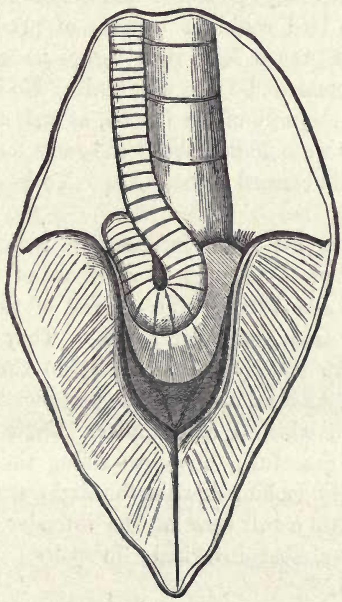
§ Abbildungen Vogel-Skeleten, pl. vii. *a*, p. 5.

|| All but one of Pavesi's specimens (fig. 6 of his second paper) are, it is to be observed, really *P. gouldi*, having been obtained at Cape York by D'Albertis.

¶ On its arrival it was supposed to belong to the species *M. viridis* (seu *chalybeata*), and was noticed as such (P. Z. S. 1881, p. 450).

** "Non pare che questa specie possegga vere circonvoluzioni externe della trachea, ma, secondo le osservazioni del D'Albertis, i maschi adulti avrebbero *soltanto un' ansa piegata* ad S nella fossetta della forchetta."—*Ornitologia della Pupuasia e delle Molucche*, ii. p. 509.

Of *Phonygama gouldi*, the Australian representative of *P. keraudreni*, I have been enabled to examine three detached tracheæ, as well as three entire birds collected at Cape York by H.M.S. 'Challenger,' and kindly intrusted to me by the late Sir Wyville Thomson. The first three are those already mentioned by Mr. Tegetmeier in his appendix to the 'Natural History of the Cranes' *. All are convoluted, though that of the female specimen is least so, and those of the two males vary slightly in the amount of convolution. They very closely resemble that of *P. keraudreni* figured on p. 68, fig. 2, in the second of Prof. Pavesi's papers already quoted, but have eight instead of nine folds, counting along a transverse line drawn through the centre of the coil. Of the three 'Challenger' birds, one a female †, has a trachea with a single curved loop, like Pavesi's fig. 8, P. Z. S. 1882, p. 348.



Trachea of *Manucodia atra*.

whilst in the two others the trachea is quite straight, with no trace of a curve. One of these is a *male*, probably young, whilst the other is an *adult* female, as shown by the oviduct containing an egg nearly ready to be laid.

It is clear therefore that in this species, too, the female *may* sometimes have no tracheal loop at all.

As regards the habits of *P. gouldi*, I reproduce here some extracts from the notes accompanying the receipt of the first three tracheæ

* London, 1881, pp. 87, 88.

† One of the specimens referred to in Mr. Murray's notes, *cf.* 'Voyage of H.M.S. Challenger,' Report on the Birds, p. 87.

sent—I believe, by Dr. George Bennett of Sydney—the substance of which Mr. Tegetmeier has already published (from the original MS. in my possession) in his work on Cranes:—

P. Z. S, 1882, p. 349. "Having recently purchased a pair of those elegant birds, the *Manucodia gouldi*, which had been shot at Cape York by Mr. J. A. Thorpe (now taxidermist to the Sydney Museum), he directed my attention to the peculiar formation of the trachea in them, some of which he has preserved in a dry state and presented to me; of these I have sent you three, one from a female and two from males. That of the female is much smaller in size than those of the males; and even in the males the convolutions assume different forms. This formation of the vocal organs enables the male bird to utter a very loud and deep guttural sound, indeed more powerful and sonorous than any one would suppose so small a bird could be capable of producing. Mr. Thorpe states to me that it was a long time before he could believe that so powerful a sound emanated from this bird. No information could be obtained respecting the note of the female, as only that of the male was heard. These birds were found about the same locality as the two fine species of Rifle-birds obtained also at Cape York—*Ptilorhis alberti* and *P. victoriæ*.

"Mr. Thorpe gave me some information respecting the habits of these birds as follows:—'During a residence of seventeen months at Cape York in 1867 and 1868 I shot several of the *Manucodia gouldi*, and took particular notice of their habits. They frequent the dense palm-forests, and are usually seen high up in the trees; they utter a very deep and loud, guttural note, rather prolonged, and unlike that of any other bird with which I am familiar. Their movements are particularly active and graceful; on approaching them they evince more curiosity than timidity, looking down at the slightest noise, and apparently more anxious to obtain a full view of the intruder than for their own safety. They are almost invariably in pairs; and both birds can generally be secured.'"

I may remark that, in all the specimens of the convoluted trachea in *Manucodia* and *Phonygama* I have seen, the descending limb of the loop in the natural position of the bird is to the left, the ascending to the right. The same peculiarity is observable in all the figures yet published, excepting the original one of Lesson, and in one of those of Pavesi (*l. c.* ix. p. 64, fig. 4). The reversal, in the first figure, is obviously due to the trachea being represented from the *dorsal*, instead of the ventral aspect, it being represented as quite separated from the body: Pavesi's figure, representing the parts *in situ*, does not admit of this explanation, if correctly drawn.

As regards the two forms *Phonygama* and *Manucodia*, which Mr. Sharpe adopts as genera in the 'Catalogue of Birds,' vol. iii. pp. 180, 182, it is interesting to observe that the validity of the separation is confirmed by what we now know of the tracheal conformation of the two groups in question.

Phonygama (as represented by *P. keraudreni* and *gouldi*) has the trachea (at least usually) convoluted in *both* sexes, that of the adult male being spirally convoluted several times, whilst that of the female forms a single curve with a loop to the right. *Manucodia* (in *M. chalybeata*, *jobiensis*, and *atra*), on the other hand, has the trachea convoluted in the male only, the convolution being in the form of a simple loop, extending, in the first two species, onto the pectoral muscles, but confined in *M. atra* to the interclavicular area. P. Z. S. 1882, p. 350.

As regards the occurrence of convoluted tracheæ in the class Aves generally, it may be useful to give as complete a list as is in my power of all the hitherto recorded instances. Pavesi has already (*l. c.* vi. pp. 317, 318) given such a list, compiled from various authors; but the opportunities for observation of my predecessor and myself have enabled me to give, as will be seen below, a much fuller and more complete one. I have endeavoured to state exactly in what species this convolution has been observed, or has been found to be absent, as well as to state precisely the sexes of the individuals presenting the peculiarities. Unless otherwise stated, the observation has been made by Prof. Garrod or myself.

A. The convolutions of the trachea are superficial, lying beneath the skin, extending often more or less onto the pectoral, or even abdominal, muscles.

OSCINES.

Phonygama keraudreni. ♂ [Lesson, Pavesi, Meyer]. [Probably ♀ also.]

—— *gouldi.* ♂: present, much less developed (sometimes absent) in ♀.

Manucodia chalybeata. ♂ [Pavesi, Meyer].
—— *jobiensis.* ♂. [Condition in ♀ not known.]
—— *atra.* ♂. [Condition in ♀ not known.]

At present it has been found in the males only of these three species, and, as already indicated, is, from Beccari's observations on *M. chalybeata*, probably absent altogether in the females.

Fam. ANATIDÆ.

In the males of *Anseranas melanoleuca* the trachea forms a very extensive double loop, extending to quite the end of the pectoral muscles. The female has simply a slight bend in the neck.

Fam. Scolopacidæ.

The *females* only of *Rhynchœa australis* [according to Gould] have a convoluted trachea, forming several folds on the pectoral muscles, and extending onto the abdomen. In the *males* it is simple *.

In *R. capensis*, as Mr. Wood-Mason has lately shown (P. Z. S. 1878, pp. 745–751, pl. xlvii.), the mature females only have a slightly extra-thoracic loop, the trachea of the younger females and of the males being quite simple.

P. Z. S. 1882, p. 351.

Fam. Cracidæ.

In the males of the genera *Crax*, *Pauxis*, *Mitua*, and *Ortalis* the trachea forms a loop of variable extent, often extending, particularly in the last three genera, to the end of the *carina sterni*, and then turning up a little way on the left side before it returns. In other cases it extends only about as far as the anterior end of the *carina*. In the females this loop is altogether absent, or at most the trachea presents a slight curve in the neck.

Species examined.

Crax globicera. ♂, ♀.
—— *alector.* ♂, ♀.
—— *sclateri.* ♂, ♀.
—— *daubentoni.* ♂, ♀.
—— *alberti.* ♂, ♀.
—— *carunculata.* ♂, ♀.

[The females only of *C. globulosa* and *C. incommoda* have yet been examined. The trachea is simple.]

Pauxis galeata. ♂, ♀.
Mitua tuberosa. ♂, ♀.
—— *tomentosa.* ♂, ♀.
Ortalis albiventris. ♂, ♀.
—— *garrula.* ♂. [The ♀ according to Humboldt † has the trachea simple.]
—— *motmot.* ♂. [The female has a simple trachea according to Latham, who describes this species ‡ under the name of *Phasianus parraka.*]

In *Penelope jacucaca* the trachea is convoluted in *both* sexes; and the same is the case in the male of *P. pileata*, the condition of the female being unknown.

[In *Penelope cristata* and *P. purpurascens* the male has *no* loop; and the same is the case in *Pipile cumanensis* and *P. jacutinga.* Only females

* Two specimens showing different degrees of development of this structure may be seen mounted in the Hunterian Museum (Preps. 1156, D & E).

† Humboldt and Bonpland, 'Recueil d'observations de Zoologie,' &c. p. 5. Paris, 1811.

‡ Linn. Trans. iv. p. 100 &c.

of *Pipile cujubi* and *Nothocrax urumutum* have yet been examined: these had simple tracheæ; and the same is the case in *both* sexes of *Aburria carunculata.*]

B. The trachea has a considerable superficial loop in the cervical region, anterior to the thoracic muscles.

Fam. Phasianidæ.

Tetrao urogallus. The male only, apparently.

C. The trachea has a loop entering into, and enclosed by, a bony cavity formed by the clavicular symphysis.

Fam. Numididæ.

The Guinea-fowls of the genus *Guttera*, as seen in both sexes of *Guttera cristata* and *G. pucherani.* The same conformation occurs in *G. eduardi*; but the sex of my specimen is not, unfortunately, recorded. P. Z. S. 1882, p. 352.

[In *Numida* proper (*N. meleagris*, *ptilorhyncha*, and *mitrata* have been examined), as well as in *Acryllium vulturinum*, the trachea is quite simple in both sexes.]

D. The trachea has several *intrathoracic* convolutions.

Fam. Ciconiidæ.

Tantalus ibis, in the male (*cf.* Garrod, Coll. Papers, p. 286).

[The condition of the female is unknown.]

[In both sexes of *T. loculator*, as well as in the females of *T. leucocephalus* (the other sex not yet having been dissected) the trachea is unconvoluted.]

Fam. Ibididæ.

Platalea leucorrodia. ♂. (♀, Nitzsch.)

[In *Ajaja rosea* the trachea is known to be simple in both sexes, though the bronchi are peculiarly long. *Cf.* Garrod, *l. c.* p. 288.]

E. The trachea is convoluted, the convolution impinging on, or entering, the *carina sterni.*

Fam. Cygnidæ.

In the Swans of the *Cygnus ferus* group, the trachea, as has long been known, has a number of *intrasternal* convolutions, which may extend to near the end of the bone.

This is well known to occur in both sexes of *Cygnus ferus*: it is likewise the case in both males and females of *C. buccinator*, *C. americanus* (according to Macgillivray, Sharpless, &c.), and *C. bewicki* (Yarrell).

[In *Cygnus olor*, *C. immutabilis* (Macgillivray), *C. nigricollis*, and *C. coscoroba* the trachea is quite simple in both sexes.]

According to Yarrell, in *Cygnus atratus* there is a slight downwardly-directed loop of the trachea in the interclavicular region.

Fam. Gruidæ.

The genus *Grus*, as a rule in both sexes, possesses a convoluted trachea, which usually enters the *carina sterni*, which it may excavate to its posterior extremity. The amount of convolution varies much in different specimens of the same species.

Species examined.

Grus cinerea. ♂, ♀. (Yarrell, &c.)
—— *antigone.* ♂ (Tegetmeier). ♀.
—— *americana.* ♀ (*cf.* Roberts, Am. Nat. 1880).
—— *caruncalata.* ♂, ♀.
—— *leucogeranos.* ♂, ♀.

P. Z. S. 1882, p. 353. As regards these two species, it appears from Prof. Garrod's MS. notes that the male of *G. leucogeranos* has a convoluted trachea, only slightly folded in the *carina sterni*, extending in it for less than half its extent *; whilst in the female "there was formed a genu of small size, that does not enter the *carina sterni*." The female of *G. carunculata* examined had a trachea as well convoluted as the most developed forms of *G. americana*, whilst in the male the condition was as in the female of *G. leucogeranos*.

Grus australasiana. ♂ [? ♀].
—— *canadensis.* ♂.

In *Tetrapteryx paradisea*, according to Yarrell and Tegetmeier, as well as in *Anthropoides virgo* according to Parsons and Yarrell, the trachea is convoluted, but does not enter the *carina sterni*, being contained in a special groove developed along the anterior margin of that bone.

[In both species of *Balearica* the trachea is known to be quite simple; and the same is probably true in *Aramus scolopaceus*.]

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* The observations of Mr. A. O. Hume (*cf.* Tegetmeier's 'Cranes,' p. 39, &c.) do not, therefore, always hold good for this species.

60. ON SOME POINTS IN THE ANATOMY OF THE TODIES (*TODIDÆ*), AND ON THE AFFINITIES OF THAT GROUP.* P. Z. S. 1882, p. 442.

ONE of the few important forms of birds that the late Prof. Garrod had not an opportunity, at some time or other, of dissecting was the genus *Todus*, the sole representative of the family Todidæ. I was therefore much gratified at being able to examine, some months ago, a spirit-specimen of *Todus viridis*, which was placed at my disposal for dissection by Prof. Newton with his accustomed liberality; but I hesitated to publish my notes without having further material to confirm my observations. An opportunity of doing this has lately been afforded to me by the kindness of Prof. Baird and the authorities of the Smithsonian Institution in Washington, who forwarded to me, with other valuable P. Z. S. 1882, p. 443. specimens, four examples in spirit of the Tody of San Domingo (*Todus dominicensis*). It is on the examination of these two species that the following paper is based.

Dr. Murie has given us, in his article on *Todus*†, an exhaustive account of the opinions held by previous writers as to the position of the Todies, as well as a valuable description of their osteology, and reference to what was known of their visceral anatomy. To this paper I therefore refer any reader interested in the literary history of the group in question. Since its publication Sundevall, Garrod, and Sclater have all treated of the classification of birds.

The Swedish ornithologist‡, relying as usual solely upon external characters, was misled into placing *Todus* amongst the Passeres, in the close vicinity of the Tyrannidæ and Pipridæ, though in the same year Mr. Sclater pointed out§ the impropriety of such a position.

Garrod at first‖ made the Todinæ with doubt a subfamily of the Coraciidæ, the Momotinæ forming another; but subsequently, on discovering that the Momotidæ lacked colic cæca¶, removed the latter altogether from the group of Passeriformes, and, adopting the opinion of Murie, Sclater, and others as to the close affinities of *Todus* to the Motmots, included the Todidæ with them, the two "almost certainly forming a single family." Mr. Sclater, in his lately published opinions on the classification of birds**, maintains his earlier view, the Todidæ being

* Proc. Zool. Soc. 1882, pp. 442–450. Read May 16, 1882.

† "On the skeleton of *Todus*, with remarks as to its allies," P. Z. S. 1872, pp. 664–680, pl. lv.

‡ 'Tentamen,' p. 60: Stockholm, 1872.

§ Ibis, 1872, p. 179.

‖ Coll. Papers, p. 216.

¶ *L. c.* p. 427. The contrary had been asserted by Blyth and Murie.

** Ibis, 1880, p. 401.

placed nearest the Momotidæ. My better opportunities for observation do not allow me to fall in with the opinion of the last two distinguished naturalists. Reserving for the present comparison, I append my notes on the dissection of the two species of *Todus* I have examined.

P. Z. S. 1882, p. 444.

The tongue is elongated, about ·75 inch long, flat and thin, nearly parallel-sided, though slightly tapering apically, and of horny consistence for most of its length. The root of the tongue, which is more fleshy, has some small spines developed along its base and for a short distance along the lateral margins. These margins anterior to this are frayed-out or ciliated, the direction of the laminæ so produced being backwards; the tip itself is quite entire. There is no crop; the proventriculus is, as usual, zonary; and the stomach (containing insects and seeds in the specimen examined) is a fairly muscular gizzard, lined by hard epithelium. The right lobe of the liver is much larger than the left. The intestines are remarkably short, their total length not exceeding $3\frac{1}{4}$ inches. The cæca are well-developed*, and large for the size of the bird, measuring about one-third of an inch. Their shape is that constantly met with in all the non-Passerine Anomalogonatous birds possessing cæca—narrowed towards their insertion, and dilated apically. There are two carotid arteries.

In the leg, the ambiens and accessory femoro-caudal muscles are absent, as are the gluteus quintus and primus. The femoro-caudal, semitendinosus, and accessory semitendinosus are all well developed. The myological formula is thus — A. XY. The obturator internus is triangular. The deep plantar flexor tendons of the toes blend about three quarters down the leg, the slip to the hallux being given off from the inner of the two tendons a little before it joins the other one.

The pectoralis secundus extends nearly to the end of the sternum. There is no third pectoral, nor biceps slip to the patagium. The *expansor secundariorum* muscle, on the other hand, is well developed, the long thin tendon ceasing on the axillary margin of the *teres* muscle in a way hitherto only known in some of the Gallinaceæ †. I find, however, that exactly the same condition occurs in *Momotus* (*lessoni*) and *Hylomanes* (*gularis*), in some of the Alcedinidæ (e. g. *Tanysiptera*, *Syma*, and *Cittura*), as also in *Steatornis*. The presence of this muscle at all in these groups of birds was, I may remark, hitherto unknown ‡. The

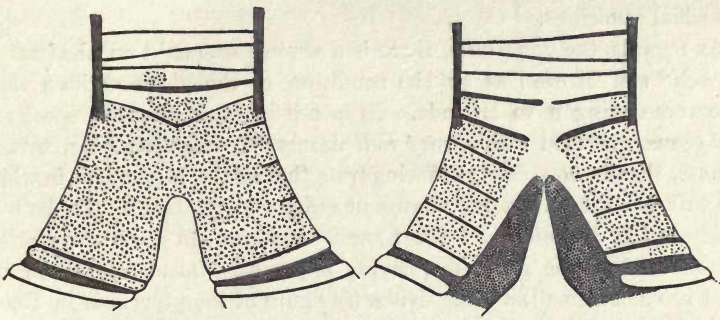
* They are erroneously stated by Duvernoy (Anat. Comp. Cuv. iv. [2] p. 284) to be absent.

† *Cf.* Garrod, Coll. Papers, p. 324.

‡ Besides the Coraciidæ, the existence in which of this muscle was pointed out by Garrod (Coll. Papers, p. 324), it exists also of the same "ciconiiform" shape in the Meropidæ, *Leptosoma* (P. Z. S. 1880, p. 470), and, as already noted in MS. by Garrod, in the Galbulidæ. It is absent in all (? Bucconidæ) the other families of Anomalogonatæ.

tensor patagii brevis at its termination has an arrangement almost identical with that of the Momotidæ*, only differing from it in the absence of the thin slip of fascia which is continued, in them, from the recurrent "passeriniform" tendon to the fascia covering the ulnar side of the fore-arm. The deltoid has no special tendinous slip of origin from the scapula.

Fig. 1.



A B

Syrinx of *Todus*: A, from before; B, from behind.

The triceps is Y-shaped at its scapular origin, and receives no tendinous slip from the humerus. P. Z. S. 1882, p. 445.

The construction of the syrinx may be best understood from an inspection of the accompanying figures (fig. 1), representing the anterior (A) and posterior (B) views of that of *Todus dominicensis*. The trachea terminates below in an ossified bony box, formed of three or four modified rings (probably bronchial) fused together, as is very evident in the posterior view: as may also be seen there, the two preceding tracheal rings are coossified with this box in the middle line posteriorly, though in front they are quite free from it. The box is deeply notched in front, a narrow pessular bar running backwards from the apex of the notch, forming a three-way piece. The bronchial semirings succeeding the box have the normal character. The lateral muscle of the trachea continues downwards to terminate just on the upper limits of this syringeal box. The syrinx of *Todus viridis* is constructed on exactly the same plan.

Comparing these figures with those of *Momotus lessoni* given by Garrod †, it will be seen that *Todus* differs from *Momotus* in its syringeal box being deeply notched anteriorly, and much more perfect posteriorly, the two parts being united by a pessular bar unrepresented in *Momotus*. In fact it resembles that of the Alcedinidæ or Galbulidæ rather than that of the

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* *Cf.* Garrod, loc. cit. p. 359.

† *L. c.* p. 428.

Momotidæ. The chief difference from the former is that in the Alcedinidæ the intrinsic muscle, often very broad, passes down over the syringeal box to be inserted on one or more of the movable bronchial semirings, instead of ceasing before doing so, as in *Todus*. In *Galbula* there is a bony box nearly similar to that of *Todus*, but with its sides more strongly concave below, and produced downwards anteriorly into strongly projecting points; the lateral muscle only passes on to the *lower* margin of the box, thus stopping short, as in *Todus* and *Momotus*, of the movable bronchial semirings.

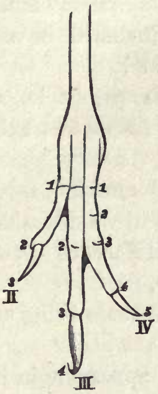
As regards the pterylosis, there is a strange oversight on the part of Nitzsch * and Murie † as to the condition of the oil-gland, both these observers stating it to be nude. In fact it is, in all the four species of the genus, provided with a very well developed, and even long, tuft of plumes, therein completely differing from that of the Momotidæ, in which the tuft is either altogether absent or quite rudimentary ‡. In both *T. viridis* and *T. dominicensis* I count twenty remiges, ten being secondaries; Nitzsch and Murie give nine, having apparently failed to observe the most proximal, smallest one. Nitzsch's figure of the pterylosis in *Todus*, having nearly certainly been constructed from an examination of the skins only, is not quite accurate—it making the outer pectoral branch to the inferior tract too markedly divergent, and not showing the weaker lines of contour-feathers that run from its apex to the hypopterum. The connexion between the dilated part of the main pectoral tract as it passes on to the breast and the patagial feathering is also made unduly important in his figure, this connexion in reality consisting only of some
P. Z. S. 1882, slight, scattered, irregularly-placed contour-feathers lying outside the
p. 446. main tract on the surface of the breast, between that tract and the patagial one.

Concerning the external characters of *Todus*, I may remark that the structure of the foot, when carefully compared with that of the Momotidæ, presents considerable differences. In the first place, the long tarsometatarse, instead of being covered by distinct transverse scutes anteriorly, and by two or more series of smaller scutella behind, is "ocreate," being invested anteriorly by a single long scute, without any traces of division; this spreads round both external and internal aspects of the leg, leaving behind a narrow margin of naked skin, with some indication of scutellation. The feet (fig. 2) are much more syndactylous than they are in the Momotidæ. The second digit is united to the third *beyond* the first phalanx of each, and the third to the fourth *beyond* the second joint of the third. In *Momotus* and its allies (*vide* fig. 3) the union between the second and third digits only extends for about the basal half of their first

* 'Pterylography,' Ray Soc. ed. p. 88. † *L. c.* p. 679.
‡ *Cf.* Garrod, *l. c.* p. 427.

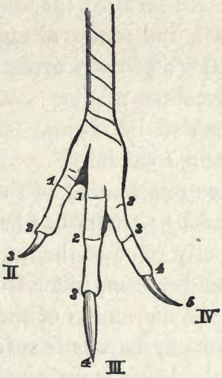
phalanges, and that of the third and fourth for about half the second phalanx of the former. The feet of *Todus* resemble rather those of the Kingfishers, though the syndactylism has advanced further than in these birds. The position of the hallux is quite normal, it being directed

Fig. 2.



Foot of *Todus dominicensis.*

Fig. 3.



Foot of *Momotus lessoni.*

altogether backwards, *not* largely inwards, as imagined by Dr. Murie. The nostrils have a well-defined circular aperture; they lie, unconcealed by the frontal plumes, close to the culmen. Behind them, and extending back as far as the gape, is a well-developed series of rictal vibrissæ, directed downwards and forwards. Another smaller patch of similar vibrissæ, but directed *upwards*, springs, as in *Steatornis*, from the inter-ramal skin of the lower jaw just behind the mandibular symphysis.

Dr. Murie has so elaborately described the osteology of *Todus viridis* that I have not much to add to his account.

In the two skeletons of that species which I possess the manubrium sterni is distinctly bifurcated, therein departing from the Momotidæ and reminding one of the Passeres, and of *Merops*, *Harpactes*, &c. P. Z. S. 1882, p. 447.

Careful examination of the skull of that species, as well as of one of *Todus dominicensis*, has shown me that the lower edge of the nasal septum is, for its entire extent, free from the inner edges of the maxillo-palatine plates, a narrow fissure existing on each side between it and them, along which it is possible, with care, to pass the blade of a fine scalpel. In the Motmots (of which I have examined skulls of the genera *Momotus*, *Baryphthengus*, and *Hylomanes*) the maxillo-palatines, though apposed to each other in the middle line, do not actually ankylose for the greater part of their length; so that if the skull be cut across transversely behind the line of union, and the maxillo-palatines with their connected bones separated from the rest of the skull, the two lateral halves of the separated portion fall asunder naturally, there being no union either between the maxillo-palatines themselves (for the greater part of their extent) or between them and the nasal septum, which here does not appear at all in the roof of the mouth in this region. In the Todies, though the septum thus appears, the maxillo-palatines are free altogether both from it and from one another, apparently for their whole extent *. If this is so, the Todies are not "*Desmognathæ*," and, inasmuch as they lack the vomer altogether, cannot be included in any other of Prof. Huxley's primary groups of Carinatæ at all!

The vertebræ number 35, exclusive of the pygostyle, as already correctly stated by Murie. Of these I reckon 15 as cervical, 5 dorsal, 8 sacral, and 7 caudal †.

The close relationship of the Todidæ to the Momotidæ having been so often urged by some of our best naturalists, it will be desirable to point out succinctly some of the important points of difference between them.

The Todidæ, then, differ from the Momotidæ,

(1) In the non-union of the maxillo-palatines, these being attached in the Motmots by harmonic suture.

(2) In the lower margin of the nasal septum appearing in the roof of the mouth between the free edges of the maxillo-palatines. In the Motmots the nasal septum—which ankyloses with the maxillo-palatines anteriorly—does not appear in the palate.

(3) In the complete absence of a vomer, always represented in the Momotidæ by a small, but distinct, ossicle.

(4) In possessing a well-developed lacrymal, quite absent (or early ankylosed with the frontals) in the Motmots.

P. Z. S. 1882, p. 448. (5) In the very slight development of the ascending plates of the palatines, well represented in the other group.

(6) In the small amount of ossification in the interorbital septum, this, in the Motmots, being nearly entirely osseous.

(7) In the shape of the sternum, this having four distinct and deep notches (the outer pair being far the larger) never converted into foramina, and separated by delicate xiphoid processes. In the Motmots the inner pair at least (*Hylomanes*), but usually both (*Momotus*, *Baryphthengus*, *Eumomota*) are converted into smallish foramina.

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* It is impossible to state for certain how far anteriorly the maxillæ extend, from a study of the adult skull only; but in *Todus* the osseous roof of the mouth is incomplete as far forwards as the anterior end of the unusually large nares, so that probably it is only by the union of the dentary plates of the præmaxillæ that it is completely ossified here.

† Defining as "dorsal" all those, whether ankylosed to the sacrum or not, that bear ribs united directly or indirectly with the sternum. Those that precede, whether or not bearing ribs, are "cervical;" those that follow, and are ankylosed together, are "sacral," the remainder being "caudal."

(8) In the tendency to bifurcation of the manubrium sterni.

(9) In possessing 8 sacral and 7 caudal vertebræ, as opposed to 11 and 6 in the Momotidæ *.

(10) In the oil-gland having a large tuft of plumes on its apex, this being quite or almost altogether absent in the Momotidæ.

(11) In the better development of the rictal and mandibular vibrissæ.

(12) In the ocreate tarsus, which is very long, whereas in the Momotidæ it is transversely scutellated and short.

(13) In the much greater syndactylism of the toes.

(14) In the less development of the outer pectoral branch of the inferior tract, which, in *Momotus* at least, is given off much nearer the anterior margin of the breast, and diverges much more than in *Todus*.

(15) In the shape of the tongue in the Motmots, apically frayed-out and brush-like, and with the lacerations of the margin directed forwards, not *backwards*.

(16) In the possession of large and well-developed intestinal cæca, these being *completely absent* in all the Motmots.

(17) In the triangular shape of the obturator internus, this in the Motmots being oval.

(18) In the conformation of the syrinx.

Of special points of resemblance between Todies and Motmots I am unaware of any that can be considered characteristic of these two families as a group, the points in which they do approach each other being equally met with in other allied birds. Thus the simple dorsal tract of *Todus* and *Momotus* reappears in *Alcedo*, as do the crenulated beak-margins in *Merops* †. Neither is the termination of the *expansor secundariorum* muscle on the *teres* peculiar to the two groups in question, as it is found, as already observed, in some Kingfishers, as well as in *Steatornis*.

The resemblance between the termination of the *tensor patagii* tendons in the two families is perhaps the best-marked feature of special resemblance; but, as already pointed out, though the arrangement is similar, it is not identical, whilst, on the other hand, that characterizing the Todies could easily be produced by a slight modification of that found in some of the other groups of Anomalogonatæ. P. Z. S. 1882, p. 449.

In the face, then, of the many important differences that exist in all

* In all the Momotidæ I have examined (including the genera *Momotus*, *Baryphthengus*, and *Hylomanes*) this is the number of these vertebræ, the total being 37, except *Baryphthengus*, which has only 36, by the reduction of its dorsal vertebræ to 4 (C. 15, D. 4, S. 11, Cd. 6=36). Dr. Murie, after stating the number of the vertebræ in the Motmots to be 36, 37, or 38, curiously enough gives the number characteristic of *Todus* (35) as one of the characters of his group "Serratirostres," in which he includes the Motmots (Ibis, 1872, p. 410)!

† As already pointed out by Murie, Ibis, 1872, p. 398.

parts of the structure of the two forms, and in the absence of any special features common to them, I cannot agree to the proposition that the Todies are more closely related to the Motmots than to any other group.

In the possession of cæca and in the conformation of their pectoral tract the Todies agree with all Garrod's "Passeriformes," with one of the families of which indeed, the Galbulidæ, one of the most acute ornithologists that has ever lived, the late Mr. Blyth, associated them as a special group, "Angulirostres" *. On the other hand, in possessing a well-developed tuft to the oil-gland, the Todies differ altogether from the Passeriform series of Anomalogonatæ. Detailed comparison of the structure of the Todies with that of the other families of this great group is unnecessary, none of them possessing features indicating such affinities to the former as to render probable any particular genetic connexion of the two.

As Dr. Murie has already remarked, "*Todus* is inconsistent in several respects" †, a truth made more obvious by the facts above recorded. In the possession of *cæca* combined with the tuft to the oil-gland, *Todus* presents an exception to Garrod's definition of his group Anomalogonatæ ‡, though it agrees with all of them in the absence of both the ambiens and accessory femoro-caudal muscles. Nevertheless it is certain, from its characters generally, that *Todus* is an Anomalogonatous bird, though its isolation from any other of the families of that group seems to me to preclude its insertion in the Piciformes, Passeriformes, or Cypseliformes of Garrod §. It is impossible, I think, to say that *Todus* is more clearly related to any of the Piciformes than it is to the Passeriformes; and to include it the definitions of either of those groups would have to be altered. I propose, therefore, to create a group of equivalent value to those just named, which may be called "Todiformes," and of which *Todus* is the sole living representative.

Next, as to the meaning of these facts. I think few ornithologists who have carefully considered the question can doubt that the "Anomalogonatæ" of Garrod are a natural group of birds ||, *i. e.* one descended from a common ancestor. On this view this ancestor must have possessed the *sum* of the characters—supposing, unless there is reason for the contrary, that the latter have not been *re*-developed, and excluding

P. Z. S. 1882, p. 450. those that may reasonably be supposed to be adaptive, or more recently

* Charlesworth's Mag. Nat. Hist. ii. 1838, p. 361.

† P. Z. S. 1872, p. 678.

‡ P. Z. S. 1874, p. 118; Coll. Papers, p. 216.

§ *L. c.* p. 222.

|| It is nearly certain that the Cuculidæ and Musophagidæ, as also the Psittacidæ, are in no way related to the other so-called Picariæ.

acquired—exhibited by its existing descendants. As most of the Anomalogonatæ possess *either* well-developed cæca, *or* a tufted oil-gland, whilst *all* lack the ambiens and accessory femoro-caudal muscles, it may be presumed with some certainty that the ancestor of the group generally possessed both well-developed cæca and a tuft to the oil-gland—the first having disappeared in the Piciformes, the latter in the Passeriformes, and both in the highly specialized Cypseliformes: at the same time it was destitute of both ambiens and accessory femoro-caudal muscles. The existence of *Todus* therefore exactly substantiates what might have justly been inferred *à priori* on purely theoretical grounds; whilst its insular habitat, the small number of species, and their diminutive size are exactly what might have been expected of a very ancient and synthetic form, which has been unable to hold its own, on the larger areas, with more lately developed and highly specialized forms. On the other hand, it is not to be expected, on the doctrine of descent, that any *living* form, however synthetic, should be *exactly* intermediate between any other two *living* groups, because it is nearly certain to have been modified in some points *pari passu* with those forms to which it (or, rather, its ancestors more or less remote) gave origin. There are structures in other families of the Anomalogonatæ—as, *e. g.*, the *biceps*-slip of the Caprimulgidæ, the *gluteus quintus* of the Coliidæ, the vomer and the *gluteus primus* of several—which are not represented at all in *Todus*. These *may*, of course, have been independently reacquired; inasmuch as, however, they are all structures met with in the Homalogonatous birds—from some form of which I cannot doubt that the Anomalogonatæ are descended—it is more probable that they have been inherited directly from a common ancestor which possessed these along with the other structural characters of the Anomalogonatæ. That one or more of such structures should have disappeared in *Todus*, though present in the hypothetical common ancestor, is in no way surprising. I submit, in conclusion, therefore,

(1) That *Todus* is a much isolated form, with affinities to both the Passeriformes and Piciformes of Garrod.

(2) That it cannot be substantiated that *Todus* is clearly allied to any particular living form of these.

(3) That this view may be most correctly expressed by making a group Todiformes, equivalent to Passeri-, Pici-, and Cypseliformes, for the sole reception of the genus *Todus*.

(4) That in all probability *Todus*, though in some respects much modified and specialized, represents more nearly than any other existing form the common stock from which all the living groups of Anomalogonatous birds have been derived.

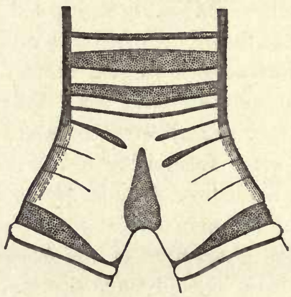
P. Z. S. 1882, p. 455.

61. NOTE ON SOME POINTS IN THE ANATOMY OF AN AUSTRALIAN DUCK (*BIZIURA LOBATA*).*

Two male specimens of *Biziura lobata*, the first the Society has received, were purchased of a dealer in February last; both were in very weak condition when received, and, unfortunately not recovering, did not long survive. The trachea of this bird being, so far as I know, unknown, I take this opportunity of describing it, as well as of adding some notes on other points of its structure.

The trachea is of nearly uniform calibre throughout, with no dilatation anywhere in its course; below it is perhaps a little narrowed as it approaches the bronchi, but in no degree laterally compressed, as it is, *e. g.*, in such genera as *Anser* or *Cereopsis*. There is no syringeal *bulla* formed at its thoracic end, there being merely, as will be seen from the annexed drawing (fig. 1), a simple ossified box, notched in front and

Fig. 1.



Lower part of the trachea of *Biziura lobata*.

behind, and with a narrow pessular bar below. This is formed by the few last tracheal and early bronchial rings co-ossified together, though not equally so on each side, or before and behind. The four or five preceding tracheal rings differ from those higher up the tube in being narrower and of more uniform breadth throughout, not being notched and incompletely ossified in the middle line, both before and behind, as these are. The bronchi are quite normal in structure, being non-dilated, and with partly ossified semirings of the ordinary form.

In the non-development of a *bulla*, whether osseous or partly membranous, and in the perfectly simple character of its trachea, *Biziura* differs from all the forms of ordinary Ducks known to me, all the genera

* Proc. Zool. Soc. 1882, pp. 455–458. Read May 16, 1882.

of these that have been as yet examined exhibiting, in the male sex, either one or other of (or, more rarely, both) these peculiarities. The condition of the male *Biziura* is nearly identical with that found in the females of other Ducks. Very probably it may be that characteristic of all the Erismaturinæ, of which, however, only *Erismatura rubida* has, so far as I know, been examined as regards this point. In that species

P. Z. S. 1882, p. 456.

Fig. 2.

Mouth of *Biziura lobata*.

the syrinx, judging from Macgillivray's description *, is quite similar to that of *Biziura*, there being no *tympanum* whatever, but simply a long box formed of several rings united.

The examination of these two specimens has revealed a feature in them very unexpected in Ducks, and only comparable with that found in

* Audubon, Orn. Biography, iv. p. 331.

certain Bustards. This is the possession of a small, but distinct, *subgular pouch*, formed, as in the males of *Otis tarda*, by the duplicature of the *frænum linguæ* *. On opening the mouth, the tongue being forced up against the roof of the mouth as is depicted in fig. 2, there is seen at its base, some way behind the level of the basihyal, a small circular aperture, about the size of a pea, lying between the two folds of the *frænum*, the left of which is much stronger and better developed than the right. This aperture is the mouth of a small pouch, almost large enough to receive the end of the little finger, which extends backwards for some little distance to the base of the tongue, its breadth being nearly as great as that of that organ. This pouch is lined by mucous membrane of similar character to that found over the adjacent parts of the mouth; its anterior limit extends forwards as far as the posterior end of the curious wattle attached to the lower jaw; but there is no connexion between the two, the wattle being merely formed by a fold of the integuments, with no cavity contained in it.

P. Z. S. 1882, p. 457.

The observations hitherto made on the habits of *Biziura* in its native state fail to throw any light on the use or *raison d'être* of this curious structure, though, judging from analogy, it is nearly certain that it is in some way connected with display during sexual excitement, and therefore confined, as we know the wattle is, to the male sex. The first specimen I examined had, I may remark, the pouch less developed than in the second one, probably an older bird. It is not improbable that further observations may show that, in thoroughly adult and breeding birds, this pouch acquires much greater dimensions than was the case in these two specimens.

As regards other points, *Biziura* is in most of its features thoroughly Anatine. The tongue is quite duck-like, though very broad. There is a well-developed penis of the peculiar type found in other Anatidæ. The number of remiges is 28, of which ten are, as usual, primaries. The pollex bears a small claw. There are 24 rectrices, a number not exceeded in any of the Anseres, though found in certain Swans. All are peculiarly stiff and curved, with flat lamellar rhachises. The cæca are long, measuring 6·75 and 7·75 inches respectively in the two specimens. The ambiens muscle is large, and peculiar in that its tendon *perforates* the large-sized triangular patella, just as it does in *Phalacrocorax* and the extinct *Hesperornis*.

The carina sterni is shallow, as might have been expected in a bird with such weak powers of flight as *Biziura* has. There is a minor myological peculiarity in the hind limb of *Biziura*, such as I have not yet observed in other Anserine birds. In all these the *flexor longus hallucis*

* Murie, P. Z. S. 1869, p. 140; and Garrod, Coll. Papers, p. 245.

and *flexor profundus digitorum* blend together towards the lower part of the tarso-metatarse, a comparatively very insignificant tendinous slip being given off from the tendon of the first-named muscle to the hallux before it blends with the other *. In *Biziura* the two tendons completely blend, but the small tendinous slip, given off, as usual, before they unite, does not go to the *hallux* as it normally does, but continues down to the bottom of the bone, and is there lost on one of the annular masses of fibro-cartilage surrounding the other flexor tendons. The *flexor brevis hallucis*, which is present, though small, is thus the only functional flexor of that digit. P. Z. S. 1882, p. 458.

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62. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—PART V.† ON THE STRUCTURE OF THE GENUS *ORTHONYX*. ‡

P. Z. S. 1882, p. 544.

THE position in the series of Passeres of the genus *Orthonyx* has for many years been a moot point with ornithologists, Johannes Müller having long ago § surmised that these birds might be tracheophones, and so connected with the Neotropical Dendrocolaptidæ. Some recent writers (*e. g.* G. R. Gray, Bonaparte, and Salvadori) have placed them in, or in the neighbourhood of, the Menuridæ; Sundevall, on the other hand ||, assigns them a position amongst his Cichlomorphæ Brevipennes.

Up to the present time the formation of their soft parts, and particularly of the syrinx, has remained unknown—a deficiency in our knowledge I am now able to supply by my dissection of both the Australian and New-Zealand forms. For my specimens of the former (*Orthonyx spinicauda*) I am indebted to the kindness of Mr. E. P. Ramsay, of the Australian Museum; for a pair of the latter (*O. ochrocephala*) to that of my friend Prof. Jeffery Parker, of the University of Otago.

Both forms are *typical* Singing-birds (" Oscines Normales "), with a well-developed Oscinine syrinx with its normal complement of *four* pairs of muscles. Of these the *short* anterior muscle runs to the anterior end of the third bronchial semiring alone in *O. spinicauda*; whilst in *O. ochrocephala* this ring receives its muscular supply from a fasciculus of the *long* anterior muscle. They thus differ essentially from *Menura*,

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* Garrod, Coll. Papers, pp. 293 and 298.

† For Part IV. see above p. 217.

‡ Proc. Zool. Soc. 1882, pp. 544–546. Read June 6, 1882.

§ In 1848. *Vide* 'Vocal Organs of Passeres,' Garrod's edition, p. 36.

|| 'Tentamen,' pp. 9 & 11.

with which they have been associated, that bird having but *three* pairs of muscles, peculiarly arranged *.

In this, as in all other points examined—with one exception in the case of *Orthonyx spinicauda*—these birds quite resemble the normal Passeres, as they do in having the bilaminate tarsus and reduced "first" (tenth) primary nearly always associated with the normal Acromyodian syrinx. *Orthonyx spinicauda*, however, has a peculiarity quite unknown to me in any other bird, inasmuch as its carotid artery, the left alone of these vessels (as in all Passeres) being developed, is not contained anywhere in the subvertebral canal, but *runs up superficially in company with the left vagus nerve* to near the head, where it bifurcates in the usual manner. This is just the same arrangement as that which occurs in many of the Parrots—all those in fact included in Garrod's "Psittacidæ" †,—save that in them the right carotid artery as well is present, running as usual in the hypapophysial canal.

P. Z. S. 1882, p. 545. In *Orthonyx ochrocephala* the left carotid retains its normal situation, though the point of entrance into the canal is somewhat higher up than is usual in other Passeres.

Examination of my spirit-specimens of these two birds has convinced me that the two forms are not really congeneric, the New-Zealand bird (*O. ochrocephala*) differing from the Australian in its more slender bill, less development of the nasal operculum, less spiny tail, and more slender claws. The coloration of the two forms is quite unlike ; whilst internally the skull and syrinx exhibit differences, slight in amount, but greater than those usually found in birds of the same genus. Under these circumstances it seems that *Clitonyx* of Reichenbach ‡ will be the correct generic term for the New-Zealand birds, as Lesson's name *Mohoua*, though of prior application §, is not only barbarous but, what is more important, liable to be confounded with *Mohoa*, also a genus of Passeres from the Pacific Subregion.

In the present unsatisfactory condition of the systematic grouping of the Oscinine Passeres, it is impossible for me to point out clearly any definite position either for *Orthonyx* or *Clitonyx*, though both forms might, I apprehend, be safely placed in Mr. Sharpe's somewhat vaguely-defined "Timeliidæ."

The determination of the not-intimate relation of *Orthonyx* to *Clitonyx* is a point of some importance, from its bearing on the question of the general relationships of the fauna of New Zealand to that of Australia,

* Garrod, Coll. Papers, pp. 362-364.

† Coll. Papers, p. 255.

‡ Handb. Spec. Ornith. p. 167 (1851).

§ Hist. Natur. Oiseaux, iii. p. 139 (1837).

Orthonyx having been sometimes mentioned as one of the few peculiar Australian genera of birds also represented in the satellite island *.

I may take this opportunity of stating that I have, in the course of the last few months, been enabled to examine examples of several genera of Passeres the condition of the syrinx in which has not before, I believe, been recorded. These include, of Old-World forms, *Rimator*, *Ptenœdus*, *Sphenura*, *Sphenostoma*, *Climacteris*, *Creadion*, *Miro*, *Certhiparus*, *Petrœca*, *Entomyza*, *Pomarea*, *Phæornis*, *Falcunculus*, *Nesocichla*, *Nesospiza*, *Cracticus*; and of American forms, *Chamæa*, *Dulus*, *Phainopepla*, *Ptilogonys*. In all these genera the syrinx is perfectly Oscinine, as indeed was to be expected from the external structure of the birds. Johannes Müller at first placed *Ptilogonys* amongst the Tyrannidæ †, misled by the slightly aberrant structure of its tarsus, but on subsequently examining the nearly allied *Myiadestes*, and ascertaining its Oscinine nature, concluded that *Ptilogonys* too would, on examination, be found to have the muscular organs of voice ‡, a surmise the correctness of which is now demonstrated. *Petrœca* has been stated by Prof. Parker § to be a "Tracheophone" (*i. e.* Mesomyodian), having "the muscles of lower larynx quite indistinct." P. Z. S. 1882, p. 546.
In three specimens, however, of that genus examined by me I find a perfectly Oscinine syrinx with its muscles as well developed as in other birds of the same size. Whether the statement made by that author to the same effect about *Sittella* is accurate still remains to be seen.

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63. ON THE RUDIMENTARY HALLUX OF BIRDS ‖.

P. Z. S. 1882, p. 548.

Mr. W. A. Forbes exhibited preparations showing the rudimentary hallux of several birds commonly described as three-toed, and made the following remarks :—

"Whilst engaged in working out my 'Report on the Anatomy of the Petrels' for the 'Voyage of H.M.S. Challenger,' I happened to come across Dr. Kidder's note ¶ on the existence of a rudimentary external hallux in *Phœbetria fuliginosa*, a bird hitherto supposed, like other Albatrosses, to lack the hind toe altogether. Finding, on an examination of my specimen, his remarks correct, I proceeded to examine examples

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* Wallace, 'Geogr. Distribution of Animals,' i. p. 451 ; but see also 'Island Life,' p. 453, footnote.

† Vocal Organs of Passeres, Garrod's ed. p. 41.

‡ *L. c.* p. 61.

§ Trans. Z. S. ix. p. 336.

‖ Proc. Zool. Soc. 1882, pp. 548, 549.

¶ Bull. U.S. Nat. Mus. i. p. 22.

of three other species of Albatrosses that I had in the flesh, namely *Diomedea exulans*, *D. brachyura*, and *Thalassiarche culminata*. In all of these I discovered a hallux present, though in a most rudimentary condition, consisting of a single small nodule of bone, which lies altogether underneath the skin, in the fibrous subcutaneous tissues, and only appears externally as a minute pimple-like elevation, with *no* claw. In *Phœbetria* there is a minute claw visible externally, whilst internally *two* small bony nodules are discernible, representing undoubtedly the metatarsal element and the hallux, which, as in all other Tubinares, is reduced to a single phalanx. It is difficult at present to say whether the single nodule of the other Albatrosses represents these two elements fused together, or only one of them: in the latter case it is probably the phalanx itself that is wanting *.

"The discovery of the rudimentary hallux in the Diomedeinæ has led to finding a similar one in some other birds usually considered to be three-toed, namely the Woodpeckers of the genera *Picoïdes* and *Tiga*. In these the hallux consists of its normal number of phalanges, of minute size, as is also the metatarsal. The 'great toe' thus formed lies completely under the skin, and is only discernible on reflecting the integuments carefully, when the chain of minute ossicles, connected to each other and to the tarso-metatarse by fibrous tissue, appears.

"These facts render it not improbable that a similarly reduced hallux
P. Z. S. 1882, p. 549. may really exist in many birds commonly described as three-toed. On the other hand, I have been quite unable to detect even a trace of it in some such birds, as *e. g. Rhea*, *Tetrax*, and *Pelecanoïdes*.

P. Z. S. 1882, p. 569.

64. CONTRIBUTIONS TO THE ANATOMY OF PASSERINE BIRDS.—Part VI.† ON *XENICUS* AND *ACANTHISITTA* AS TYPES OF A NEW FAMILY (*XENICIDÆ*) OF MESOMYODIAN PASSERES FROM NEW ZEALAND.‡

A few months ago I received, through the kindness of my friend Prof. Jeffery Parker, of the University of Otago, New Zealand, a small collection of birds in spirit from that country, which included most of the peculiar forms of Passeres found there. Amongst them were single specimens of *Xenicus longipes* and *Acanthisitta chloris*, the examination of which has proved to be of especial interest.

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* *Cf.* Voyage of H.M.S. 'Challenger:' Report on the Anatomy of the Petrels, pp. 13, 14.

† For Part V. see above, p. 357.

‡ Proc. Zool. Soc. 1882, pp. 569–571. Read June 20, 1882.

The genus *Xenicus* was founded by the late Mr. G. R. Gray * for the reception of the *Motacilla longipes* of Gmelin †, Lafresnaye having some twenty years previously established *Acanthisitta* for Sparrman's *Sitta chloris* ‡.

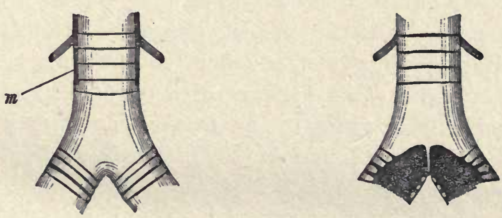
Subsequent ornithological writers have pretty unanimously assigned both these forms to the "Certhiidæ" or their immediate neighbourhood, in company with *Sitta*, *Sittella*, and their allies. The peculiar structure of the tarsus in *Xenicus* first induced me to examine these birds more closely, with the unexpected result that I find that the two genera in question are true Mesomyodian forms, and therefore in no intimate degree related to such Oscines as those just mentioned.

The subjoined drawings of the syrinx of *Xenicus*—with which in all points *Acanthisitta* appears to agree in every essential respect—will show that it has none of the complex nature of that organ in the Oscines, the thin lateral tracheal muscle terminating on the upper edge of a somewhat osseous box formed by the consolidation of the last few tracheal rings, and there being no other intrinsic syringeal muscle whatsoever. The box has a well-developed antero-posterior pessular piece. The bronchial rings are throughout of quite simple form, and are separated by but narrow intervals. None are modified in form to serve for the insertion of a vocal muscle, as the latter terminates higher up, as already described, on the tracheal box, and therefore quite out of the region of the bronchi.

P. Z. S. 1882, p. 570.

The lateral position of the single syringeal muscle is that characteristic of all the Mesomyodian Passeres, though in most of these it terminates on one of the bronchial rings, and not, as in the birds under consideration, on the sides of the trachea. This may easily be seen by comparing the

A B



Syrinx of *Xenicus longipes*, much enlarged.
A. From in front. B. From behind.
m. Lateral tracheal muscle.

accompanying figures of *Xenicus* with the beautiful series given by

* Ibis, 1862, p. 218. † Rev. Mag. Zool. 1842, Ois. pl. xxvi.
‡ Mus. Carls. fasc. 2, no. 33.

Johannes Müller of the syrinx of many of the Neotropical Mesomyodi *, with those of Garrod of *Pitta* †, or my own of *Eurylæmus*, *Cymbirhynchus* ‡, and *Philepitta* §. In fact it resembles rather that of *Todus*, as lately described and figured by myself ||. Externally the non-oscinine nature of *Xenicus* and *Acanthisitta* is at once proclaimed by the structure of their wings, which have a "first" ¶ (tenth) primary nearly as long as the preceding one, and by the non-bilaminate tarsus. The latter is covered almost completely by a single large scute, with only some very obsolete traces of transverse division below, whilst behind its edges are contiguous for the greater length of the tarsus, leaving only small areas at each end of that bone, which are covered by very small scutella of irregular form. The digits are slender and compressed, the foot being slightly syndactyle by the union of the fourth toe to the third for the greater part of its two most basal joints. The tail is short and weak; and there are only ten rectrices in each of my specimens. As there is no evidence of a pair
P. Z. S. 1882, p. 571. more having been present, this number of tail-feathers must be considered to be that normal in the present family, twelve being that universal, with a few isolated exceptions, in all other Passeres.

In all other points, *Xenicus* and *Acanthisitta* conform to the general Passerine type. There is no trace of a plantar *vinculum*. The *tensor patagii brevis* has the peculiar arrangement characterizing the Passeres, only slightly masked by the muscular fibres somewhat concealing the two superimposed tendons, as is frequently the case in the short-and-rounded-winged forms of the group. The *gluteus primus* is well-developed. The tongue is lanceolate and horny, with its apex somewhat frayed out and its base spiny. The main artery of the leg is the sciatic. The sternum has a single pair of posterior notches and a bifid manubrium. In the skull the nostrils are holorhinal, the vomer broad and deeply emarginate anteriorly, the maxillo-palatines slender and recurved.

As regards the affinities of the Xenicidæ, the "haploophone" form of their syrinx, combined with the complete loss of a vinculum, shows that it is only with the Pipridæ (including the Cotingidæ), Tyrannidæ, Pittidæ, and Philepittidæ that they can be compared. From all of these they differ markedly, however, in the number of rectrices, the ocreate tarsus, and the nature of the syrinx, the latter never having the form of a complete bony box, and never lacking a bronchial "intrinsic" muscle in any of the families just enumerated. The Pittidæ they approach somewhat in their general *facies*, short tail, and long tarsus, though the tarsal scutellation is different in the two forms.

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* Vocal Organs of Passeres: Garrod's ed., Oxford, 1878.

† Coll. Papers, pl. xxvi.

‡ *Anteà*, pp. 140, 141, 142. § *Anteà*, p. 146. || *Anteà*, p. 347.

¶ Sundevall is in error in assigning to these birds only nine remiges (Tentamen, p. 47).

The Pittidæ are also, it is interesting to note, the only other family of Mesomyodian Passeres that enters the Australian region, though they have not extended their range to New Zealand. I know at present of no other Australian Passerines that can be considered allied to the Xenicidæ; nor are there apparently any other forms than the two here described present in New Zealand itself, *Certhiparus* and *Miro* both being, as well as *Clitonyx* *, Oscines of the normal type.

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65. REPORT ON THE ANATOMY OF THE PETRELS (*TUBINARES*) COLLECTED DURING THE VOYAGE OF H.M.S. 'CHALLENGER.' †

Zool. Chall. Exp. vol. iv. pt. xi. p. 1.

(Plates XII.–XXIV.)

I. Introductory.

Materials for the knowledge of the structure of the soft parts of the class Aves, when the members of that group indigenous to a country have been examined, are for the most part only to be obtained through the medium of zoological gardens, by the inhabitants of these, on their decease, coming into the hands of some person competent to examine them. In spite of the increased facilities of communication of the present day, and the greater experience of those in charge of living zoological collections, there still remain many groups of birds which as yet it has been found impossible to obtain or keep in a living state. Such birds in consequence can only be adequately studied from spirit-specimens, and these also it is frequently very difficult to obtain, especially if the species wanted are of large size, or inhabit little-explored and inaccessible countries.

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* *Vide anteà*, p. 358.

† Report on the Scientific Results of the Voyage of H.M.S. 'Challenger' during the Years 1873–76 under the command of Captain George S. Nares, R.N., F.R.S., and Captain Frank Tourle Thomson, R.N. Prepared under the superintendence of the late Sir C. Wyville Thomson, Knt., F.R.S., &c., Regius Professor of Natural History in the University of Edinburgh, Director of the Civilian Scientific Staff on Board, and now of John Murray, F.R.S.E., one of the Naturalists of the Expedition. Zoology: vol. iv. pt. xi. pp. 1–64, Pls. I.–VII. (1882).

[Note.—After the lamented death of Professor A. H. Garrod, Mr. W. A. Forbes was induced to undertake the Anatomical examination of the Petrels collected during the cruise of the 'Challenger.' The result of Mr. Forbes's labours is given in the present Report. This contribution will be found a most valuable addition to the literature on this remarkable order of pelagic birds.

The paper was received on the 6th May, 1882.—John Murray.]

The group of PETRELS is one that has till the present been hardly at all examined anatomically, as but few species inhabit the European seas, and even these, on account of their peculiar habits, are rarely to be obtained in the flesh, either in a living or dead state. The majority of the group, inhabiting the little-visited oceans and islands of the Southern Hemisphere, have been known simply from skins or skeletons, the great size of many of them rendering bringing their bodies home in spirit impracticable to any ordinary collector. Nor have we as yet succeeded in obtaining or keeping any in a living state, except on one or two rare occasions.

When therefore H.M.S. 'Challenger' was starting on her voyage of circumnavigation it seemed that an excellent opportunity would be afforded for obtaining material to fill up the blank that thus existed in our knowledge of the Petrels. At the suggestion of my lamented predecessor Prof. A. H. Garrod, at that time Prosector to the Zoological Society, the naturalist staff was requested to pay special attention to forming a collection of these oceanic birds in spirit, so as to be available for anatomical examination. The result was a very considerable collection indeed of the birds in question, all excellently preserved, and including nearly all the most important and interesting of the known genera. These were handed over, when the collections were being broken up for working out, to Professor Garrod for examination. Unfortunately he had hardly commenced to work seriously on them before he was struck down by the lingering illness which eventually proved fatal to him. During that time, whenever well enough to do so, he continued to work away at his favourite subject, and many of his drawings made then, chiefly relating to the conformation of the syrinx in these birds, are now before me. An unfinished MS. paper of his written about that time, treating on the anatomy of the Diving Petrel (*Pelecanoïdes*)—a form the Procellarian affinities of which were then doubtful—was sufficiently complete and important to justify, in the writer's opinion, its publication in the reprint of Professor Garrod's papers which has since been edited by him.

Zool. Chall. Exp. vol. iv. pt. xi. p. 2.

Succeeding to Professor Garrod's position at the Zoological Gardens early in 1880, I applied immediately to the late Professor Sir Wyville Thomson to be allowed to retain so much of the material collected by the 'Challenger' as was likely to prove of service to me in my researches on the anatomy of birds, and I especially asked to be allowed to retain the collection of Petrels, with the object of drawing up a report thereon for the present series of papers. I must take this opportunity to record my best thanks to Sir Wyville Thomson for the very ready way in which he acceded to both my requests. Having commenced work on the specimens of Petrels collected by the 'Challenger' it seemed desirable to make my report on the structure of that group as perfect and complete as possible, and during the past two years I have therefore taken every

List of Material Examined.

Zool. Chall. Exp. vol. iv. pt. xi. p. 3.

Name of Bird.	Number of Specimens.	Remarks.
Oceanitidæ.		
Oceanites oceanicus	3	One from the Smithsonian Institution.
Garrodia nereis	4	One from the Godeffroy Museum in Hamburg. The other three old specimens from the Museum of the Royal College of Surgeons.
Pelagodroma marina	1	
Fregetta grallaria	2	One a skinned trunk.
—— melanogastra	2	From the Godeffroy Museum.
Procellariidæ.		
Halocyptena microsoma	1	(I must thank Mr. Salvin for his kindness in allowing me to dissect his spirit-specimen of this extremely rare bird, previously only known from the type specimen in the Smithsonian Institution.)
Procellaria pelagica	3	Prosector's stores.
Cymochorea leucorrhoa	5	Two, one a chick, from the Smithsonian Institution. Three from Prosector's stores.
Bulweria columbina	1	O. Salvin, Esq.
—— macgillivrayi	1	Received from Canon Tristram (skinned trunk only).
Œstrelata mollis	1	An old specimen from the College of Surgeons.
—— lessoni	1	
—— sp. inc.	1	
—— brevirostris	8	All young (two from the Transit Expedition).
Majaqueus æquinoctialis	3	One young.
Puffinus obscurus	4	
—— brevicauda	3	
Pagodroma nivea	1	
Daption capensis	2	One from the Zoological Society's Gardens.
Aeipetes* antarcticus	2	
Thalassœca glacialoides	1	
Fulmarus glacialis	2	Zoological Society's Gardens.
Ossifraga gigantea	2	One, a nestling, from the Transit Expedition.
Prion vittatus	1	
—— banksi	2	One from Celebes (O. Salvin, Esq.), one from the College of Surgeons.
—— desolatus	4	One a chick.
Pelecanoïdes urinatrix	7	Two young.
Diomedea brachyura	2	
—— exulans	2	
Thalassiarche culminata	1	
Phœbetria fuliginosa	1	A nestling.

In all thirty-one species, represented by seventy-four specimens and belonging to twenty-two different genera. Besides the above, which only represent entire birds, there were a number of separate heads, which have been cleaned, and will be found enumerated below in the list of osteological material in this group examined by me.

* For the characters of this new genus *vide infrà*, p. 426.

Zool. Chall. Exp. vol. iv. pt. xi. p. 2.

opportunity of acquiring specimens of them fit for dissection. By these means I have been enabled to examine several species and genera of these birds not represented in the 'Challenger' collection, though that collection has formed the groundwork of my investigations.

I herewith give a complete list (p. 365) of those species that I have been enabled to examine in the flesh. All not otherwise indicated were collected by H.M.S. 'Challenger.' And I must take this opportunity to thank my friend Mr. Osbert Salvin, F.R.S., who reported on the collection of Tubinares made in skins during the voyage *, for his kind assistance in naming the spirit-specimens under my charge, as well as for much subsequent assistance in points of nomenclature, and for valuable material that would not have otherwise been available.

Zool. Chall. Exp. vol. iv. pt. xi. p. 4.

II. Previous Literature on the Anatomy and Classification of the *Tubinares*.

I propose under this head to briefly notice the more important papers or memoirs that have appeared dealing with the structure and classification of these birds. Titles of several less important ones not mentioned here may be found duly recorded in the third instalment of Dr. Coues's 'Ornithological Biography' †, Procellariidæ, pp. 1021–1033.

1826. One of the very earliest contributions to the anatomy of the Petrels we owe to the voyage of circumnavigation made by the 'Coquille.' Garnot, in the account of that expedition ‡, gives some brief anatomical notices chiefly relating to the digestive organs of several Tubinares. The species dissected are, unfortunately, not referred to by scientific names, but they appear to be *Phœbetria fuliginosa*, *Thalassœca glacialoides*, a *Prion*, *Fregetta melanogastra*, and *Pelecanoïdes urinatrix*, as well as another species I cannot determine (" Petrel de la Mer Pacifique ").

In 1827 L'Herminier § described the general character of the sternum of the Tubinares, which formed his twenty-eighth family of birds, and proposed to divide the group up, on sternal characters, into three sections —(1) the smaller Petrels (*Procellaria*, *Cymochorea*, &c.) with the posterior margin of the sternum more or less entire; (2) the Albatrosses, with the sternum with two large and shallow excavations posteriorly; and (3) the Petrels proper, with four posterior sternal excavations. As regards the general position of the group, he remarks:—" Ces oiseaux . . . par la

* Zoology of the Voyage of H.M.S. 'Challenger,' vol. ii. part viii. pp. 140–149 (Report on the Birds: XI. On the Procellariidæ collected during the Expedition). Also Proc. Zool. Soc. 1878, pp. 735–740.

† Bull. U. S. Geol. Surv. vol. v. No. 4 (Washington, 1880).

‡ Voyage autour de la Monde, Zool. tom. i.: Recherches anatomiques relatives à divers oiseaux marins, pp. 603–612.

§ Recherches sur l'appareil sternal des Oiseaux, pp. 79–81, vol. iv. (Paris, 1827).

forme de l'appareil sternal, sont intermédiaires aux mouettes et aux pélicans." On plate iv. of the plates illustrating his memoir, two figures of the sternum of a *Puffinus* are given.

1838–39. W. Macgillivray, in Audubon's 'Ornithological Biography' *, describes and figures the alimentary canal and trachea of two species of Petrels, namely, *Oceanites oceanicus* (vol. v. pp. 645–646) and of *Procellaria pelagica* (vol. iv. pp. 313–315).

In the second part of the same author's 'Manual of British Ornithology' † are given a few notes on the visceral anatomy of the British species of the group.

In the same year J. F. Brandt, in his 'Beiträge zur Naturgeschichte der Vögel' ‡, called attention to the existence of a peculiar ossicle, connected with the lachrymal and palatine bones, and hence called "ossiculum lacrymo-palatinum," which he had discovered in many of the Tubinares and also in *Fregata aquila*.

1840. It is to Nitzsch, perhaps the most acute and original ornithologist that ever lived, that we are indebted for nearly our whole existing knowledge of the important subject of the pterylosis of birds. In his classical, though posthumous, 'Pterylographie,' the Nasutæ seu Tubinares form the second group of his order Natatores, and the pterylosis of the group is described at some length. Further details of Nitzsch's observations are recorded below (*infra*, pp. 377–380) in the space devoted to the consideration of the pterylographical characters of these birds. So far as I am aware nothing else was contributed by Nitzsch to our knowledge of this group.

Zool. Chall. Exp. vol. iv. pt. xi. p. 5.

In the same year as that in which the 'Pterylographie' appeared, Rudolph Wagner, a disciple of Nitzsch's, contributed to the tenth volume of Naumann's 'Vögel Deutschlands' § some remarks on the anatomical structure of three genera of Tubinares included in that work, namely, *Procellaria*, *Fulmarus*, and *Puffinus*. These consisted of short notes on the skeleton and the thoracic and abdominal viscera, and, as far as they go, are accurate enough. The general similarity in structure of the members of this group examined, as well as of *Diomedea*, is noted, as well as many points of resemblance to the Laridæ, and particularly *Lestris*.

In the year 1844 MM. Hombron and Jacquinot communicated to the Academy of Sciences in Paris a paper entitled "Remarques sur quelques points de l'anatomie et de la physiologie des Procellaridées, et essai d'une nouvelle classification de ces oiseaux." An abstract, by the authors, is

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* Edinburgh, 1839.

† London, 1842, pp. 258–264.

‡ Beiträge zur Kenntniss der Naturgeschichte der Vögel (St. Petersburg, 1839), pp. 4–9.

§ *Loc. cit.* pp. 555–556, 587–588, 614–617.

published in the 'Comptes Rendus' for that year *. The material for their paper was obtained, I may remark, during the expedition of the French ships 'Astrolabe' and 'Zélée,' commonly known as the 'Voyage au Pôle Sud.' Basing their classification on the form and structure of the beak, palate, and tongue, they divide up the group as follows :—

1. Borders of mandibles excavated by a longitudinal furrow dividing them into inner and outer cutting surfaces. Tongue small, one-third the length of beak, sagittate, posteriorly and laterally denticulate.

Three genera—*Diomedea*; *Puffinus*, subdivided into *Puffinus* proper (*anglorum*, *obscurus*, *fuliginosus*?, &c.) and *Priofinus* (*cinereus*, *æquinoctialis*, *arcticus*?); and *Thalassidroma* (*pelagica*, *leachii* [=*leucorrhoa*], *oceanica*, *fregetta* [=*grallaria*], *marina*).

2. Edges of upper mandible with transverse lamellæ. Tongue as long as the beak, large and thick, only free at the apex.

One genus, *Prion*, divided into five subgenera—*Prion s.s.*, *Daption*, *Fulmarus*, *Ossifraga*, and *Priocella* (for *Priocella garnoti*=*Thalassœca glacialoides* of this paper).

3. Mandibles simple, with no double cutting-edges or transverse lamellæ, but with two slight, elongated "teeth"; palate smooth or nearly so; tongue of intermediate length.

One genus, *Procellaria*, separated into two groups, one with the beak quite short (*nivea*, *desolata*, *brevirostris*), the other with it long (*antarctica*, *lessoni*, *hæsitata*, Forst. [?=*Adamastor cinereus*]).

Zool. Chall. Exp. vol. iv. pt. xi. p. 6.

These points are illustrated in the atlas to the 'Voyage au Pôle Sud' (pl. xxxii.), the classification adopted being explained in the text (vol. iii. pp. 143–152) published some years later.

The genus *Pelecanoïdes* is expressly excluded from the Petrels by these authors, according to whom it is closely allied to the Little Auk (*Alle nigricans*) of our northern seas.

1849. Gray and Mitchell, in the 'Genera of Birds' †, make the Procellariidæ the fourth family of their Anseres. They are subdivided into the Diomedeinæ (of one genus) and the Procellariinæ, of which latter five genera are recognized (*Prion*, *Pelecanoïdes*, *Procellaria*, *Thalassidroma*, and *Puffinus*). The most characteristic generic characters of these are figured on plate 178.

1857. Bonaparte in his 'Conspectus' ‡ gives a list of the then known genera and species of the Procellariidæ, which he divides into three subfamilies, Diomedeinæ (*Diomedea*), Procellariinæ, and Halodrominæ. The Procellariinæ again are divided into five smaller groups, designated by letters as follows :—

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* *Loc. cit.* tom. xviii. pp. 353–358.

† *Loc. cit.* iii. pp. 646–650.

‡ Conspectus generum avium, tom. ii. pp. 184–206.

A. Fulmareæ—

Ossifraga, Fulmarus, Adamastor, Daption.

B. Œstrelateæ—

Œstrelata, Cookilaria, Pterodroma, Thalassœca, Pagodroma.

C. Prioneæ—

Prion, Halobœna.

D. Procellarieæ—

"* *Unguibus compressis"; Bulweria, Oceanodroma, Thalassidroma, Procellaria.*

"** *Unguibus depressis"; Fregetta, Pelagodroma, Oceanites.*

E. Puffineæ—

Majaqueus, Thiellus, Nectris, Puffinus.

1866. In this year Dr. Elliott Coues completed his Critical Review of the family Procellariidæ commenced in 1864 *.

This is the most complete account yet published of the synonymy and distribution of the species of this group, which is divided into 24 genera, containing 92 species (17 of these being doubtful). Following Bonaparte, the same three subfamilies are adopted, the Procellariinæ, as before, being subdivided into five groups.

The genera composing these are as follows:—

Section Procellarieæ—

Oceanodroma, Cymochorea, Halocyptena (gen. nov.), *Procellaria, Oceanites, Fregetta, Pelagodroma.*

Section Puffineæ—

Majaqueus, Adamastor, Thiellus, Nectris, Puffinus. Zool. Chall. Exp. vol. iv. pt. xi. p. 7.

Section Œstrelateæ—

Œstrelata, Pagodroma, Daption.

Section Prioneæ—

Halobœna, Pseudoprion, Prion.

Section Fulmareæ—

Fulmarus, Thalassœca, Ossifraga.

Although the names of these five sections are the same as Bonaparte's, yet the genera included in them are, it will be seen, different, the arrangement in many respects being more natural.

1867. Eyton in his 'Osteologia Avium' † describes briefly some of the more salient features of the osteology of *Ossifraga gigantea*, *Diomedea exulans* and *fuliginosa*, *Puffinus major* (and another undetermined species), and *Thalassidroma oceanica* (=? *Oceanites*). The skeletons of the *Ossifraga*, *Diomedea exulans*, and *Thalassidroma* are figured, with details of some of the bones.

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* Proc. Ac. Nat. Sci. Philad. 1864, pp. 72–91 (part 1), and pp. 116–144 (part 2); *loc. cit.* 1866, pp. 25–33 (part 3), pp. 134–197 (parts 4 and 5).

† London, 1867, pp. 221–225.

The same year witnessed the publication of M. Alphonse Milne-Edwards's great work on fossil birds *. Pages 301–341 of the first volume are devoted to the consideration of the osteology of the living Longipennes, composed of the Gulls (Laridæ) and Petrels (Procellariidæ). The Petrels are considered to be, as regards their osteological characters, allied most closely to the Gulls, with some resemblances to the Steganopodes. "Par quelques-uns de leurs caractères, les Procellarides se lient aux Totipalmes. Ainsi on ne peut se refuser à reconnaître une grande ressemblance entre la constitution de la charpente osseuse des Frégates, des Phaétons, c'est-à-dire des Totipalmes grand voiliers, et celle des Pétrels ou des Puffins. Cette analogie a d'ailleurs été parfaitement saisie par L'Herminier, qui cependant n'avait étudié que la conformation de l'appareil sternal" (*loc. cit.* pp. 302, 303).

A complete skeleton of *Prion vittatus* is figured on plate l. fig. 1, with numerous details of the bones of *Puffinus cinereus*—skull (pl. xlix. fig. 12), leg-bones (pl. li.), pelvis and humerus (pl. lii.), sternum and scapular arch (pl. liii.).

Hydrornis natator (pp. 362–365, pl. lvii. figs. 18–22), from the Miocene deposits of Langy, is perhaps allied to the Shearwaters (*Puffinus*), but the remains found (a tarso-metatarsus, and a femur of doubtful ownership) do not suffice to decide the point certainly.

Professor Huxley † places the Petrels with the Gulls, Divers, and Auks in the group Cecomorphæ of his Schizognathous series. Respecting their palate we read—"The Procellariidæ differ from the families which have just been enumerated (Gulls, Divers, Grebes, Auks, and Penguins) in the great expansion of the maxillo-palatines, which become thick and spongy, and so closely approach the middle line that, in the Albatrosses, only a very narrow cleft is left on each side of the vomer. The front part of the vomer itself is much more strongly bent downwards than in the Gulls; and the ascending process of the palatine bone is greatly produced, and becomes anchylosed with the vomer. *Procellaria gigas* [i. e. *Ossifraga*] holds a sort of intermediate place between the Gulls and the Albatrosses, the maxillo-palatines being less swollen, and the clefts between them and the vomer far larger than in *Diomedea*. In this species again the basipterygoid processes are present, though I have not been able to observe them in other Procellariidæ" (*loc. cit.* pp. 430, 431). [As regards this last sentence, as will be seen below, such basipterygoid processes are the rule and not the exception in this group.] In illustration of these remarks, views of the palate of "*Procellaria*" *gigantea* and *Diomedea exulans* are given.

Zool. Chall. Exp. vol. iv. pt. xi p. 8.

* Recherches anatomiques et paléontologiques pour servir à l'histoire des oiseaux fossiles de la France (Paris, 1867–1868).

† "On the Classification of Birds," Proc. Zool. Soc. 1867, pp. 415–472.

Of the Cecomorphæ, "the Procellariidæ are aberrant forms, inclining towards the Cormorants and Pelicans amongst the Desmognathæ" (*loc. cit.* p. 458).

1871. G. R. Gray, in the 'Hand-list of Birds'*, places the Procellariidæ between the Uriidæ and the Laridæ in his order Anseres. They are divided into three subfamilies, corresponding to those already adopted by Bonaparte and Coues.

J. Reinhardt, in the same year, in his paper on the "Os crochu," or uncinate bone, in the skull of birds †, records its presence in nearly all the genera of this family that he has examined. In a note on p. 339 he corrects Professor Huxley's statement as to the usual absence of basipterygoid facets in the Petrels, such being only absent in the Albatrosses and Procellariinæ ("Stormsvalerne"), present in all the rest.

1872. Carl T. Sundevall ‡ makes the Tubinares the fourth cohort of his order Natatores. He adopts the same three subfamilies as Bonaparte, Coues, and Gray.

1873. Reinhardt describes § and figures two peculiar ossicles, of the nature of sesamoids, developed at the elbow-joint of these birds in the tendon of origin of the *extensor metacarpi radialis longior*. The existence of such an ossicle in the genus *Puffinus* had already been described by Meckel ||, and Reinhardt finds two similar ones developed in the Albatrosses, as well as in the genera *Œstrelata*, *Puffinus*, *Majaqueus*, and *Adamastor* of the Procellariinæ. In *Œstrelata fuliginosa* and *bulweri*, *Diomedea chlororhyncha*, and *Phœbetria fuliginosa*, he states that the smaller of these ossicles is wanting, though the larger is still developed. In a table he proposes the annexed classification of the Procellariinæ.

Zool. Chall. Exp. vol. iv. pt. xi. p. 9.

I. Wing-ossicles present. Twelve rectrices.
  a. Puffineæ—
    Œstrelata, *Puffinus*, *Majaqueus*, *Adamastor*.
II. Wing-ossicles absent.
  First primary longest.
    More than twelve rectrices.
  b. Fulmareæ—
    Ossifraga, *Fulmarus*, *Daption*.

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* *Loc. cit.* vol. iii. p. 102.

† "Om en hidtil ukjendt Knogle i Hovedskallen hos Turakoerne (*Musophagides*, Sundev.) med nogle Bemærkninger om de lignende Knogler hos andre Fuglefamilier," Videnskab. Medd. Naturh. For. Kjöbenhavn, 1871, pp. 326–341, pl. vii.

‡ Methodi naturalis avium disponendarum tentamen, Stockholm, 1872, pp. 140–143.

§ "Om Vingens anatomiske Bygning hos Stormfugle-Familien (Procellaridæ s. Tubinares)," *l. c.* 1873, pp. 123–138; also Gervais's Journal de Zoologie, vol. iii. pp. 139–144 (1874).

|| Traité général, &c., vol. iii. p. 144 (Paris, 1829).

Twelve rectrices.

Margin of beak without lamellæ.

Pagodroma.

Beak with lamellæ.

c. Prioneæ—

Halobœna, Prion.

Second primary longest.

d. Procellarieæ—

Procellaria, Oceanites.

A. H. Garrod, in the same year, shows* that the Petrels being "holorhinal" must be separated from the "schizorhinal" Laridæ and their allies. He further proposes† to divide the Petrels or Nasutæ into two groups, the "Storm-Petrels," with a formula AB.XY and no cæca, and the "Fulmaridæ," with formula AB.X and two short cæca. *Bulweria* alone has a formula A.X, and is therefore quite different from the Storm-Petrels. In both groups the great pectoral muscle is double, as in many of the "Ciconiiformes," and there are two carotids‡. The Nasutæ form the second cohort of his "Anseriformes," consisting of them and of the Anseres, which latter include the Anatidæ, Spheniscidæ, Colymbidæ, and Podicipitidæ.

1876. P. Pavesi, in his "Studi anatomici sopra alcuni uccelli"§, has given a few details on the visceral anatomy of *Diomedea exulans*, especially as regards the form of the stomach and the presence of spines on the laryngeal eminence, continuous laterally with a zone of similar papillæ developed round the commencing œsophagus.

Zool. Chall. Exp vol. iv. pt. xi. p. 10.

1879. Dr. Hans Gadow, in his paper on the digestive organs of birds‖, describes the alimentary viscera of the Tubinares, apparently based upon an examination of the four genera *Puffinus*, *Fulmarus*, *Procellaria*, and *Diomedea*. The arrangement of the intestinal folds is "orthocœlic," the intestine being disposed in eight folds lying close to and parallel with each other. In their orthocœlic character the Tubinares

* Proc. Zool. Soc. 1873, p. 37; Collected Papers, p. 128.

† *Loc. cit.* pp. 641 642; 1874, p. 122; Collected Papers, pp. 204 and 220, 221. The passage on pp. 641, 642, describing the muscles of the Petrels, is unfortunately misprinted in the original paper. It is given in a corrected form, as altered by the writer, in the reprint of Professor Garrod's papers, p. 204. The two birds called in Garrod's text *Procellaria pelagica* (?) and *Procellaria fregata* (?), the "Storm-Petrels" on which his observations were based, were probably in reality *Oceanites oceanicus* and *Garrodia nereis* (*cf.* Proc. Zool. Soc. 1881, p. 736).

‡ *Loc. cit.* 1873, p. 470; Collected Papers, p. 175.

§ Ann. Mus. Civ. Gen. vol. ix. pp. 66–82.

‖ "Versuch einer vergleichenden Anatomie des Verdauungssystems der Vögel," Jen. Zeitschr. f. Naturw. Bd. xiii. (n. F. vi.) pp. 92–171, 339–403, pls. iv.–ix., xvi.

agree with the Steganopodes and Erodii, differing from the "cyclocœlic" Pelargi, Raptatores, and Laridæ.

1881. In a posthumous paper*, published in the "In Memoriam" volume of his works, the late Professor A. H. Garrod describes the anatomy of the Diving Petrel (*Pelecanoïdes urinatrix*), based upon an examination of specimens collected during the 'Challenger's' voyage. *Pelecanoïdes* has no *ambiens* muscle, in which respect it differs from all the other true Petrels, and resembles *Bulweria* alone of them in its formula A.X. The main vein of the leg, the femoral vein, is superficial to, instead of deep of, the tendon of the femoro-caudal muscle, a peculiarity hitherto only observed in the genus *Dacelo* amongst the Kingfishers. "The Procellariidæ may be divided into the Storm-Petrels or Thalassidrominæ, and the true Petrels or Œstrelatinæ, the former differing from the latter in possessing the accessory semi-tendinosus muscle." These two groups therefore correspond to those already distinguished by Garrod in his former paper as the "Storm-Petrels" and the Fulmaridæ.

As regards the systematic position of the Petrels it is said—"I may mention that since writing my paper 'On Certain Muscles of Birds, and their value in classification,' I have changed my views as to the affinities of the Procellariidæ. In that communication I place the family amongst the Anseriformes; now it is evident to me that it is with the Ciconiiformes that they are most intimately related. Reason for my change of opinion will be found in what here follows." Unfortunately the paper was never completed, and the reasons mentioned not stated in consequence.

In a paper read before the Zoological Society on June 18th of the same year† I proposed to make the so-called *Procellaria nereis* of Gould, the *Procellaria fregata* of Professor Garrod's earlier papers, the type of a genus to be called *Garrodia*, it being not a true Petrel at all, but one of the allied group without cæca and with a formula AB.XY, the Thalassidrominæ of Garrod, which includes besides the genera *Oceanites*, *Fregetta*, and *Pelagodroma*, the family so formed constituting my Oceanitidæ.

1882. Lastly, in the concluding part of the Atlas to the great work on Madagascar‡, MM. Grandidier and A. Milne-Edwards have given figures of the skeletons and separate bones of *Prion vittatus*, *Puffinus chlororhynchus*, and *Thalassidroma oceanica*. Zool. Chall. Exp. vol. iv. pt. xi. p. 11.

* 85. "Notes on the Anatomy of *Pelecanoides* (*Puffinuria*) *urinatrix*," *loc. cit.* pp. 521, 522.

† Proc. Zool. Soc. 1881, pp. 735, 736.

‡ Histoire physique, naturelle et politique de Madagascar, publiée par Alfred Grandidier, xv.; Histoire naturelle des oiseaux, x. iv., Atlas iii. (Paris, 1881), plates 293, 294, 297, 298, 299, 300.

III. Comparative Anatomy of the *Tubinares*.

My object in working out the present report has been, not to produce a detailed description of the structure of any particular Petrel, but to describe the most important deviations from the ordinary avian type met with in this group, and to compare the members of it with each other, and with other groups of birds, in those points of their structure in which experience has shown birds to differ from each other.

Some of the modifications here described are of great physiological and morphological interest, whilst the numerous differences in points of detail displayed in the different sections and genera of the Tubinares lead one to expect that the future study of systematic ornithology will be not a little elucidated by the labours of the anatomist, wherever he, as in the present case, has material at his command sufficient for something like an adequate study of a natural group on the basis of structural differences more important than those that can be discerned from the superficial inspection of an ordinary skin.

In the present section the external characters, pterylosis, and visceral anatomy are first described; these are succeeded by an account of the myology, to which follows a description of the tracheal structures, and of certain other points in the anatomy of the soft parts. An account of the osteology concludes the whole.

1. *External Characters and Pterylosis.*

There are some points in the external characters of the Tubinares that may be noticed here, because in ordinary skins they can only be made out with difficulty, owing to changes and distortion in the process of drying*.

The order Tubinares derives its name from the character, prevalent throughout the group, of the external nares, which are prolonged into a more or less lengthy cylindrical tube, lying usually on the dorsal surface of the beak, and opening by one or two apertures (*cf.* figs. 1, 31, and 32, *infra*, pp. 375 and 432). The exact disposition and degree of development of these tubes vary in the different members of the group.

In the Oceanitidæ, and the smaller species of Procellariidæ (belonging to the genera *Procellaria*, *Cymochorea*, and *Halocyptena*), the nasal tubes quite coalesce, lying on the dorsal surface of the beak for about its basal half; the tube so formed rises rather abruptly from the forehead, and is truncated anteriorly, the single aperture so formed looking upwards and forward (*vide* Pl. XII. figs. 1–3, Pl. XIII. figs. 1–3). In the Oceanitidæ (*e. g.* Pl. XIII. fig. 5) the aperture viewed from in front is nearly circular, and with scarcely any appearance of a median septum. In the Procellarian

Zool. Chall. Exp. vol. iv. pt. xi. p. 12.

* I need not do more here than refer to the peculiar bill of the Tubinares,—the peculiarity arising from the subdivision, into more or less distinct plates, of the corneous covering of the mandibles,—as it is sufficiently described in systematic works on ornithology.

genera, on the other hand (fig. 6), the aperture is more oval and distinctly double, owing to the median septum (formed by the coalesced inner walls of the narial tubes) being much less deeply, in a lateral view, excavated anteriorly, and so appearing to a greater extent superficially. The other Procellariinæ repeat this form of nostril, though the septum becomes much thicker, so that the nostrils open in them by two perfectly distinct apertures (*vide* fig. 4, where the nostrils of *Bulweria* are shown). They might thus be said to be "platyrrhine," in opposition to the "catarrhine" Oceanitidæ and other genera already mentioned. It is in *Bulweria* and *Majaqueus*, perhaps, that the nasal septum is broadest and most superficial; in *Prion* it is well developed; in the remaining genera it is less near the external opening, but always quite evident. In the genus *Puffinus* the septum is also broad, but the narial tubes are so obliquely truncated that they hardly rise above the lateral outline of the beak; their openings are ovals, with their longer axis vertical or (*Puffinus obscurus*) oblique inwards.

In *Pelecanoïdes* the nasal tubes are short and swollen externally; the septum is distinct, but not broad; and the apertures, which are sinuated ovals directed antero-posteriorly, look almost vertically upwards, their lateral outline being nearly parallel with the axis of the upper jaw.

In the Diomedeinæ the nasal tubes are quite separate from each other, lying just at the lower margin of the "culminicorn." They are usually described as tubes with a distinct circular complete aperture; but, on looking at this carefully, there may be seen (*vide* fig. 1) in front and

Fig. 1.

Base of Beak of *Diomedea exulans*, to show the form and position of the nostril.

below this tubular opening a deep cavity leading backwards and continuous behind, over the edge of the apparent outer boundary of the aperture, with the general cavity of the tube, an infolding of the outer wall of the latter forming the apparent outer wall of the tubular aperture.

The nasal tubes of the Petrels are formed, it may be observed, by the elongation of the cartilaginous walls of the nasal capsules. The upper and lower turbinal cartilages are well developed; the alinasal turbinal cartilage, on the other hand, is represented only by a slight ingrowth from the internal nasal wall. Such, at least, is the condition of these parts in *Majaqueus*, the only form I have examined as regards these structures.

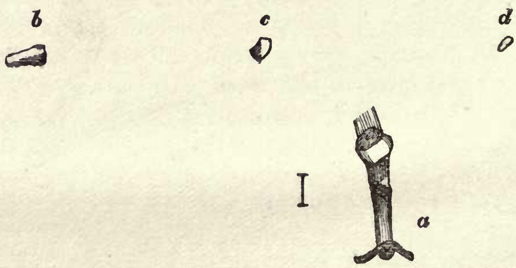
The legs are always bare of feathers for some little distance above the tarsal joint, the metatarsal scutellation extending upwards over the joint some little way, but disappearing where the leg is covered by the feathers, and there replaced by simple skin.

Zool. Chall. Exp. vol. iv. pt. xi. p. 13.

The scutellation of the tarsi presents different characters in the Procellariidæ and Oceanitidæ respectively. In the former, in all the forms, the legs, which are often much compressed below the lower limit of feathering, are covered pretty uniformly by small scutella of hexagonal shape (*vide* Pl. XIII. fig. 2, *a*). In the Oceanitidæ, on the other hand, though the back and more or less of the lateral aspects of the leg are so covered, the front of the leg is either, as in the genera *Oceanites* (Pl. XII. fig. 1, *a*) and *Fregetta* (Pl. XIII. fig. 1, *a*), "ocreate," being covered for nearly all its length by a single long scute, or, as in *Garrodia* and *Pelagodroma* (Pl. XII. figs. 2, *a*; 3, *a*), has a series of strong, well-marked, obliquely transverse scutella, extending on to the external and internal faces of the leg for some distance.

The hallux in the Tubinares is always extremely small, and in the genus *Pelecanoïdes* quite absent. When present it consists only of a single joint (*vide infrà*, p. 425, and Pl. XXII. fig. 6), which, even when best developed, is very small and covered by a short, nearly straight, spur-like claw, which projects externally, some little way above the level of the other digits, and, being very small, may easily be passed over. In the Oceanitidæ this nail is extremely minute, considerably more so than in

Fig. 2.



Rudimentary Hallux of the Albatrosses: of the natural size, except *a*.

a. *Phœbetria fuliginosa*, showing the two ossicles, connected together by fibrous tissue, the distal one being covered by a minute claw, which appears outside the skin (represented in section).

b. *Diomedea exulans*. *c*. *Diomedea brachyura*. *d*. *Thalassiarche culminata*.

the Procellariidæ of similar size, but is always present * and very straight and spur-like. In most of the Procellariidæ it is larger and more curved: it is best developed proportionately, perhaps, in *Pagodroma*.

In the Albatrosses the hind toe is so minute that these birds are usually described as being three-toed, but this is not really quite correct. In *Phœbetria* the hallux externally only just appears, being represented merely by a slight pimple-like elevation, with a very minute claw. On dissecting away the skin, the pimple is seen to be connected with two minute bony nodules, the basal one, which represents the metatarsal, more globular, the apical one more pointed and covered by the minute claw. They are only connected by connective and fibrous tissue to the tarso-metatarsus †, and are separated from each other by a considerable interspace, the whole having a total extent of only 3 mm. (*vide* fig. 2, *a*).

In *Thalassiarche* (*culminata*) and *Diomedea* (*brachyura* and *exulans*) this hallux is still more rudimentary, and there is not a trace of a nail outside. Still, on careful inspection, there is a slight elevation visible on the area usually occupied by the hallux, and on dissecting away the skin a single minute ossicle, of triangular shape, is to be found attached to the tarso-metatarsus and surrounding structures by fibrous tissue. This single bone probably represents the metatarsal element. In *Diomedea exulans* it has a length of 0·2 inch (5 mm.); in the other two species, particularly in *Thalassiarche*, it is much smaller, not exceeding here 2 mm. in length (*vide* figs. *b*–*d*). I have been unable to find it at all in *Pelecanoïdes*, even in quite young birds.

Zool. Chall. Exp. vol. iv. pt. xi. p. 14.

The anterior three toes are well developed, and are completely webbed, the web, however, not extending to the hallux. The claws are well developed; in the Procellariidæ they are always more or less curved, compressed, and sharp-pointed (*vide* Pl. XIII. fig. 2, *b*, *Procellaria pelagica*), whilst in the Oceanitidæ they become lamellar, depressed, and flattened, a shape that attains its maximum in the genus *Fregetta* (*vide* figs. 1–4, *b*). Hence an inspection of the legs alone of a Petrel will show, by the character of the tarsal scutellation and the form of the claws, whether it is one of the Oceanitidæ or of the Procellariidæ.

Pterylosis.—The pterylosis of this group seems to be, on the whole, very uniform throughout, both in the form of the tracts and the structure of the feathers.

The number of rectrices and remiges is not absolutely constant however, and there are also some slight differences in the form of the dorsal and lumbar tracts.

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* Mr. Dresser erroneously describes it as wanting in *Oceanites* (Birds of Europe, vol. viii. p. 503).

† The existence of the rudimentary hallux in *Phœbetria fuliginosa* was first, I believe, pointed out by Dr. Kidder in his account of the birds of Kerguelen's Land, Bull. U. S. Nat. Mus. vol. i. p. 22.

As regards the number of rectrices in the Tubinares, twelve is the ordinary number in both families, and this is never reduced *, and only in a few instances exceeded. *Fulmarus* and *Daption* have fourteen tail-feathers, as already pointed out by Nitzsch, and the same is the case in *Thalassœca*; *Ossifraga* has as many as sixteen. *Aeipetes antarcticus* (in both the specimens examined by me) has, on the other hand, unlike *Thalassœca*, the normal number of twelve.

The number of primary remiges is always ten, but that of the secondaries varies. The number of these in the Oceanitidæ is always ten; in the Procellariidæ it is never, even in the smallest forms (*Pelecanoïdes*, *Cymochorea*, *Halocyptena*, *Procellaria*), less than thirteen. *Bulweria* has twenty, which is about the average number throughout the group, increasing, however, in the larger forms to twenty-nine (*Ossifraga*, *Thalassiarche*), thirty (*Diomedea brachyura*), and even, in the largest of all, *Diomedea exulans*, to thirty-seven †. The pollex never has the claw so often present in birds on that digit.

As regards the distribution of the tracts of contour-feathers, I may quote Nitzsch's general description (Pterylography, Ray Soc. ed. pp. 143, 144):—"In this family the tract-formation of *Lestris* is elevated into the type of a group, undergoing scarcely any change in the form of the inferior tract, but showing some little modification in the dorsal tract. We find, therefore, on the head a uniformly dense plumage, from which the two principal tracts issue. The latter are separated from each other by the two lateral neck-spaces, which extend high up, nearly to the head. The inferior tract is divided near the head, becomes of considerable breadth whilst still on the neck, and passes in this condition on to the breast, the surface of which is covered by each band in a rather broad, parallel-sided form, emitting no branch as far as the margin of the *musculus pectoralis major*. Here it is divided by a space starting from the knee-covert in such a manner that a short continuation of the tract, which is to be regarded as an outer branch, passes near the knee into the lateral space of the trunk, runs on over the thigh, and soon afterwards terminates. The other, inner branch, which represents the main band, then proceeds on the belly, turns in a somewhat arcuated form outwards, dilates considerably in the middle of the bow, and terminates near the anus. . . . The dorsal tract is at first broad, becomes narrower towards the middle of the neck, then expands at the shoulder, and divides at that point, or from the middle of the scapulæ, into two limbs. In most of the Tubinares these limbs pass uninterruptedly into the posterior half

Zool. Chall. Exp. vol. iv. pt. xi. p. 15.

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* Nitzsch (Pterylogr. Ray Soc. ed. p. 141) thought that the smaller species of Petrels had but ten tail-feathers, but such is not in reality the case.

† Nitzsch even describes the species as having as many as forty secondaries. The total alar expanse of the specimen I counted this number in was 9 feet $7\frac{3}{4}$ inches.

of the dorsal tract; and this circumstance forms their family character as distinguished from the Longipennes. In the present group the posterior half of the dorsal tract encloses a longitudinal space as far as the caudal pit, dilates a little outwardly on the pelvis, and thus usually becomes united with the very oblique lumbar tracts, and grows rather strong in the simple uropygial band, also covering the base of the oil-gland."

Nitzsch had no opportunity of examining the pterylosis of *Pelecanoïdes*, nor any of the Oceanitidæ. His remarks were based on examination of *Fulmarus glacialis*, *Daption capensis*, *Ossifraga gigantea*, *Procellaria pelagica*, *Halobœna cœrulea*, *Puffinus obscurus*, and *Diomedea exulans* and *chlororhyncha*. Nitzsch points out certain peculiarities in the latter genus, the most important of these being the division of the dorsal tract into two quite separate parts—an anterior stronger part, ending in an interscapular fork, and a posterior, weaker, dilated part. The lumbar tracts he describes as weak and uniserial. I find this division of the dorsal tract to hold good in *Diomedea exulans* and *brachyura*, as well as in *Thalassiarche culminata*, though the break is not very obvious, and chiefly marked by the difference in strength of the feathers. In a nestling of *Phœbetria*, however, there is no such break apparent; though the dorsal tract anteriorly is stronger, it passes behind into the posterior part, and the same condition, as is pointed out by Nitzsch, obtains in *Ossifraga*. The lumbar tracts also can hardly be strictly described as uniserial, as they tend to coalesce, by rows of interposed contour-feathers, with the external borders of the dorsal tract, no very obvious demarcation separating the two.

Pelecanoïdes and the Oceanitidæ quite conform to the general type of the group, and indeed the only at all obvious difference in this, beyond those already mentioned, lies in the greater or less amount of the connection between the lumbar and dorsal tracts, this being almost *nil* in *Cymochorea* and *Procellaria*, and considerable in the larger forms, *Majaqueus*, *Puffinus*, &c. The knee-gap may become so deep as to completely divide the inferior tract into two parts below (e.g. *Pelagodroma*, *Prion*, and, according to Nitzsch, *Halobœna*) *.

Zool. Chall. Exp. vol. iv. pt. xi. p. 16.

The hypopterum is usually well-developed, with long feathers, and the humeral tracts are very strong and broad.

The contour-feathers always have an after-shaft, though in the Diomedeinæ it is extremely small, most so in *Diomedea exulans*, where it

* Nitzsch lays some stress on the angle, whether acute or obtuse, made by the lumbar tracts at their junction with the dorsal; but the difference in the direction of the two parts is not, as seen in entire birds, so obvious as would be judged from Nitzsch's figures (*loc. cit.* pl. x. figs. 2, 3), which were probably made up from the examination of skins only. The lumbar tracts, where the connecting rows of feathers are best developed, seem always to run outwards and backwards from the dorsal tracts, as shown in his figure of *Puffinus obscurus*.

is reduced to a short tuft, about half an inch long, of five or six nearly simple, straight plumes. In the smaller Albatrosses it is larger, and in the rest of the group, including *Pelecanoïdes*, it is of good size.

All the forms have their spaces as well as tracts covered by down-feathers, which may become very long and close-set, especially in *Pagodroma*.

The oil-gland is always large, globular, with its surface covered above at the base—which is also partly covered by the termination of the uropygial band of the dorsal tract—by scattered semi-plumes, and with a tubular mamilla, provided with a good tuft of down-feathers. The tuft and gland are never absent. In the Oceanitidæ and smaller forms (*Cymochorea*, &c.) the tuft of feathers simply encircles the apex of the gland, but in the larger ones it sends a median prolongation across it as well, so as to divide the surface of the mamilla into two lateral parts, separated from each other by the median row of feathers, and each with its opening or openings. The number of these varies in the different forms of the group, as already indicated by Nitzsch (*loc. cit.* p. 144). *Diomedea exulans* has about half a dozen small ones in each half, arranged in a crescent. *Diomedea brachyura* and *Thalassiarche* have numerous small apertures opening into a single large circular common opening. The Fulmars, except *Aeipetes*, have several apertures in each half, as have *Daption* and *Pagodroma*, *Ossifraga* having as many as five. *Majaqueus* has four; *Œstrelata* three. *Aeipetes*, *Pelecanoïdes*, *Bulweria*, and the smaller Procellariidæ, as well as the Oceanitidæ, have apparently only two pores, one in each half of the gland.

The very young birds, I may remark, are, in all the species I have seen, covered with a thick coating of fluffy grey down, which is pushed off as usual at the ends of the contour-feathers when the latter appear. There are apparently no intermediate changes of plumage, the first plumage of the young bird being similar to that of the adult *, a condition of things very unlike that in the Gulls (Laridæ), with which the Tubinares have so often been associated. Besides the long down on the tracts corresponding to the future tracts of contour-feathers, the young birds have a shorter downy covering distributed pretty uniformly, as in the adults, over the intervening spaces, and between the feathers of the tracts.

2. *Alimentary Canal and its Appendages.*

Zool. Chall. Exp. vol. iv. pt. xi. p. 17.

The Tubinares as a group agree very closely together in the form of stomach and intestines possessed by them, which have peculiarities not occurring in any other groups of birds, and it is only in the variations in form and structure of the tongue, in the nature of the armature of the

* *Diomedea exulans* may be an exception.

mucous membrane of the mouth, and in the presence or absence of cæca that the various forms differ in any important degree from each other.

The mucous membrane of the palate usually presents, in the Tubinares, several series of longitudinal rows of pointed, retroverted papillæ, which no doubt serve in the capture and retention of the prey by these birds. The most ordinary arrangement of these may be understood from Plate XIV. fig. 3, where the palate of *Œstrelata lessoni* is represented.

The palate is cleft for about half its length by a narrow median fissure, fringed on each side by a row of small spines, which dilates behind into the opening of the posterior nares, which is similarly fringed. Behind this, separated by a small interval, is the linear median aperture of the Eustachian tubes. From the anterior extremity of the median fissure runs forwards, to near the end of the beak, a sharp median ridge, with four or five strong, conical spines developed on it posteriorly. This ridge is separated by a deep groove on each side from the margins of the beak. Along a line corresponding to that of the palatine bones, and extending for an extent equal to that of the median fissure, there is developed on each side a second longitudinal row of retroverted and pointed spines, much longer and stronger than the more median series. In front of the posterior-narial aperture there runs between the two longitudinal series an oblique series of smaller spines, whilst behind the Eustachian aperture is a second transverse series, concave anteriorly.

In all the species of the genera *Œstrelata*, *Bulweria*, and *Majaqueus* examined by me the same condition obtains, the larger species, however, as that figured, frequently developing one or two rows of smaller spines lying parallel to the external longitudinal row, one outside, and the other between it and the median fissure. *Puffinus* is similar, but the anterior median keel is smooth, and almost without spines, and the palate to the sides of the Eustachian aperture becomes covered with small spines.

In *Cymochorea* and *Procellaria*, as in *Halocyptena*, the palate is much as in *Œstrelata*, but with all the spines smaller and feebler, particularly those on the palatal ridge. In the first genus at least the prenarial ridge is nearly smooth, and between the palatine row of spines—only developed posteriorly—and the median a stronger row is developed, so that there are here altogether three pairs of longitudinal spines above.

In the Oceanitidæ the palate is much the same, but the palatine row becomes very weak and nearly obsolete, whilst the intermediate row is the strongest, considerably, of all. The prenarial ridge may be slightly toothed or nearly smooth: it always ends, however, at the commencement of the median fissure, in a slightly raised prominence, divided into two lateral parts, in a way not seen amongst the Procellariidæ. (*Vide* Pl. XIV. fig. 6, giving an enlarged view of the palate of *Oceanites oceanicus*.) Zool. Chall. Exp. vol. iv. pt. xi. p. 18.

Pagodroma resembles *Œstrelata*, but all the spines have become much smaller and weaker, and this is still more the case in *Daption*, where they have almost entirely disappeared save round the posterior nares. The line of the interior margins of the premaxillæ and of the palatines is marked by a distinct raised ridge, and the edges of the upper mandible, from the angle of the mouth as far forwards as the dertrum, are marked by a series of slight, closely-set, raised ridges, oblique forwards and outwards. It is by a great development of these that the peculiar fringed bill of the genus *Prion*, reminding one of that of a duck, is produced. In *Prion* (Pl. XIV. fig. 5, *Prion banksi*) the palate is almost smooth throughout, with the exception of a distinct prenarial ridge, and some indications of the palatine series of spines posteriorly (not represented in the figure): the median fissure and narial opening are however, as usual, bounded by small spines. From a point corresponding to the angle of the mouth forwards to a little behind where the dertrum forms the cutting-edge of the bill, the margins of the mouth are bounded by a well-developed fringe of closely-set lamellæ, reminding one much of the plates of a whale's baleen. These lamellæ are developed from the mucous membrane of the mouth, and are probably entirely epidermic in origin; in the cleaned skull there is no trace of their presence (*vide* Pl. XXII. fig. 4). They are best developed a little way in front of their posterior termination of the fringe; here the lamellæ are nearly vertical thin plates, set on at right angles to the axis of the beak, but curved both forwards and outwards. Anteriorly they become more oblique forwards, and much shorter. Outside of them the cutting-edge of the beak is produced downwards for a little way, so that a groove is formed between the beak and the pectinated fringe.

When the lower bill is in position, the more posterior and strongest of the lamellæ completely occupy the slight space left between the cutting-edge of the two jaws, lying with their free ends curved outwards in a slight groove outside the lower mandible formed by the reflection from it of the feather-covered skin. Anteriorly this groove disappears, and the fringe simply lies against the outer surface—which is quite smooth, and not, like that of the duck or flamingo, correspondingly grooved for the reception of the lamellæ of the fringe—of the lower jaw, which in front it does not even reach. In the larger-billed *Prion vittatus* these lamellæ are even more developed, whilst in the smaller-billed *Prion desolatus* they are less so: *Prion banksi* is so completely intermediate in this respect that I see no reason for the adoption of Dr. Coues's genus *Pseudoprion**. The only other Petrel in which the

Zool. Chall. Exp. vol. iv. pt. xi. p. 19.

* Proc. Ac. Nat. Sci. Phil. 1866, p. 164, where that writer has also described the structure of these fringes at length.

beak is fringed in a way similar to that here described is *Halobœna cœrulea*, of which, however, as yet I have been unable to examine more than skins.

The existence of a peculiar fringe of lamellæ along the margin of the mouth has often been insisted on as an argument for placing *Phœnicopterus* amongst the Lamellirostres ; but the development of, at least, a very similar arrangement in *Prion* and *Halobœna*, birds of a very different group again, ought to show that an adaptive contrivance of this kind may be, apparently, independently developed without great difficulty, and yet with many features of common resemblance, in different birds without necessitating any immediate genetic connection between its possessors.

In *Fulmarus* (Pl. XIV. fig. 4) a rudimentary fringe of the upper mandible is present, a little more developed than in *Daption*; in other respects it conforms to the type of *Œstrelata*, the spines, however, being very small and rudimentary. *Ossifraga* is similar in all essential points, but the palate is longer, and, at least in young birds, more spinulose. In *Aeipetes* and *Thalassœca* the pectination of the mandible can only just be traced; the palate is much longer and narrower in shape than in *Fulmarus*, the spines smaller, and the palatine ridges better marked.

In *Pelecanoïdes* (Pl. XIV. fig. 2) the palate is quite smooth throughout, with no ridges or spines, except on the area round the posterior nares, which is pretty uniformly covered with sharp elongated spines of fair size.

In the Diomedeinæ the palate is comparatively smooth. There is a long prenarial ridge, only with slight indications of spines at its most posterior part. The spines bounding the narial and Eustachian apertures are well-marked, those on the palate small and best developed towards the posterior end of the prominent palatine ridges. Between the latter and the median fissure are developed, especially in *Diomedea exulans*, additional spines of small size, as well as a short row outside their most posterior part. Outside the tongue, between it and the inner margin of the jaws, the mucous membrane of the floor of the mouth has on each side a well-developed series of stronger spines.

The tongue, as may be seen by a glance at Plate XV., where the chief variations of its form are represented, is by no means constant in shape in the Tubinares.

In the Oceanitidæ (*vide* Pl. XV. fig. 1, *Oceanites*), and the genera *Cymochorea* (fig. 5), *Procellaria*, and *Halocyptena* of the Procellariidæ, the tongue is of triangular shape, fairly fleshy basally, but tapering and becoming thinner anteriorly, its extremity being pointed and more or less membranous, so as to easily be destroyed by rough usage. Its posterior margin, or base, is somewhat concave, and fringed by a row of small retroverted pointed papillæ. This is the form of tongue found, more or less modified, through the entire group.

In *Œstrelata* (Pl. XV. fig. 12)*, *Majaqueus*, *Bulweria*, and *Puffinus obscurus* the tongue becomes more fleshy, and slightly grooved above, especially anteriorly. The sides, moreover, are edged by a series of large triangular backwardly directed papillæ, extending forwards for about the back half of the length of the tongue, but in *Puffinus* to nearly its apex. In *Puffinus brevicauda* (fig. 14) there are, in addition, four longitudinal fairly regular rows of such papillæ developed on its dorsal surface, those nearest the middle line being the biggest.

Zool. Chall. Exp. vol. iv. pt. xi. p. 20.

In the species of the genus *Diomedea* (fig. 3) the tongue is also similarly covered above, pretty uniformly, with spines, best developed on the dorsum a little behind the apex of the organ, but is much shorter in form, being of an elongated cordate shape. In *Phœbetria* (fig. 4), on the other hand, the tongue is much more pointed and elongated, being free for about its apical two thirds, and with the dorsal surface glabrous, the spines being confined to its basal margin. In a nestling of this species the tongue has much the same shape, but is covered for the greater part of its extent above by spines, as in *Diomedea*: these must therefore disappear as the bird reaches maturity. In *Thalassiarche* the tongue is somewhat intermediate in shape, though most resembling that of *Phœbetria*. *Pagodroma* (fig. 8) has a very elongated, tapering tongue, with its base and lateral margins for about their posterior quarter spinulose. The tongue of *Daption* (fig. 7) is much broader and more fleshy; the spines are small, and almost confined to its base, with only a few very obsolete ones towards the posterior angles laterally. It is only free for a little more than a quarter of its length. *Prion* (fig. 10) is similar, but the tongue is more fleshy, and the spines are smaller and quite confined to the base; the apex is also only free for a very small extent. In *Prion vittatus* the tongue becomes extremely large and fleshy, occupying the whole of the wide space between the rami of the mandible. *Aeipetes antarcticus* (fig. 6) has a tongue very like that of *Pagodroma*, but of course larger and less elongate: that of *Thalassœca glacialoides* is very similar, but longer a little than that of *Aeipetes*. In all these forms the tip is blunt or emarginate, with a slight dorsal groove apically. *Fulmarus* has a more fleshy tongue of the same type, with a distinctly emarginate end, and a more evident groove, extending for two fifths of its length.

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* I have figured (fig. 13) on Plate XV. a tongue of different form from any other known to me as occurring in the group of Petrels. It has been labelled "*Œstrelata brevirostris*," but does not agree with the other species of that genus (*lessoni* and *mollis*) examined by me nor with any of my young specimens of the so-called *Œstrelata brevirostris*, these resembling rather the species just named. This tongue is remarkable for having no spines laterally, those of the base being well developed, and for its narrow and deeply grooved form and slightly emarginate tip. In spite of its label, it belongs, I strongly suspect, to some species of the Laridæ.

In *Ossifraga gigantea* (fig. 9) the tongue is very elongated,—three inches long,—and narrow proportionally. Its apex is slightly emarginate, and there is a deep groove for about two fifths of its length, and traceable further back to the base of the tongue. The base has a fringe of pointed spines, which are continued, of smaller size, along the lateral margin for some way, there being some very much smaller spines developed inside them on the borders of the tongue for about an inch, though not reaching the posterior angles of the organ by half that extent.

In *Pelecanoïdes* (fig. 2) the tongue is fleshy, and fairly parallel-sided, tapering apically. It is but little free, and occupies most of the inter-space between the mandibular rami. Its base is notched, and provided with some largish spines, which continue forwards for about the basal half, or more, of the lateral margins. On the dorsal surface there is always a peculiar lanceolate mark, apparently due to a difference in the nature of the mucous membrane covering the tongue over this area. Zool. Chall. Exp. vol. iv. pt. xi. p. 21.

The œsophagus—which in the Albatrosses, as already described by Pavesi, may be surrounded at its commencement with a zone of spines, continuous below with the spines covering the laryngeal eminence—is always capacious and distensile, but possesses no crop. Inferiorly, in the thorax, it passes without any marked constriction or other difference into an enormous proventriculus, which is a thin-walled bag, reaching down nearly to the posterior extremity of the abdominal cavity, which it largely occupies, lying to the left side of the stomach proper and the mass of the intestines. This great proventricular bag is twisted back on itself apically, and then, becoming slightly narrower, passes by a small aperture into the stomach proper or gizzard. This aperture is therefore to the right of, and anterior to, the great "fundus," which lies freely in the posterior part of the abdominal cavity, covering there the terminal portion of the intestine and cloaca. Internally, the proventricular glands are seen to cover pretty uniformly the whole surface of the mucous membrane, with the exception of a more or less narrow zone which lies between this glandular part and the stomach proper, corresponding pretty nearly to the narrower, ascending part of the bag as seen from outside (*vide* Pl. XIV. fig. 1 and Pl. XV. fig. 15). The extent of this very deep "zonary" proventriculus (*pr.*) is always very considerable in the Petrels, being of course, *cæteris paribus*, larger in the larger than in the smaller species. In *Majaqueus* its extent is 4·0 inches; in *Pelecanoïdes*, 1·85 inches; in *Fregetta grallaria*, 1·2 inches.

The stomach proper (*g.*) is always small and more or less globular, with fairly muscular walls and provided with the usual central tendinous sheets, so that it may fairly be called a gizzard. Its situation is peculiar, lying always above and to the right of the proventricular fundus, and with its pyloric part so flexed on itself that it looks backwards instead of forwards as in all ordinary birds (*vide* Pl. XIV. fig. 1 and Pl. XV. fig. 15), in this respect somewhat resembling the stomach of *Struthio*. In *Struthio*, however, the pyloric aperture is on the deep (dorsal) side of the stomach, nearly in the middle line, and so concealed when the viscera are viewed from the abdominal aspect. In the Tubinares the pyloric aperture, on the other hand, is quite superficial, lying at the inferior (posterior) end of the gizzard in the angle formed by the two parts of the bent proventriculus.

The gizzard, which is nearly always found full of the horny beaks of *Cephalopoda*, is lined internally by an "epithelium," which is usually dark in colour, and frequently of almost corneous texture, with a more or less corrugated or wrinkled free surface (*vide* Pl. XV. fig. 16, where the epithelial lining of the everted gizzard of *Fulmarus glacialis* is represented *). In the Oceanitidæ and Diomedeinæ this epithelium is softer; its character in other Petrels is but an exaggeration or reproduction of that existing in some other birds, particularly that occurring in such Storks as *Xenorhynchus*.

Zool. Chall. Exp. vol. iv. pt. xi. p. 22.

The displacement of the pyloric orifice of the gizzard to the left necessitates a corresponding change in the commencing duodenum, so that this at first ascends in an upward curve towards the right before it returns to form the backwardly-directed loop, characteristic of Aves and Mammalia, round the pancreas (Pl. XIV. fig. 1, *p.*).

This peculiar upward curve of the commencing duodenum, the singularly small inverted stomach, and enormously deep proventriculus are all peculiar, so far as I am aware, to the group of Tubinares, though universal amongst them, and no other bird yet examined has, so far as I know, a similar disposition of these viscera †.

The intestinal cæca are entirely absent in all the Oceanitidæ, but are, with one exception, present, though of small size, in the Procellariidæ. They are always short and globular, and closely connected to the intestine, so as to appear as mere nipple-like projections from it. Plate XIV.

* The figure of Carus and Otto (Tabulæ Anat. Comp. Illustr. part 4, t. vi. figs. 15, 16) of the epithelium of the gizzard of *Fulmarus glacialis* does not at all faithfully represent what I have seen in two (quite fresh) specimens of that bird, nor have I ever in other Petrels seen epithelium of such a corneous and pavement-like nature as that figured by them. I have, therefore, had one of my specimens carefully drawn of the natural size. In this place it will be well to recall the still more highly developed gastric epithelium of some of the Fruit-Pigeons (*Phænorhina goliath* and *Carpophaga latrans*) described by Verreaux and Des Murs, Viallanes and Garrod (*vide* Report on the Birds collected during the Voyage of H.M.S. Challenger, in the years 1873–76, Zool. Chall. Exp. pt. viii. pp. 152–154).

† The description of these parts in the Little Auk (*Alca alle*) given by Professor Owen (Anat. Vert. vol. ii. p. 163), and originally due to Home (Lect. Comp. Anatomy, i. pp. 283, 284, 1814), does not all apply to that bird (*cf.* the figure and description given by Macgillivray in Audubon's 'Ornithological Biography,' iv. pp. 306–309), and probably refers to some member of the Tubinares.

fig. 7 represents those of *Majaqueus* slightly enlarged. They are usually situated quite close to the cloaca, the large intestine in nearly all the Tubinares being quite short; the length of the cæca themselves rarely exceeds ·25 inch, except in the very largest species (*vide* table below). In five specimens (one a nestling) of *Cymochorea leucorrhoa* that I have examined, I find only a solitary cæcum, lateral in position, developed, owing apparently to the abortion of its fellow. As Mr. Swinhoe in his description of *Cymochorea monorhis* * also records the cæcum as single, it is probable that the existence of such a single cæcum is a character of the genus *Cymochorea*. It is not unusual, I may observe, in a group of birds in which the cæca are of small size, and probably of no physiological importance, to find specimens or species with the normal number of cæca reduced by one. I may give as instances *Mergus albellus* (*cf.* Hunter, Observ. vol. ii. p. 325; and Garrod, Coll. Papers, p. 220) amongst the Anseres, and *Plotus anhinga* (Garrod, *l. c.* p. 345) amongst the Steganopodes, not to mention all the Ardeidæ amongst the Herodiones. In *Halocyptena*, in the only specimen yet examined, I could find no trace of any cæca at all, so that the tendency to their disappearance already observable in *Cymochorea* seems here to have progressed further still. The intestines are not capacious, but the commencing duodenum may be slightly dilated. Zool. Chall. Exp. vol. iv. pt. xi. p. 23.

The following are intestinal measurements:—

	Small Intestine.	Large Intestine.	Cæca.	Total length of Intestine.
Oceanites oceanicus	...	...	—	10·0
Garrodia nereis	...	...	—	8·5
Fregetta grallaria	...	...	—	13·0
—— melanogastra	...	...	—	8·0
Pelagodroma marina	...	...	—	12·2
Procellaria pelagica	8·0	1·0	·075	...
Cymochorea leucorrhoa	9·9	·6	·1	...
Prion desolatus	19·5	...	...	...
—— banksi	17·0	·25	·2	...
Daption capensis	33·0	1·4	(?)	...
Thalassœca glacialoides	48·25	1·4	·2	...
Aeipetes antarcticus	50·2	1·2	·3	...
Ossifraga gigantea	94·0	2·0	·5	...
Fulmarus glacialis	53·5	1·5	·25	...
Puffinus obscurus	17·0	·5	·2	...
—— anglorum	23·0	1·0	·2	...
—— brevicauda	24·0	1·25	·25	...
Majaqueus æquinoctialis	54·4	1·75	·25	...
Œstrelata lessoni	42·0	...	·25	...
Bulweria columbina	—	—	·25	12·0
Pelecanoïdes urinatrix (*a*)	16·25	...	·2	...
—— urinatrix (*b*)	15·0	1·5	·2	...
Diomedea exulans	121·4	4·0	·8	...
—— brachyura	89·0	2·0	·3	...

* Ibis, 1867, p. 387. I have examined the type of this species, which is now in Mr. Seebohm's collection, and find it to be a true *Cymochorea*.

The liver is usually about equilobed, the lobes not being large, and rather triangular in shape. In the Albatrosses, however, the right lobe becomes elongated and distinctly bigger. The gall-bladder, developed on the right hepatic duct, is always present so far as my observations extend. The hepatic ducts (Pl. XIV. fig. 1, *r.h.d.*, *l.h.d.*) open close together into the ascending arm of the duodenal loop, close to the pancreatic ones, of which there are usually two or three in *Majaqueus.* In the specimen of *Thalassœca glacialoides* dissected the left hepatic duct divided, soon after leaving the liver, into two branches, each of which opened separately into the duodenum, so that altogether this received three ducts from the liver. The vitelline rudiment is not to be found in the adult birds. The *bursa fabricii*, in young birds at least, is a well-developed large sac, with thick glandular walls, and a small opening into the cloaca. The spleen is circular, or nearly so.

3. *Myology.*

The myology of the Tubinares presents many features of interest, as will be seen from the following description. The species of the group, broadly speaking, resemble each other very much in the details of their muscular structure, though in the fore limb the structure of the *biceps* and the termination of the *tensor patagii* tendons, and in the hind limb the presence or absence of the *ambiens* and the accessories to the femoro-caudal and *semi-tendinosus*, present characters available for taxonomic purposes.

Zool. Chall. Exp. vol. iv. pt. xi. p. 24.

Anterior Extremity.

Pectoralis primus.—This muscle is always largely developed in the Tubinares, as might have been expected from their great powers of flight. It is peculiar in that it is always *easily divisible into two quite separate layers* superimposed on each other, besides which it gives off thin fan-like cutaneous branches. A similar disposition of the *pectoralis primus* in two distinct layers is very characteristic of many of the Ciconiiform birds of Garrod, occurring in all the Storks and Cathartidæ, and in *Phaëthon*, *Fregata*, *Plotus*, *Sula*, and *Pelecanus* amongst the Steganopodes. A tendency to a similar condition, though the two layers are only separable with difficulty, may be seen in the Ardeidæ, Falconidæ, and *Scopus.*

The *superficial* layer of the *pectoralis primus* arises (*vide* Pl. XVI. figs. 1 and 2, *p.* 1*a*) from the posterior and lateral margins of the body of the sternum, from the margin of the sternal *carina*, and from the inferior border and external surface of the clavicles. In the latter position it is divisible into two layers, one arising from the extreme margin, the other and deeper from the surface, of those bones. The common insertion into the large humeral crest is very tendinous behind, more fleshy anteriorly, these two parts being somewhat divided by the thick tendon of the deep layer of the muscle (*vide* Pl. XVI. fig. 1, *p.* 1*a*).

The *deep* layer of the *pectoralis primus* arises chiefly from the body and keel of the sternum outside the origin of the *pectoralis secundus*—from which it is separated by a strong fascia—from the tip of the furcula, and from the fascia over the second pectoral, especially anteriorly, where a large air-space separates these two muscles in the interval between the furcula and coracoid (Pl. XVI. figs. 1 and 2, *p.* 1*b*). Its tendon is thin anteriorly, strong and cylindrical posteriorly, and is inserted, as already described, between the two parts of the tendon of the superficial layer which arches over it.

The muscle is perforated a little anteriorly to its posterior border, and in front of the strong tendinous band dividing it, by a group of vessels and nerves destined for the supply of the muscles and skin incumbent on it. The most posterior of its fibres do not apparently join the main tendon of insertion, but are lost in the loose fibrous tissue occupying the axillary region.

There is a large cutaneous branch given off by the superficial layer close to its insertion, which runs back over the humerus, and is distributed as a fan-shaped expansion to the outer branch of the pectoral tract. Another cutaneous branch comes off from the anterior end of the muscle on the breast close to the *symphysis furculæ*, and goes to the skin of the lower and anterior aspect of the neck. Zool. Chall. Exp. vol. iv. pt. xi. p. 25.

Pectoralis secundus.—This muscle is also well developed, but though broad is usually short, extending for not more than one third, one half, or sometimes two thirds the length of the sternum. In *Pelecanoïdes*, however, it is much longer, extending to nearly the end of that bone, and in *Procellaria*, *Garrodia*, *Fregetta*, and *Pelagodroma* its extent is nearly as large, in which cases it extends beyond the posterior margin of the deep layer of the first pectoral.

It arises from the antero-superior part of the *carina sterni*, and from the body of the bone external to that, from the greater part of the coraco-furcular membrane below the *pectoralis tertius*, from the *symphysis furculæ*, and from a greater or less extent of the antero-inferior border of the coracoid bone. Its insertion is by the usual tendon on the superior aspect of the humerus, behind the much smaller tendon of the third pectoral.

In the Albatrosses the *pectoralis secundus* is unusually short, and broken up into four quite separate parts, which unite before passing the shoulder-pulley. This arrangement is clearly shown in fig. 2 of Plate XVI., representing the muscle in *Diomedea brachyura*. In the other Petrels, the muscle is much more homogeneous, and only separable by dissection into its various component parts.

Pectoralis tertius.—This muscle (Pl. XVI. fig. 2, *p.* 3) is always well developed in the Tubinares, in the form of a broad, thin band, more or less parallel with the coracoid, occupying the superior half of the broad space between that bone and the furcula, its fibres arising chiefly from the strong membrane between these bones, sometimes with additions from the anterior margin of the coracoid, or from the body of the sternum close to the middle line.

Tensor patagii brevis and longus.—These muscles have always a common, rather thin and flat fleshy belly, arising from the extreme upper end of the clavicle, and receiving, in addition, special small slips from the surface of the great pectoral. From this fleshy belly spring two tendons, of which one always forms the marginal patagial tendon, and must therefore be considered as the *tensor patagii longus.* Both the tendons are connected, close to their origin, by fibrous slips to the humeral crest, from which indeed they might be said to arise, receiving then the main muscular belly. The connection of the marginal tendon with the humerus is always provided with a small tract of strong elastic tissue (*vide* Pl. XVIII. fig. 3, *t.p.l'.*), and another such tract of longer extent is found on its course opposite the bend of the elbow (Pl. XIX. fig. 4 and Pl. XVIII. fig. 3).

In other respects the development and distribution of these tendons differs much in different groups of genera, and their arrangement will therefore be here considered *seriatim.*

It is in the Oceanitidæ that the disposition of the tendon of the *tensor patagii brevis* (*t.p.b.*) is simplest, it here, in all the four genera, passing straight downwards as a thin band, parallel to the humerus, to be lost on the fascia covering the outer side of the forearm. In *Procellaria*, *Cymochorea*, *Halocyptena*, and *Pelecanoïdes* (*vide* Pl. XIX. fig. 2) it is nearly equally simple, but as it passes over the superficial belly of the *extensor metacarpi radialis longior* (*e.m.*) it gives off to it a small tendinous slip, which lies on the wristward side of the main tendon.

Zool. Chall. Exp. vol. iv. pt. xi. p. 26.

In the genus *Prion* (Pl. XIX. fig. 1) the condition of things is slightly more complicated. The superficial belly of the *extensor m.r.l.* (*e.m.*) is quite tendinous throughout, with no fleshy fibres at all; where the *tensor patagii brevis* (*t.p.b.*) crosses it the two tendons are firmly fused together, and there is also a well-developed wristward slip sent off from the main tendon of the *tensor patagii* to meet the extensor tendon beyond this junction. The main *tensor* tendon where it crosses the extensor muscle is quite free from it in most cases, though occasionally a few fleshy fibres may arise from its anterior margin to join the deeper belly of the *extensor m.r.l.* (*e.m.*). In a specimen of *Prion banksi* the wristward slip goes mainly to the deep belly of the extensor, sending off a thin band to the more superficial one. From the point of junction of the wristward slip with the extensor tendon, a thin fan-shaped tendinous fascia is sometimes sent off to the patagium generally.

In *Œstrelata brevirostris* (Pl. XIX. fig. 3) the condition of things is similar, but the patagial fan is more strongly developed, and the tendinous superficial part of the *extensor metacarpi* is split, proximad of the *extensor patagii*, one part arising superficially to, the other (*e.m.**) deep of, the prominent supracondylar humeral process.

In the genus *Œstrelata* proper—as represented by *Œstrelata lessoni* (Pl. XVIII. fig. 1), *Œstrelata mollis*, and an undetermined species—the arrangement differs considerably from that observed in *Œstrelata brevirostris* †. The *tensor patagii brevis* tendon, which is more or less fused above with the marginal *tensor patagii longus* tendon (*t.p.l.*), develops at its junction with the superficial tendon of origin of the *extensor* (*e.m.*)—this being, as in *Œstrelata brevirostris*, double—a small, elongated ossicle (*a*) from which arise not only tendinous fibres—some of which form a patagial fan, whilst others join the marginal tendon directly—but also a number of muscular fibres which form the belly of the superficial part of the *extensor*. The *tensor patagii brevis* continues on in the usual manner to the ulnar fascia. No bony nodule, it is to be observed, is found in the tendon of the superficial part of the *extensor* where it arises from the humerus. Zool. Chall. Exp. vol. iv. pt. xi. p. 27.

In *Majaqueus* (Pl. XVIII. fig. 3), *Bulweria*, and *Puffinus* the *tensor patagii brevis* (*t.p.b.*) tendon is not fused with the much broader and stronger *tensor patagii longus*, but is a distinct, very slight, slip, lying between this and the humerus.

At the elbow it joins the superficial ossicle (*a*), developed at the junction of the *tensor patagii* with the *extensor* tendons. In *Puffinus* (*brevicauda* and *obscurus*) this thin *tensor patagii brevis* is split below into two slips, one joining the deeper of the twin tendons of origin of the superficial *extensor*, whilst the other is inserted on the supracondylar process. The ossicle is larger than the corresponding one of *Œstrelata*, and of somewhat smaller form; from it spring both tendinous fibres for the patagial tendon, and fleshy fibres for the superficial belly of the

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† The condition above described as obtaining in *Œstrelata brevirostris* was exactly the same in all the specimens, eight in number, dissected. Unfortunately all these were young birds, though the largest must nearly have attained its mature plumage, and was probably able to fly. In other young birds in the group that I have examined the disposition of these elbow tendons is always exactly the same as in the adults, and even when these last develop ossicles here, such ossicles can be found, in a cartilaginous condition, in quite young birds. I have no reason therefore to suppose that the differences described here as existing between *Œstrelata brevirostris* and the other species of that genus are due to any difference in age.

[P.S.—Since the above was written, Mr. R. Ridgway has been kind enough to examine, at my suggestion, the skins of this species in the Smithsonian Institution, and finds, as he informs me, no difference in the development of the ossicle between this and the other species of the genus. The question, therefore, requires further material to elucidate it.]

extensor (*e.m.*); from it also, or from the fibres of the last muscle, passes off a thin tendinous fasciculus (*f.*) to the ulnar fascia. Proximad of this larger ossicle is a smaller, more circular, one (*a'*), which is developed in the more superficial of the twin tendons already described a little beyond its origin, where it plays over the supracondylar process. This second ossicle is very small in *Bulweria.*

In the genera *Pagodroma*, *Daption*, *Fulmarus*, *Thalassœca*, *Aeipetes*, and *Ossifraga*, no bony nodules are developed, but the arrangement of these tendons at the elbow becomes very complicated. Their arrangement in *Ossifraga*, with which the others are almost identical, is represented in Plate XVIII. fig. 2.

The *tensor patagii longus* (*t.p.l.*) tendon divides near the elbow into two parts, one continuing as the marginal patagial tendon, provided with the usual cushion of elastic tissue opposite the bend of the arm, the other receiving the much thinner *tensor patagii brevis* (*t.p.b.*). The united tendon so formed becomes somewhat diffused distally, and more or less fused with the superficial tendon of origin of the *extensor metacarpi radialis longior* (*e.m.*), from which it is continued onwards to the ulnar fascia by two well-defined bands. Between the most wristward of these and the marginal tendon of the patagium there is developed a narrow vinculum.

In addition to this the main tendon of the *tensor patagii*, which has a clear, well-defined edge on its humeral side, where it crosses the *extensor* muscle, sends a small special slip of tendon (*t.p'.*) to the deeper of the two bellies of that muscle.

In the Diomedeinæ the arrangement (Pl. XIX. fig. 4) more resembles that of the Puffineæ, as here also two ossicles are developed with nearly the same relationships to their surroundings as in that group. The *tensor patagii brevis* (*t.p.b.*) is separate from the *tensor patagii longus* (*t.p.l.*) till near the elbow, the marginal tendon of the latter muscle having received, a little before, the very long and thin tendinous biceps slip (*b.s.*).

The relations of the ossicles are very nearly as in *Majaqueus* (*vide* the figures), but the tendinous band to the ulnar fascia—which represents the morphological termination of the *tensor patagii brevis*—arises in the Albatrosses nearer the middle of the fibrous tissue lying between the two ossicles. As in the Œstrelateæ and Puffineæ, the tendon of origin of the superficial part of the *extensor metacarpi* (*e.m.*) is double, and in the figure an arrow is introduced between them to show this double nature. The proximal and smaller of these two ossicles is developed, as before, in the more superficial of these twin tendons. The larger of the two ossicles is somewhat different in shape in the Albatrosses and Petrels, being more hammer-shaped in the latter group *.

Zool. Chall. Exp. vol. iv. pt. xi. p. 28.

* *Cf.* also the figures of these ossicles given by Reinhardt (*l. c.*, p. 128).

The presence of these peculiar wing-ossicles is thus confined to the Diomedeinæ, and to the genera *Majaqueus*, *Puffinus*, *Bulweria*, and *Œstrelata* (in which last there is only one), and, according to Reinhardt (*s. c.*, p. 133), *Adamastor*, of the Procellariinæ. In the genus *Fregata* there is a similar small bony nodule developed at the point where, as in the Petrels, the inner part of the *tensor patagii longus* tendon meets the tendon of the superficial belly of the *extensor metacarpi*, and from it radiate out tendinous fibres to the patagial margin. I have observed similar ossicles, developed at points of intermittent straining, in several other birds, as *Larus argentatus* and *glaucus*, *Fratercula arctica*, and *Merops*.

These bones must be considered to be of the nature of sesamoids, which, as is well known, are often developed in the tendons of muscles at the points of greatest strain. Their occurrence therefore in different groups of birds is by no means a proof of any genetic connection between such.

Biceps.—This muscle, in all Tubinares, is remarkable for its excessive reduction, the muscular bellies being small and short, and the tendon of insertion excessively narrow and thin (*vide* Pl. XIX. figs. 1, 2, and Pl. XVII. fig. 1, *b*).

It is best developed perhaps in the Diomedeinæ, where as usual it arises by two heads, a coracoid and humeral (*vide* Pl. XVII. fig. 3, *c.*, *h.*), both, however, being largely tendinous, and soon uniting. From the coracoid head is given off a very narrow slip, chiefly tendinous, with a few fleshy fibres only, which runs down in the patagium, and joins the margin of the patagium formed by the *tensor patagii longus* close to the elbow (Pl. XVII. fig. 3, and Pl. XIX. fig. 4, *b.s.*).

In the Oceanitidæ the *biceps* muscle is very slender. It has the two usual heads of origin, the tendons of these being often closely united together by fibrous tissue, and ending in a small short, common belly. This apparently gives off no "biceps-slip" at all *.

In nearly all the other Procellariidæ, including *Pelecanoïdes*, the *biceps* becomes modified in a peculiarly interesting way. The coracoid head alone forms the muscle proper, whilst the humeral head, becoming detached from the coracoid head, goes *entirely* to the *tensor patagii longus* tendon, which it joins as a short, cylindrical tendon close to the shoulder (Pl. XVII. fig. 1, *h.*). It is, therefore, functionally a "biceps-slip," though it differs from the ordinary "biceps-slip" found in so many birds †, in

Zool. Chall. Exp. vol. iv. pt. xi. p. 29.

* The dissection of these parts in this group of birds is attended with considerable difficulty, partly owing to the smallness of the various parts involved, partly to the great accumulations of fat round the tissues, making the true nature of these very difficult to determine in spirit-specimens. It would be very desirable to dissect out these parts in fresh specimens.

† *Cf.* Garrod, Coll. Papers, p. 324.

that it arises independently from the humerus, and is not a part of the true *biceps* muscle, although it is supplied by the same nerve as that which goes to the coracoid head. In *Diomedea*, it is to be observed, the "biceps-slip" is derived from the *coracoid* head alone, whereas in the other Procellariidæ this slip represents the shorter or *humeral* head of the normal muscle.

Only occasionally have I seen (*e. g.* in specimens of *Procellaria pelagica*, *Cymochorea leucorrhoa*, *Œstrelata lessoni*, and *Prion banksi*) a very small tendinous slip derived from this humeral head, which may be either continued downwards with the nerves and vessels to the elbow, where it is apparently lost in the general fascia, or joins the tendon of the true "biceps" (*Procellaria*, *Cymochorea*).

Supposing this latter to represent a more primitive condition, now nearly or quite lost in most of the species, the biceps muscle must originally have been two-headed, with a patagial slip derived from its humeral head. This slip gradually increased at the expense of the other tendon of the humeral head, till eventually the latter disappeared altogether, the *biceps* proper (*i. e.* that flexing the forearm) being then reduced to its coracoidal moiety.

Expansor secundariorum.—This peculiar muscle * is wanting altogether in the Procellariidæ. It occurs, however, in the Oceanitidæ, though in a form different from any previously observed, being attached to (or derived from) thoracically the surface of the *pectoralis major* muscle (*vide* Pl. XVII. fig. 2).

Its small belly is attached to the few last secondary remiges (*S.*) at the elbow, and the thin tendon (*e.s.*) runs parallel to, but behind, the humerus, to the axilla, where it is joined by a similar but shorter tendon, which is derived from the most posterior feathers of the humeral tract, the so-called "scapularies" (*Sc.*). The common tendon then runs forwards, being superficial to the extensor and flexor muscles and the nerves and vessels of the forearm (*v.n.*), to be attached to the surface of the first pectoral (*p.* 1) close to its insertion into the humerus. In no other instance, so far as I know, does the *expansor secundariorum* become thoracically attached to the *pectoralis primus*, though it may be so to the *teres*, *coraco-brachialis longus*, or *coraco-brachialis brevis* muscles. Nor have I yet met with any other bird in which the tendon of this muscle is connected to the scapularies, which here it serves to expand as well as the secondaries.

The attachment of this muscle to the *pectoralis* suggests that the *expansor secundariorum* may originally have been formed from a cutaneous branch of the former similar to others of the same function derived from it, which are still broad thin expansions of muscular fibres. In other

Zool. Chall. Exp. vol. iv. pt. xi. p. 30.

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* *Ibid.* pp. 323, 324.

birds this has either completely disappeared, or has developed thoracically new attachments to other muscles or to bone.

As regards the other muscles of the anterior extremity, the deltoid is always remarkable for its shortness, extending but a very small distance down the arm (*vide* Pl. XVIII. fig. 3, *d.*), frequently allowing the anterior belly of the *latissimus dorsi* (*l.d.*) to appear superficially below it. Only in *Phœbetria fuliginosa* (a nestling specimen) have I found the special tendinous slip of origin from the scapula which is found in so many birds.

The *triceps* has a well-marked tendinous attachment to the humerus superficial to the insertion of the *latissimus dorsi.* Its muscular belly arises from the scapula by fleshy fibres, and is comparatively short, its tendon, on the other hand, being long, and not joining the tendon of the *biceps* till over the elbow.

The *latissimus dorsi* is in two bellies, as in birds usually; of these the posterior is much the largest, the anterior being comparatively small and narrow.

Posterior Extremity.

The *gluteus primus* is nearly always very small, scarcely or not at all covering the *biceps cruris* (*vide* Pl. XX. fig. 1). It is larger in the Oceanitidæ, especially in *Oceanites* (*t. c.*, fig. 3, *gl.* 1) and *Garrodia*, where it does cover the *biceps* to some little extent anteriorly.

The *gluteus quintus* appears to be absent, or not differentiated off from the posterior fibres of the preceding, in all the Tubinares, except the Diomedeinæ, where it can be distinctly defined.

The *ambiens* is present and usually well-developed in all the Tubinares, except the genera *Fregetta* of the Oceanitidæ, and *Pelecanoïdes* amongst the Procellariidæ, in which it is quite absent.

In *Pelagodroma*, *Oceanites*, and *Garrodia* its fleshy belly is of fair size, but the tendon I have been unable to trace across the knee, it apparently terminating on the cnemial process of the tibia. In the other genera this tendon crosses the knee as usual, passing in front of the patella, when that is ossified, between the great cnemial process of the tibia and the end of the femur, and ends as usual in the leg.

The *femoro-caudal* is always present in the form of a usually not broad ribbon, inserted about halfway along the femur (Pl. XX. figs. 2–4, *f.c.*). It does not pass through, as it does in some of the Ciconiiform birds, a sort of pulley formed by the posterior angle of the pelvic bones.

The *accessory femoro-caudal* (Pl. XX. figs. 2, 3, *a.f.c.*) is always present and well-developed, except in the genera *Bulweria* and *Pelecanoïdes* (*t. c.*, fig. 4), where it is quite absent. It is fairly broad and ribbon-shaped, overlapping the *semi-membranosus* in the Oceanitidæ at its origin, and inserted into the femur together with the femoro-caudal. In the genera *Fregetta*, *Puffinus*, and *Majaqueus* it is decidedly small. Zool. Chall. Exp. vol. iv. pt. xi. p. 31.

The *semi-tendinosus* (*t. c.*, figs. 1–3, *s.t.*) muscle is always present and strong. It arises from the iliac bone round its most posterior angle, and has no connection at all with the caudal vertebræ. Anteriorly it slightly overlaps the *biceps*.

Excepting in the Oceanitidæ, it has no accessory head, so that all its fibres are inserted by a thin, broad tendon, quite distinct from that of the *semi-membranosus*, on to the tibia. In the Oceanitidæ, in all the species and genera, there is a strong and broad accessory head, arising from the femur, as usual, and joining the main belly of the muscle by an oblique tendinous raphe (*vide* Pl. XX. fig. 3, *a.s.t.*).

The *semi-membranosus* (*t. c.*, fig. 1–3, *s.m.*) is always very large, of broad, flat, ribbon shape, not so parallel with the *semi-tendinosus* nor so covered by it, as usual, its direction being more oblique than is that of the other muscle, and thus more parallel to that of the adductors. It arises from the posterior margin of the ilium, ischium, and pubis, from a little above the ischial prominence to within a small distance of the end of the pubis. Its insertion is by a thin, broad tendon, anterior to, and separate from, that of the *semi-tendinosus*.

Of the other muscles in the hind limb the *biceps* always passes through a tendinous loop on its way to its insertion, as is nearly always the case with birds.

The *obturator externus* is never large, and is inserted near the femur head. The *obturator internus* is of peculiar shape, nearly oval, but with a slight indication of becoming triangular. The deep flexors of the toes and of the hallux blend, usually about halfway down the leg, and their tendons may become ossified. Even when a hallux is present it receives no tendon at all from these muscles.

4. *Other Anatomical Features.*

There are always two carotid arteries situated in the hypapophysial canal. There are also two jugular veins, the right of which is frequently the largest.

The main artery of the leg is always the sciatic one, accompanying as it does the sciatic nerve.

In the genus *Pelecanoïdes*, as has already been described by Garrod (*cf. antea*, p. 373), the femoral vein, instead of being, as usual in birds, deep of the femoro-caudal muscle,—from the external border of which it then seems, in the ordinary course of dissection for the thigh-muscles, to emerge (Pl. XX. fig. 2, *f.v.*),—is superficial to it, appearing at the external edge of the obturator externus, and then crossing the femoro-caudal superficially as represented in Pl. XX. fig. 4, *f.v.*

Zool. Chall. Exp. vol. iv. pt. xi. p. 32.

In the Procellariidæ, except *Pelecanoïdes*, the two most anterior air-cells, which lie between the rami of the furcula at the entrance to the thorax, are not, as is usually the case in birds, fused together to form an interclavicular air-cell, but—at least in all the species in which I have examined into this point—remain partially distinct, being separated for the greater part of their length by a median septum formed by the coalescence of their internal walls—and double in consequence—but imperfect behind in the middle line, so that there is here a free communication between the two cells over the trachea. In the Oceanitidæ and *Pelecanoïdes* the ordinary structure prevails *.

There are always large supra-orbital glands, which occupy depressions excavated for them in the top of the skull (*vide* Pl. XXII. fig. 3), and open by a small duct into the nasal cavities. Similar glands occur in many birds, notably the Penguins, Colymbidæ, Auks, Gulls, and many others †.

As in all other Ciconiiform birds, there is no true penis developed.

5. *Trachea and Vocal Organs.*

The trachea in all Tubinares is a straight, simple tube, never convoluted in any way, and with the normal structure of this organ in birds. In some of the genera—*Fulmarus*, *Thalassœca*, *Aeipetes*, and *Ossifraga*—it is divided, as will be described in detail further on, to a greater or less extent by a median longitudinal septum, as in the Penguins alone of other birds so far as I know. The trachea has the ordinary long lateral muscle on each side, as well as a pair of well-developed sterno-tracheales, these arising from the costal processes of the sternum, as in so very many birds.

The constitution of the syrinx, or lower larynx, differs very considerably in the different genera and groups of the Tubinares as regards the number and modifications of form of the various tracheal or bronchial rings that enter into its composition. When, as *e.g.* in the Gallinæ, the syrinx has no intrinsic muscles, the only guides for determination of the exact rings forming the syrinx are the variations in form of the rings themselves, according as to whether they are tracheal or bronchial, and the facts elucidated by a comparative study of these parts in a series of genera. Such a study of the syrinx in the Tubinares has made it evident to me that in this group at least the attachment of the intrinsic syringeal muscles (of which of course there are only a pair) to a particular bronchial semi-ring is constant, thereby affording a landmark by which the contiguous rings on both sides can at once be assigned to their proper position. The semi-ring that bears the muscle in the Tubinares is the fifth, the four bronchial rings (or semi-rings) above it, as well as a less or

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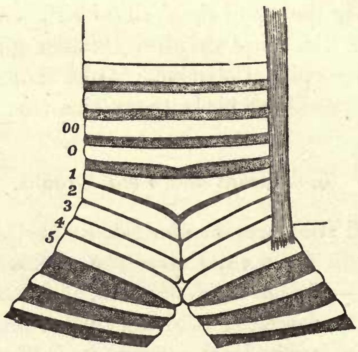
* In one of the three specimens of *Oceanites* examined, there appeared to be a division of the interclavicular air-cell into two, as in the Procellariidæ.

† *Cf.* Nitzsch's article, "Ueber die Nasendrüse der Vögel," Meckel's Archiv, 1820, pp. 234–269.

Zool. Chall. Exp. vol. iv. pt. xi. p. 33. greater number of the last tracheal rings, forming together the framework of the lower larynx. In most cases the last tracheal ring bears a well-marked antero-posterior pessular bar.

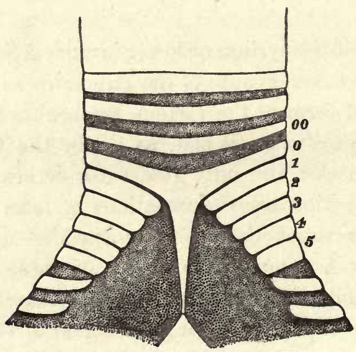
It is in the genus *Pelecanoïdes* (figs. 3, 4) that the typical construction of the syrinx of the Tubinares is seen in its simplest form; it will, therefore, be described first on the present occasion.

Fig. 3.



Syrinx of *Pelecanoïdes urinatrix*, from before.*

Fig. 4.



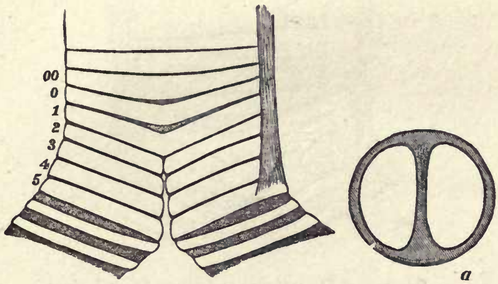
The same, from behind.

The last tracheal ring is complete in front, and not modified in shape; posteriorly it is produced downwards into a well-developed pessulus, so forming a complete three-way piece. The first bronchial semi-rings are

* This and the succeeding figures of the syrinx of the Tubinares have been drawn as nearly as possible of one uniform size, irrespective of that of the originals, and are also slightly diagrammatic. The bronchial rings are numbered from 1–5; the tracheal are marked 0, 00, 000, &c., in the reverse direction.

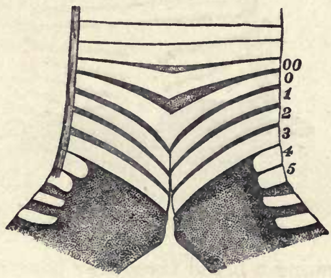
united in front, where they are produced triangularly downwards; behind, their inturned ends do not unite either with each other or with the pessulus, or with the second semi-rings. These last, as well as the

Fig. 5.



Syrinx of *Garrodia nereis*, from before.
a. The last tracheal ring, from below, to show the pessular bar.

Fig. 6.



The same, from behind.

third, fourth, and fifth, on which is inserted the muscle, are all similar in shape, and separate from each other; they are closely approximated in front, gradually getting shorter posteriorly.

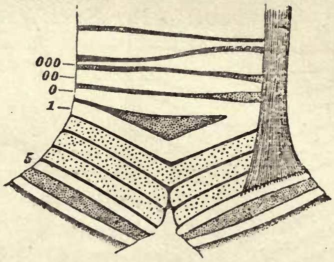
Garrodia, which may be considered typical of the Oceanitidæ, is anteriorly (fig. 5) almost the same as *Pelecanoïdes*, but the first, second, and third bronchial rings are complete (fig. 6). The last tracheal ring bears a complete pessulus (5, *a*).

A very similar type of syrinx prevails in the other Oceanitidæ, and is also that found in the genera *Procellaria* (figs. 7, 8), *Cymochorea* (figs. 9, 10), and *Halocyptena*. In all these the first few bronchial rings closely resemble in character tracheal rings, being nearly straight, closely apposed to each other, and more or less ossified. Anteriorly they may be united with one or more of the preceding tracheal rings, and very frequently the first two or three are quite complete here in the middle

Zool. Chall. Exp. vol. iv. pt. xi. p. 34.

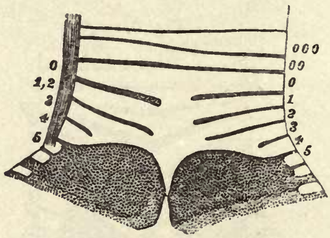
line. There is always a well-developed and complete pessular bar, supported behind by the last tracheal ring. With this bar, one or more (sometimes three or four) of the bronchial rings may fuse by their coalesced

Fig. 7.



Syrinx of *Procellaria pelagica*, from before.

Fig. 8.



The same, from behind.

ends posteriorly, forming a broad three-way piece ; or these rings may be complete rings closely apposed, though apparently not anchylosed, to each other in the pessular bar. Different specimens vary slightly in the exact number and disposition of these bronchial rings, and sometimes are not exactly similar on the two sides.

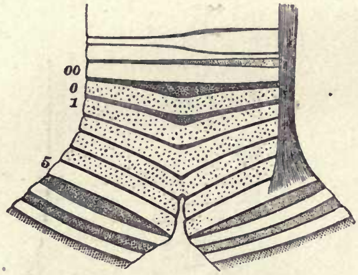
In *Prion vittatus* (figs. 11 & 12, p. 402), the first bronchial ring is either small or fused with the second, which is anteriorly entire: this is not the case with the three succeeding ones. The last three tracheal, and first two—or on one side three—bronchial rings form a pessular box, continuous anteriorly with the inturned anterior ends of the third semi-rings. The fourth pair takes no share in the formation of the box. In *Prion desolatus* there is only one complete bronchial ring, which may be the first, or the first and second united ; the others are incomplete, inturned anteriorly, and not co-ossified to form a box. There is a good pessulus borne by the last tracheal.

Zool. Chall. Exp. vol. iv. pt. xi. p. 35.

In *Pagodroma* (figs. 13 & 14, p. 403) the four first bronchial semi-rings are ossified and firmly united into a bony box behind; anteriorly, however, the first and fourth bronchial rings are free, whilst on one side the second and third are quite fused both before and behind. The last tracheal ring is free throughout.

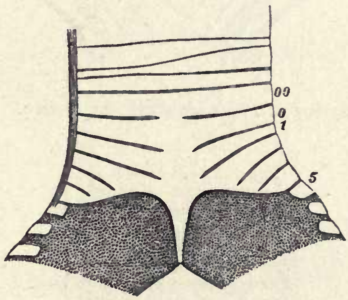
Fig. 9.

Zool. Chall. Exp. vol. iv. pt. xi. p. 34.



Syrinx of *Cymochorea leucorrhoa*, from before.

Fig. 10



The same, from behind.

Daption much resembles *Pagodroma*, there being a bony box, formed however by the fusion of the first three bronchials with the last tracheal ring. In neither of these genera is there any trace of a tracheal septum. *Ibid.* p. 35.

It is by a further development of the syrinx of *Pagodroma* that the peculiar one of the Fulmars is formed.

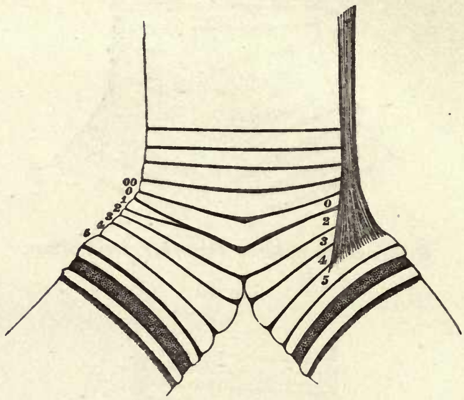
In *Thalassœca glacialoides* (figs. 15, 16, p. 404) the last two tracheal rings are ossified and fused together anteriorly, a median descending process being developed which lies between the similarly ossified and fused first three bronchial rings. The fourth pair of rings is also ossified, but free from those that precede it, at least anteriorly. Posteriorly the first four bronchial and last four tracheal rings are firmly co-ossified into a large pessular box, whilst ossification in the median line (both before and behind) of a number of the cartilaginous tracheal rings above this forms the line of attachment for the median septum which divides the tracheal tube for an extent of about 1·25 inch. *Ibid.* p. 36.

2 D

In *Fulmarus glacialis* the syrinx is very similar; the four bronchial rings are anteriorly ossified, as are many of the tracheal rings in their median area. The tracheal septum is still more developed than in *Thalassœca*, extending for about the lower two fifths of the trachea—a distance of nearly $2\frac{1}{2}$ inches.

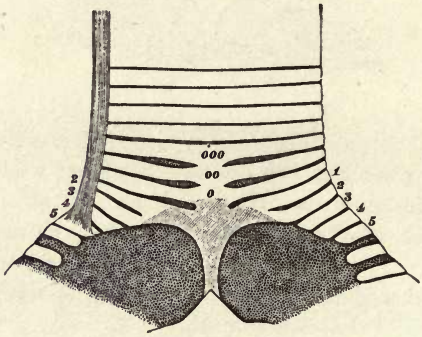
Zool. Chall. Exp. vol. iv. pt. xi. p. 35.

Fig. 11.



Syrinx of *Prion vittatus*, from before.

Fig. 12.

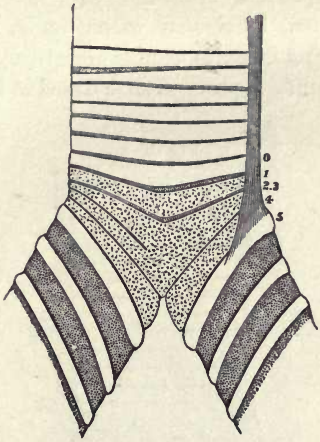


The same, from behind.

Ibid. p. 36.

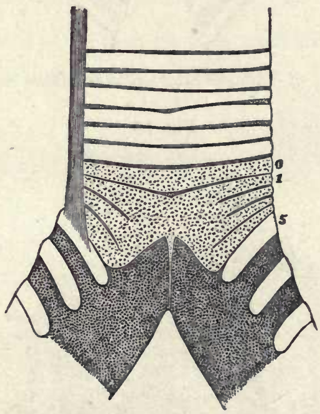
The extraordinary syrinx of *Ossifraga* is a still further modification of this type (figs. 17, 18, 19, pp. 405, 406). A number of the last tracheal rings (nine on one side, ten on the other, in the specimen—a young one—figured) become completely ossified, as are the first four or five bronchial rings, of which only the first two are complete. The inferior part of the trachea is divided inferiorly for a short way into two quite complete and separate tubes; the posterior ends of the lowest tracheal rings being so much incurved that each actually, inferiorly, forms two complete rings, those of opposite sides being quite separate, whilst above, by the gradual diminution of their opposed interior halves, they become, when viewed

Fig. 13. Zool. Chall. Exp. vol. iv. pt. xi. p. 35.



Syrinx of *Pagodroma nivea*, from before.

Fig. 14.



The same, from behind.

from outside, simple rings of the normal tracheal type. On section, *Ibid.* p. 36. however, it is seen that their ends are still incurved to form a tracheal septum like that of *Fulmarus* and *Thalassœca*. This completely divides the trachea into two tubes for a space of about 3½ inches, terminating above by a free semi-lunar border, concave upwards (fig. 19, *c*, *d*, p. 406). In fig. 19 three sections are given of the inferior portion of the trachea made along the lines *a*, *b*, *c*, in fig. 17 (p. 405), to show how the two tracheal tubes, separate below, gradually unite above.

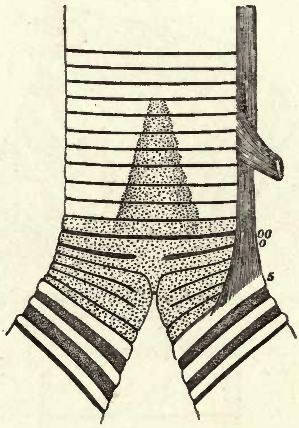
Zool. Chall. Exp. vol. iv. pt. xi. p. 37.

Aeipetes antarcticus (figs. 20, 21, p. 407), commonly placed in the genus *Thalassœca* with *Thalassœca glacialoides*, completely differs in the structure of its syrinx from the last three species described, and is more like *Prion*. The two first pairs of bronchial rings are complete anteriorly, the second being ossified, for a small extent only, in the middle line. The lowest tracheal ring is quite simple anteriorly, and posteriorly it sends forwards a pessuliform process, anchylosed in front with the second

Ibid. p. 38.

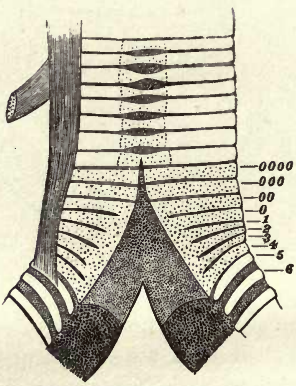
Ibid. p. 36.

Fig. 15.



Syrinx of *Thalassœca glacialoides*, from before.

Fig. 16.



The same, from behind.

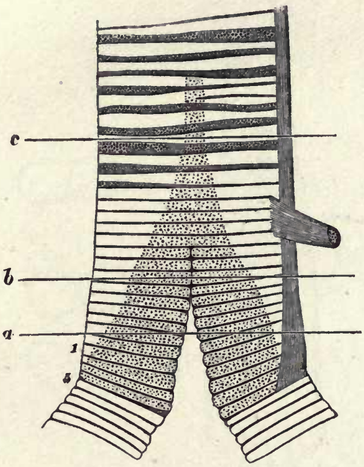
Ibid. p. 38.

bronchial rings. Two pairs of the bronchial semi-rings (3, 4) are ossified at their posterior extremities, but not fused in any way. The penultimate tracheal and preceding rings are, as in *Fulmarus* &c., ossified posteriorly in their median (narrowest) portion only to bear the tracheal septum.

This, however, is not (*vide* fig. 18, *a*) a complete septum, but is incomplete, the incurved posterior ends of the rings not reaching the anterior wall of the trachea by some little way. Its vertical extent is small, ceasing about ·85 inch above the bronchi.

Fig. 17.

Zool. Chall. Exp. vol. iv. pt. xi. p. 37.



Syrinx of *Ossifraga gigantea*, from before.

Fig. 18.

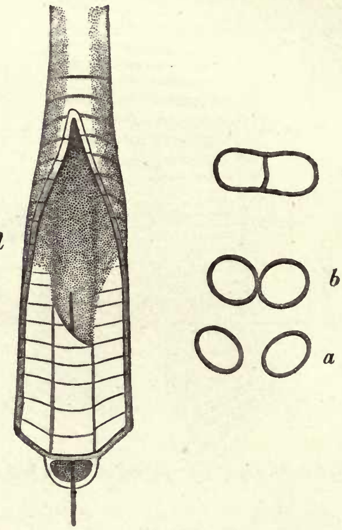
The same, from behind.

The peculiar genus *Bulweria* is, perhaps, as far as regards tracheal structure, nearer the small Storm-Petrels (*Procellaria* and *Cymochorea*) than any other group, judging at least from my examination of the *Ibid.* p. 38.

syrinx of *Bulweria macgillivrayi.* In this specimen * the rings are asymmetrical—there being only three, instead of four, bronchial rings between the pessular ring and that which bears the muscle on the left side, apparently owing to the suppression of the second bronchial ring, as

Zool. Chall. Exp. vol. iv. pt. xi. p. 37.

Fig. 19.



a, b, c, sections of syrinx and trachea of *Ossifraga* along the lines *a, b, c,* of fig. 17, to show the double nature of the tracheal tube below, and its complete division by a median septum above; *d,* trachea opened from the side, to show the median septum, dividing it into two parallel tubes, through the left of which a pointer is passed, below, and terminating above by a free margin.

Ibid. p. 38.

may be seen in the figures (figs. 22, 23, p. 408)—and irregularly developed, tending thus to hide the typical form. The last three tracheal rings are, anteriorly, more or less united, there being a pessular bar developed on the inferior margin of the last ring. Posteriorly, the antepenultimate of these is quite free and complete; the next is incomplete posteriorly, whilst the last is complete on the right side, but anchyloses on the left with the first bronchial laterally. The third bronchial rings on each side are complete, thus encircling the bronchi. The fourth is free and incomplete.

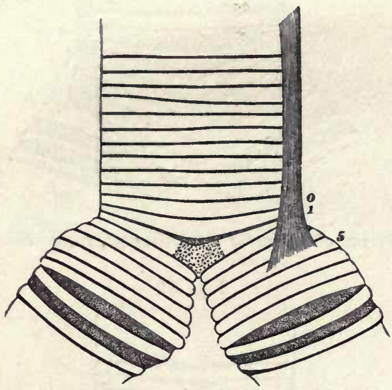
Puffinus (as represented by *Puffinus brevicauda*) presents a simple form

* Some of the peculiarities here described may be due to its being a youngish bird. I have, unfortunately, as yet been unable to examine the syrinx of *Bulweria columbina*, which might throw some additional light on the subject of the affinities of this genus.

of syrinx (figs. 24, 25, p. 409), the two first bronchial rings being complete anteriorly, the succeeding two being only semi-rings. The two last tracheal are united with the two first bronchial behind, sending off a

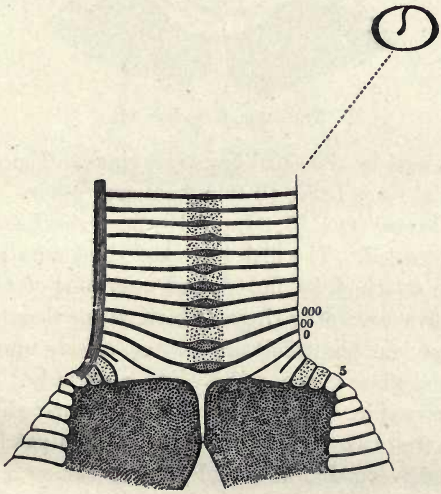
Fig. 20.

Zool. Chall. Exp. vol. iv. pt. xi. p. 39.



Syrinx of *Aeipetes antarcticus*, from before.

Fig. 21.



The same, from behind. The smaller figure represents a section of the trachea, to show the imperfect septum dividing it.

pessular process, which anteriorly, as usual, is continuous with the third semi-rings. In younger birds (fig. 26, p. 409) the various rings concerned remain more distinct, the pessular bar, it is pretty clear, being largely formed by the third semi-rings anteriorly, their backward prolongation fusing behind with cartilaginous elements developed in connection with

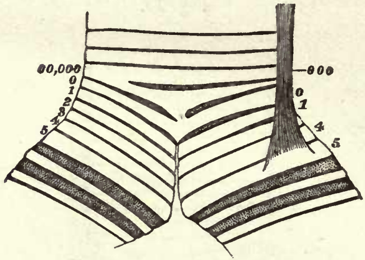
Ibid. p. 38.

Ibid. p. 39.

the posterior ends of the second semi-rings, and all ultimately fusing into the pessular box of the adult. In *Puffinus obscurus* there is a complete

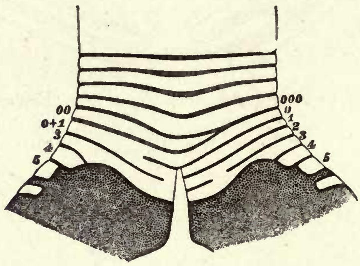
Zool. Chall. Exp. vol. iv. pt. xi. p. 38.

Fig. 22.



Syrinx of *Bulweria macgillivrayi*, from before.

Fig. 23.



The same, from behind.

Ibid. p. 39.

pessular bar, formed by the third bronchial rings. There is no pessular box, the bronchial rings being all free from each other.

In *Œstrelata lessoni* (figs. 27, 28, p. 410) the syrinx becomes much more specialized and ossified. The fifth bronchial rings are strong and curved, and to these are attached, by fan-shaped insertions of tendon, the vocal muscles. The five preceding rings (which must therefore be the last tracheal and first four bronchial) are narrow, closely united, and ossified over a rhomboidal space in the middle line anteriorly. Behind there is a pessular box formed by these rings, and the four preceding tracheal ones in addition, the first two of these having a median patch of ossification. There is a well-developed and ossified pessular bar.

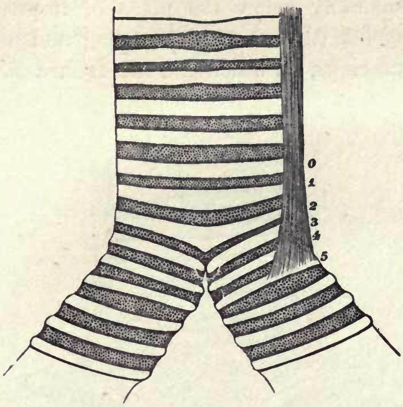
Ibid. p. 40.

Œstrelata mollis is quite similar, except that the box is composed of one ring less.*

* I regret not having as yet been able to examine any adult bird of *Œstrelata brevirostris*, all my specimens being young and consequently with the tracheal rings unossified and generally distinct. There is a box formed by the fusion behind of at least three of the bronchial rings with the last, or two last, tracheal ones. The second, third, and fourth bronchial rings are united together anteriorly, the third rings joining the pessular bar.

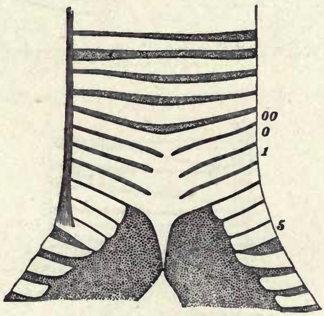
Fig. 24.

Zool. Chall. Exp. vol. iv. pt. xi. p. 39.



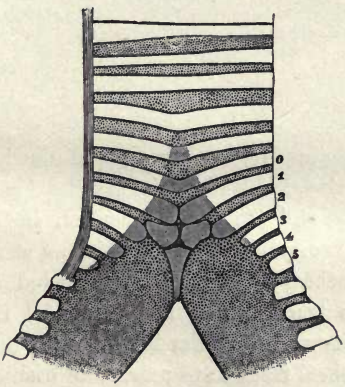
Syrinx of *Puffinus brevicauda*, from before.

Fig. 25.



The same, from behind.

Fig. 26.



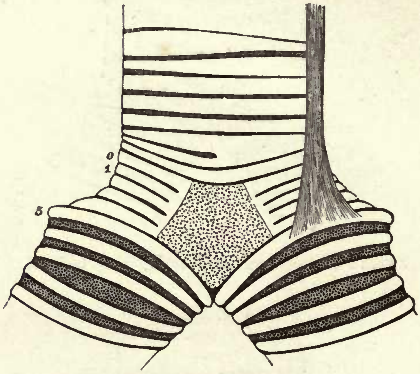
The same, from a younger bird, in which the bronchial and tracheal rings have not yet coalesced.

Zool. Chall. Exp. vol. iv. pt. xi. p. 40.

In *Diomedea brachyura* and *exulans* the calibre of the trachea diminishes very considerably below the place of insertion of the *sterno-tracheales*. The syrinx (figs. 29, 30) is strong and well ossified. The fifth bronchial semi-rings, on which end the fanned-out tendinous inser-

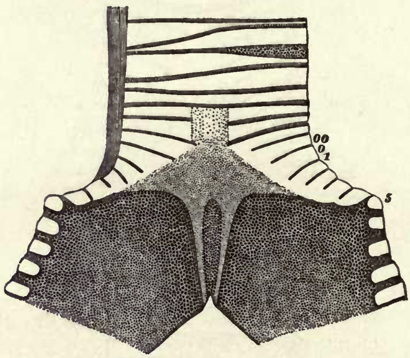
Ibid. p. 39.

Fig. 27.



Syrinx of *Œstrelata lessoni*, from before.

Fig. 28.

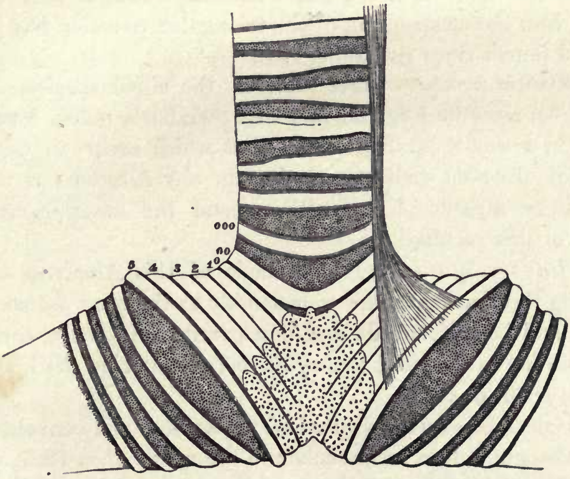


The same, from behind.

Ibid. p. 40.

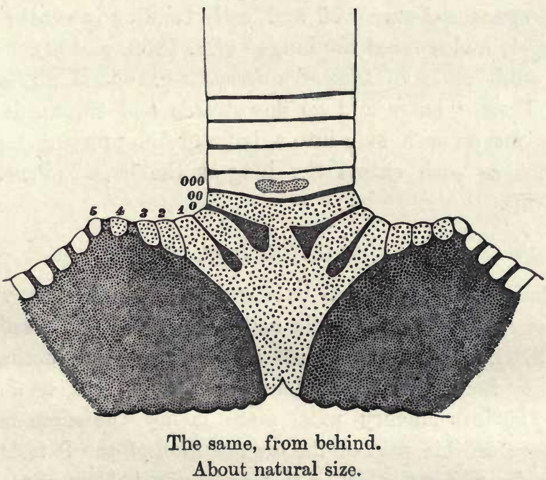
tions of the intrinsic muscles, are strong and much arched. The four preceding bronchial rings, as well as the last tracheal, are ossified anteriorly and posteriorly, and (with the exception in *Diomedea exulans* of the fourth bronchial) co-ossified anteriorly into a strong box, with which the penultimate tracheal ring is also connected in the middle line. Behind, the last two tracheal and first bronchial rings are co-ossified, forming a broadly triangular pessular bar or box, whilst one or more (5) of the preceding tracheal rings have patches of ossification mesially. In *Thalassiarche culminata* (of which I have only examined one) all the five bronchial rings, including the muscular one, are firmly co-ossified together, and free from the rest. There is no complete pessulus, the bony box formed by the rings terminating posteriorly in a straight and

Fig. 29.



Syrinx of *Diomedea exulans*, from before.
About natural size.

Fig. 30.



The same, from behind.
About natural size.

free margin, which a cuneate bar, formed by the inturned anterior ends of the fourth bronchial rings, does not reach. The syrinx of *Phœbetria* as yet I only know from a young specimen, in which the bronchial rings below the first are incomplete anteriorly, whilst behind there is a box formed by the last two tracheal and first four bronchial rings.

Majaqueus is very like *Diomedea* in its syrinx, the penultimate tracheal ring, however, being ossified anteriorly, as well as its five successors, which remain free in front. The second bronchial ring is the last entering into the composition of the triangular pessular box behind, the third and fourth rings remaining free.

Zool. Chall. Exp. vol. iv. pt. xi. p. 41.

In *Diomedea brachyura* and some of the allied species, the bronchi seem to be, according to the late Mr. Swinhoe's notes, long and convoluted, in a way reminding one of that which occurs in *Ciconia nigra*. I have not observed such convolutions in any Albatross or other Petrel dissected by myself. I herewith append the descriptions given by Swinhoe of this peculiarity.

Diomedea brachyura.—" In the male of this Albatross the bronchi on leaving the trachea bulge considerably as they run horizontally, then contract, and bend forwards and downwards, and lastly, turning sharp round, rise upwards and bulge again before entering the lungs " (Swinhoe, Ibis, 1863, p. 431).

" A female *Diomedea brachyura* had the swollen and convoluted trachea which I thought before was peculiar to the male " (*l. c.* 1867, p. 227).

Diomedea nigripes.—" In this species the trachea of the female is simple, but that of the male is terminated by large, swollen, convoluted bronchi. In a male specimen, procured in May, the bronchi ran down right and left, almost straight for about $1\frac{7}{10}$ inches, then took a bend forward for a short space, and narrowed, and lastly bending inwards and upwards, bulged largely and entered the lungs " (*l. c.* 1863, p. 432).

In five adult males of *Diomedea derogata* examined, all had contorted bronchi. These " bulge and go downwards and sidewards, then bend under the ribs on each side into a large globe, pressing between itself and the ribs as each enters the lung at the back " (Proc. Zool. Soc. 1873, p. 785).

6. *Osteology.*

M. Alphonse Milne-Edwards having described at length, with figures, the osteology of the Tubinares in his classical work on fossil birds (*vide suprà*, p. 370), whilst other points of their osseous structure have been elucidated by Brandt, Huxley, Reinhardt, and others, as already mentioned in the introductory part, there is not the same necessity for dwelling here on this part of the organization of the Petrels as was the case when describing the softer and more perishable parts. Moreover, no amount of detailed description of bones, however elaborate or well illustrated, can serve the purpose of scientific research so well as actual specimens, which can in most cases be comparatively easily obtained for, and permanently preserved in, museums.

My study of the osteology of the Tubinares has been chiefly based on the material enumerated in the subjoined list.

List of Osteological Material examined.

Zool. Chall. Exp. vol. iv. pt. xi. p. 42.

OCEANITIDÆ.

Oceanites oceanicus	Skeleton.
Fregetta melanogastra	Do.
Garrodia nereis	Bones of trunk and of limbs.
Pelagodroma marina	Limb-bones.

PROCELLARIIDÆ.

Cymochorea leucorrhoa	Skeleton.
Procellaria pelagica	Do.
Bulweria columbina	Limb-bones.
Œstrelata "grisea"	Skeleton. } (Eyton Coll.).
—— sp. inc. (also named *griseus*)	Do. } (Eyton Coll.).
—— *lessoni*	Two skulls.
Majaqueus æquinoctialis	Skeleton.
Puffinus anglorum	Do.
—— *obscurus*	Do.
—— *brevicauda*	Do. (incomplete).
Adamastor cinereus	Skeleton.
Daption capensis	Skeleton (Eyton Coll.) and skull.
Aeipetes antarcticus	Do. and two skulls.
Thalassœca glacialoides	Do.
Fulmarus glacialis	Do.
Ossifraga gigantea	Do. and skull.
Prion desolatus	Do. and three skulls.
—— *vittatus*	Skull.
Pelecanoïdes urinatrix	Skeleton and sternum.
Diomedea exulans	Skeleton and skull.
—— *brachyura*	Do.
Thalassiarche melanophrys	Do. (Eyton Coll.).
—— *culminata*	Skull.
Phœbetria fuliginosa	Two skulls.

The skull (*vide* Pl. XXI. figs. 4, 5, Pl. XXII. figs. 1–4).—The rostrum is long, and strongly hooked apically. It has no distinct hinge with the cranium proper, but the cranio-facial notch is large, and the nasal and premaxillary bones at their junction with the frontals so thin as to permit of a considerable amount of vertical movement of the beak.

The nares are large and "holorhinal," their posterior boundaries being concave, and not extending, by some way, as far back as the posterior ends of the nasal processes of the premaxillæ. In the Diomedeinæ the nostrils are widely separated, and distinctly lateral in position; in the other forms they are closely approximated, and near the culmen. The nasal septum is but little ossified, most so in the Diomedeinæ. There may be a couple of small ossifications in the floor of the nasal capsules near their anterior extremity, continuous anteriorly with the premaxillæ, united together in the median line, and externally abutting on the outer and lower wall of the nostril.

Zool. Chall. Exp. vol. iv. pt. xi. p. 43. The skull above the orbits is always deeply excavated for the fossæ in which lie the nasal ("supra-orbital") glands. In the Albatrosses there is a strong raised external border to the fossa posteriorly, prolonged from the post-orbital processes, whilst externally this floor, here perforated by numerous apertures, is deeply excavated.

The post-orbital processes are large and strong. The temporal fossæ are well-developed, nearly meeting across the middle line in most, though in the Albatrosses separated by a considerable interval. The occipital plane is inclined downwards and forwards, but in the Albatrosses is nearly vertical. In these birds the digastric fossæ are continuous, meeting each other in the middle line, whilst in the other Tubinares they are separated to a greater or less extent by the wide, smooth, convex cerebellar eminence.

As might be expected, all these fossæ and their bounding ridges are much better developed in the large Albatrosses and Petrels (*Ossifraga*, *Majaqueus*, &c.) than in the small Procellariidæ and Oceanitidæ, in which the skull is comparatively smooth, of much thinner texture, and with the cerebellar eminence occupying a much greater extent comparatively. The interorbital septum is well ossified in the larger species, most so in *Diomedea exulans*, whilst in the smaller ones it is very extensively fenestrated.

The lachrymal bone is always well developed, but varies in form in the different groups. In the Oceanitidæ and the small Petrels of the *Procellaria*-group it is T-shaped in form, the long arm of the T being horizontal, extending forwards from the body of the bone (which is nearly vertical) to articulate with the external descending process of the nasal bone, just behind the level of the end of the nostril. Between it and the rest of the skull lies a considerable oval fenestra, occupied by membrane in the recent state. The ascending process articulates with the frontal, forming a well-marked, backwardly-directed, antorbital process, whilst the descending process descends downwards towards the jugal arch, to which it may be united by ligament articulating internally with the considerable antorbital plate of the ethmoid ("ectethmoid," Parker).

In *Pelecanoïdes*, *Puffinus*, *Adamastor*, and *Majaqueus* it has the same relations, but is more triangular in form, and closely abuts on the cranium superiorly, the fenestra being reduced thus to a chink. In the Albatrosses it also remains separate from the skull, and the anterior limb is but little developed as compared with the vertical part, which is swollen, excavated by air-cells, and forms above a strong antorbital process. It loses its connection with the ethmoid. In the remaining genera the lachrymal does not exist as a free bone, being firmly anchylosed to the frontal above and the ethmoid anteriorly (Pl. XXII. figs. 1, 3). It is hollow, with one large, and several small external apertures.

In connection with the descending limb of the lachrymal bone there is often developed a peculiar ossicle, named by Brandt (*cf. suprà*, p. 367) who was the first to describe its existence in *Diomedea brachyura* and *Puffinus major*, the "ossiculum lacrymo-palatinum," from its connection with those two bones.

Its nature and relations in the group have subsequently been more extensively investigated by Reinhardt (*vide suprà*, p. 371), who calls it the "os crochu." [Zool. Chall. Exp. vol. iv. pt. xi. p. 44.]

When best developed, as in the Albatrosses, the "ossiculum lacrymo-palatinum" is a small styliform ossicle of nearly cylindrical (as in *Thalassiarche culminata*, Pl. XXI. fig. 7) or somewhat lamellar (*Phœbetria fuliginosa*, Pl. XXI. fig. 8) shape, attached above by an articulation to the inner face of the descending limb of the lachrymal bone, and below connected by a ligament to the upper surface of the palatine bone. Seen from the side, in the dried skull (*vide* Pl. XXII. fig. 1) the bone is visible below the malar arch. It lies, in the recent state, in a cavity between the nose and the roof of the mouth, in an oblique position, pointing downwards and inward. This bone is present in all the genera and species of Albatrosses examined by me, as well as in *Thalassiarche chlororhyncha*, as mentioned by Reinhardt. In the Oceanitidæ, in *Procellaria* and *Cymochorea*, as well as in *Daption* and *Pagodroma*, its place is taken by a narrow ligament in which there is no ossification at all. In *Bulweria*, *Pelecanoïdes*, *Fulmarus*, *Thalassœca*, and *Ossifraga* there is a similar ligament, with a small, more or less ossified nodule of bone lying in it, only connected by connective tissue with the surrounding bones. In *Aeipetes*, *Prion*, *Puffinus*, *Majaqueus*, *Adamastor*, and *Œstrelata* it is small and delicate, articulating with the lachyrmal above, and ending freely (in the cleaned skull) below.

It is interesting to observe that a very similar bone, both as regards shape and position, occurs in the genus *Fregata* as already pointed out by Reinhardt, whose observation I have been able to verify. But it also occurs in forms so different from these as the Musophagidæ, many Cuculidæ, *Chunga* and *Cariama*, as well as in some Laridæ and Alcidæ, so that its presence is obviously of no particular taxonomic value. Professor Parker informs me that its precise morphological significance is at present rather uncertain.

The palate (*vide* Pl. XXII. figs. 2 and 4) is always more or less incomplete below, the fissure dividing it being, by the less degree of inward developmentof the maxillary processes of the premaxillæ, and of approximation of the inward edges of the maxillo-palatines and palatine bones, longer and wider in the smaller than in the larger forms.

The maxillo-palatine processes are concavo-convex lamellæ, extensively fenestrated, pointing backwards, and with their inner edges appearing but slightly internal to the palatine bones. They remain free from each other in the middle line, and are also unconnected by ossification with the vomer or nasal septum. Hence the Tubinares are in this point strictly schizognathous birds. But in the Albatrosses, where the maxillo-palatines are very large and nearly vertical in position, the space between their inner edges is very narrow, and just in front of them the decurved end of the vomer fills up the intervening chink, especially in *Phœbetria fuliginosa*, where it is firmly fixed to, though apparently not anchylosed with, the maxillary plates. The transition from this to a desmognathous type would therefore be but very slight.

Zool. Chall. Exp. vol. iv. pt. xi. p. 45.

The palatines in the smaller forms are of generally flat form, with their posterior angles rounded off, closely apposed together for a very short way behind the posterior nares, and with fairly developed descending and ascending plates, the latter being recurved posteriorly and anchylosed to the vomer. This latter bone (Pl. XXI. figs. 4 and 5) is always broad behind, of generally depressed form, and strongly bent downwards in front, its pointed extremity appearing between the maxillo-palatine processes at about their anterior edge.

In the larger forms the vomer becomes enormously broad, and keeled both above and below. The palatines meet for a much more considerable distance posteriorly, greatest in *Fulmarus*, and their descending plate becomes more pronounced; at its anterior end the bones of opposite sides nearly meet. The ascending plate, too, becomes very large, more or less embracing the vomer at its base, and being separated, especially in the Albatrosses, only by a narrow chink anteriorly from the posterior end of the equally upturned maxillo-palatine. The posterior margin of the palatines is more or less concave. The pterygoids are nearly straight, slightly compressed, cylindrical bones, which articulate mesially partly with the basisphenoidal rostrum, partly with the truncated posterior ends of the palatines. Well-developed basipterygoid facets are present in all the forms (*vide* Pl. XXII. figs. 2 and 4), except the Diomedeinæ, the Oceanitidæ, *Procellaria* and *Cymochorea* *. The quadrate, as in most birds, is two-headed. Its distal end has two distinct articular cartilage-coated areas, separated by a depression. The most external of these is oblique from behind outwards, and is somewhat saddle-shaped, being convex from side to side, and concave antero-posteriorly. The inner facet has its axis directed forwards and inwards, nearly parallel to that of the pterygoid bone. It is divided by a prominent oblique trochlea into an inner, nearly flat, surface, of triangular shape, and a more external, deeply grooved one, also of saddle shape. As might be expected,

* *Halocyptena* has not yet been examined in this respect: it probably resembles the last two genera named.

these features are less obvious in the feeble and smaller, than in the stronger and larger, species of the group.

The foramen magnum is more or less reniform, with the major axis transverse, in the small species, whereas in the biggest it is oval, especially in *Ossifraga*, with the long axis vertical. The moderately sized species are here again intermediate in structure.

The mandible has no recurved angular process; its posterior end is more or less inturned and truncated behind, the truncated surface being of triangular shape. The articular surfaces are two in number, and, of course, of inverse shape to the corresponding facets on the quadrate bone. One or more pneumatic foramina enter the bone at this point.

Axial Skeleton.—The number of vertebræ varies from thirty-eight to forty-two, but that of the cervical ones is always fifteen, as may be seen from the table appended (p. 419). In the Oceanitidæ, it will be observed, the number of cervico-dorsal vertebræ is twenty-one, in the Procellariidæ it is twenty-two, with two exceptions, where there are as many as twenty-three.

Zool. Chall. Exp. vol. iv. pt. xi. p. 46.

The articular cup of the atlas is always incomplete superiorly, the odontoid process of the axis filling up the gap, and so completing the joint. The fifteenth cervical vertebra has a well-developed free rib, which may have an uncinate process, and one or more of the preceding vertebræ—usually two, but sometimes as many as four (*Oceanites*)—have short V-shaped ribs, which do not anchylose with the vertebræ. Sometimes (*Oceanites*, *Prion*) the fourteenth cervical rib is longer, resembling in shape that of the fifteenth, but with no uncinate process.

The dorsal vertebræ * are all free, except the last, or occasionally two last, which are anchylosed to those forming the sacrum. They usually have well-developed hypapophyses, especially anteriorly. These are particularly strong and well-developed in *Pelecanoïdes* as in other diving birds (e. g. *Uria*, *Alca*, *Podiceps*), extending there to quite the last dorsal vertebra. In the Diomedeinæ, on the other hand, they are quite absent, or merely represented, on the most anterior ones, by short expanded processes like those of the few last cervical vertebræ.

In nearly all the Tubinares, each of the dorsal vertebral centra has on its sides a distinct oval depression, of varying depth, at the bottom of which, in the largest species, open one or more small pneumatic foramina, to admit air to the interior of the bones. In the Albatrosses, however, these pneumatic depressions are absent, though air is admitted to the bones—which are highly pneumatic here—by a distinct, but small,

* I count all those vertebræ which bear ribs, whether true or false, behind the first dorsal—defined as such by its rib being the first to articulate with the sternum—as "dorsal." The succeeding ribless vertebræ which are anchylosed together are "sacral," the remaining free ones "caudal."

aperture in each centrum. The transverse processes, too, are in these latter birds very much hollowed out for air-cavities.

The ribs in the Oceanitidæ are peculiarly broad, and flattened out dorsally, to an extent not seen in any Procellarian.

In *Pelecanoïdes* the ribs are very long, and oblique in position, the more posterior ones most so, with the angles formed by their vertebral and sternal moieties very acute. Thus the whole trunk almost becomes completely surrounded by a bony box, in a way well calculated to resist the pressure of the water when these birds dive. The same modification may be seen well-developed in the diving Alcidæ (*Uria*, *Alca*, &c.).

The uncinate processes are well-developed and nearly straight. They are firmly anchylosed to the ribs.

As may be seen from the table, the number of ribs and uncinate processes varies slightly, and the same is true for the sacral and caudal vertebræ. The latter have well-developed transverse processes, and between their centres inferiorly small chevron bones, smallest anteriorly, larger and double posteriorly, are developed. The last of these may, apparently, anchylose with the body of the corresponding vertebra. The pygostyle is long and compressed. The diving *Pelecanoïdes* has, it will be noticed, a greater number of vertebræ (9) in its tail than the other forms.

Zool. Chall. Exp. vol. iv. pt. xi. p. 47.

Pectoral Arch.—The sternum (Pls. XXIII. & XXIV.) is usually rather broad and short, much longer in *Pelecanoïdes* than in any other genus, with a well-developed keel, and a short, but distinct manubrium—obsolete in *Pelecanoïdes.* The costal processes are triangular in shape, directed outwards, or in the Oceanitidæ and *Pelecanoïdes*, forwards and outwards. The anterior margin of the keel is more or less excavated, with its lower angle produced forwards, most so in *Puffinus anglorum.* In *Pelecanoïdes* (Pl. XXIII. figs. 3, 4) this part articulates with the clavicular symphysis, instead of being merely connected to it by ligament, as in the other forms. The coracoidal grooves are oblique backwards, and present two distinct articular areas for the articulation of the coracoid bone. The sides of the sternum usually converge towards the lower end of the costal process, and then diverge again to their posterior extremities. As may be seen from the figures of Plates XXIII. & XXIV., the posterior end of the sternum varies a great deal in its outline in different members of the group.

Ibid. p. 48.

In most of the larger forms of Procellariidæ, the visceral aspect of the sternum presents, towards its anterior extremity, more or fewer pneumatic apertures, which are best developed in the Albatrosses, where the whole bone is much permeated with air. In *Fulmarus*, and all the smaller forms of Procellariidæ, as well as in the Oceanitidæ, the sternum has no pneumatic apertures at all, and does not contain air.

In the genera *Cymochorea* (Pl. XXIV. fig. 7), *Procellaria*, and *Halocyptena*, as also in *Fregetta* (fig. 9) and *Garrodia*, the posterior margin of the

Zool. Chall. Exp. vol. iv. pt. xi. p. 47.

TABLE SHOWING THE NUMBERS OF THE VERTEBRÆ, RIBS, AND UNCINATE PROCESSES.

Name.	Cervical.	Dorsal.	Sacral.	Caudal.	Total No. of Vertebræ.	Ribs.	Uncinate Processes.
Oceanites oceanicus	15	6	9	8	38	8 (2+6)	5 (15 C. 1–4 D.)
Garrodia nereis	15	6	9	(?)	(?)	7 (1+6)	6 (15 C. 1–5 D.)
Fregetta melanogastra	15	6	9	8	38	7 (1+6)	5 (1–5 D.)
Cymochorea leucorrhoa	15	7	10	7	39	8 (1+7)	6 (1–6 D.)
Procellaria pelagica	15	7	9	7	38	8 (1+7)	6 (1–6 D.)
" Œstrelata grisea" (*a*)	15	7	11	7	40	8 (1+7)	5 (1–5 D.)
" —— grisea" (*b*)	15	8	10	8	41	9 (1+8)	6 (1–6 D.)
Majaqueus æquinoctialis	15	8	11	7	41	9 (1+8)	6 (1–6 D.)
Adamastor cinereus	15	7	12	7	41	8 (1+7)	5 (1–5 D.)
Puffinus anglorum	15	7	12	8	42	8 (1+7)	5 (1–5 D.)
—— obscurus	15	7	11	8	41	8 (1+7)	5 (1–5 D.)
Daption capensis	15	7	11	7	40	8 (1+7)	6 (1–6 D.)
Aeipetes antarcticus	15	7	11	7	40	8 (1+7)	6 (1–6 D.)
Thalassœca glacialoides	15	7	11	8	41	8 (1+7)	5 (1–5 D.)
Fulmarus glacialis	15	7	11	8	41	8 (1+7)	5 (1–5 D.)
Ossifraga gigantea	15	7	11	7	40	8 (1+7)	5 (1–5 D.)
Prion desolatus	15	7	10	7	39	9 (2+7)	6 (15 C. 1–5 D.)
Pelecanoïdes urinatrix	15	7	10	9	41	8 (1+7)	6 (1–6 D.)
Diomedea exulans	15	7	12	6	40	8 (1+7)	5 (1–5 D.)
—— brachyura	15	7	12	7	41	8 (1+7)	5 (1–5 D.)
Thalassiarche melanophrys	15	7	12	7	41	8 (1+7)	5 (1–5 D.)

Zool. Chall. Exp. vol. iv. pt. xi. p. 48. sternum is entire, with only a very slight concavity in the outline of each side. In the Oceanitine genera *Oceanites* and *Pelagodroma* it is very nearly the same in shape, though each side has a small excavation, the margin between the excavations being convex. In *Pelecanoïdes* (Pl. XXIII. fig. 3) also the sternum is nearly straight posteriorly. In the Diomedeinæ (*e. g. Thalassiarche melanophrys*, fig. 1) the posterior angles of the sternum are produced backwards and outwards considerably, and its posterior border is broadly excavated by a sinuous curve, convex externally, concave mesially. In *Diomedea exulans* the inner concave part is divided into two smaller concavities on each side by a process of bone, so that the posterior margin presents four slight notches, the inner pair being the bigger.

In the remaining genera of the group, the posterior border of the sternum is always more or less four-notched posteriorly, the notches being generally best developed and deepest in the genera allied to *Puffinus* and *Majaqueus* (Pl. XXIV. figs. 1–6), whilst in the Fulmarine forms the notches are smaller and tend to be irregular. *Bulweria* (fig. 11) departs widely from any of the so-called Storm-Petrels in the form of its sternum, and approaches closely *Œstrelata* &c. The exact forms of this notching, which is inclined to vary in different specimens, may be best understood from an inspection of the figures. The outer notch may, as in the specimen of *Adamastor* figured (fig. 13), be converted into a foramen by the partial ossification of the membrane filling it.

The coracoid bones in the smaller genera (*vide* Pl. XXIV. figs. 7–10) are well-developed, with nearly cylindrical shafts, dilated internally at their distal ends to meet the acromial process of the scapula, whilst proximally they are broad and expanded, and produced externally into a pointed, or slightly hooked process. In *Pelecanoïdes* (Pl. XXIII. figs. 3, 4) these bones diverge at a smaller angle from each other than in the other forms; their shafts are less cylindrical, and the proximal ends comparatively little dilated. In the larger forms, on the other hand, the coracoids become very divergent, and the shaft and both extremities, but particularly the proximal one, are much dilated, so as to assume the extraordinary form seen in *Diomedea* (figs. 1 and 2) and its allies, where the greatest transverse diameter of the bone at its base is nearly as great as its entire length. The external outline of the bone is deeply concave, owing to the great development of its external costal process.

Ibid. p. 49. The scapula is a slender, slightly curved bone, presenting no special peculiarities. Its acromial process is prolonged inwards and forwards to nearly, or quite, meet the posterior end of the clavicle. The angle it forms with the coracoid varies very much in different genera, being most acute in *Pelecanoïdes*, whilst in the Oceanitidæ it is hardly, if at all, less than a right angle (*vide* Pl. XXIV. fig. 10, *Fregetta*). *Procellaria* and *Cymochorea* resemble the other Procellariidæ, the coraco-scapular angle being in them obviously (*t. c.* fig. 8) acute.

The clavicles are always well developed, strongly convex forwards as seen from the side, and forming a more or less widely-open U when seen from in front. Their posterior ends are produced backwards to unite, by ligament, with the acromial process of the scapula. The symphysis is usually somewhat dilated and thickened and closely apposed to the antero-inferior angle of the sternum, to which it is connected by ligament. In *Pelecanoïdes* the clavicular arch is more V-shaped, its limbs diverging but little, and the symphysis develops a firm articulation with the *carina sterni* (*vide* Pl. XXIII. figs. 3, 4) as in *Phalacrocorax*, *Sula*, *Plotus*, and *Phaëthon* of the Steganopodes. In the Oceanitidæ (*vide* Pl. XXIV. fig. 8) the *symphysis furculæ* has a strong, curved hypocleidial process, directed downwards and backwards, very much more developed than the corresponding part in any Procellarian genus, even *Cymochorea* or *Procellaria* (*t. c.* fig. 6).

Anterior Extremity.—The *humerus* (Pl. XXI. figs. 1–3, where that of *Majaqueus æquinoctialis* is figured) is long, with a cylindrical shaft, often much compressed distally in such a way that the outer margin of the bone with its condyle is anterior and the inner one with its condyle posterior. The head is but little elevated above the general level of the proximal end of the bone. The pectoral ridge is prominent and triangular, but short, and the deltoid impression extends only as low as its distal termination. Behind the deltoid impression is a linear one for the *latissimus dorsi*. The bicipital surface is well developed, the lesser trochanter strong and recurved; it is excavated behind and below by a deep infra-capitular fossa, bounded above by the strong interfossal ridge, the supra-capitular fossa being a more shallow concavity. The tubercle for the insertion of the *pectoralis secundus* is strong, and is situated at the commencement of the pectoral crest, just anterior to the articular head. Below and anterior to it is an oval depression, often large, for the *pectoralis tertius*. The external condyle is prolonged obliquely upwards and inwards on the anterior surface of the bone; the capitellum is distinct, and separated by a slight notch from the internal condyle. The olecranar fossa is shallow and prolonged upwards into a smooth, slightly excavated triangular area. The impression for the *brachialis anticus* is deep and oval.

Above the external condyle there is a very strong, forwardly-directed epicondylar process, from which arises the more superficial of the bellies of the *extensor metacarpi radialis longior* muscle. This is least developed in *Pelecanoïdes* and *Thalassœca*. Zool. Chall. Exp. vol. iv. pt. xi. p. 50.

The pectoral crest, on its inferior aspect, presents an elongated surface for the attachment of the great pectoral, coextensive with the lower moiety of its border. This surface develops a roughness at each extremity, particularly below, where the main part of the more superficial layer of the muscle is attached by its strong tendon. The double nature of the pectoral muscle is indicated by a distinct muscular ridge dividing the general area of insertion into two.

In the Oceanitidæ the humerus is conspicuously a stouter and shorter bone, with its shaft evidently curved, instead of being almost straight. The epicondylar process projects much less forwards, and is continued down by an elevated ridge to the surface of the condyle itself.

In the Albatrosses the humerus is distinctly concave forwards, with its shaft considerably compressed throughout. The pectoral crest is sharply pointed, the bicipital surface very prominent and convex, the internal trochanter less developed, and the infra-capitular fossa very shallow, with its apex occupied by a large pneumatic foramen, and the *brachialis* impression long and very shallow.

In *Pelecanoïdes*, as might have been expected from its diving habits, the humerus is somewhat modified from the ordinary Procellarian type. The shaft of the bone is comparatively short and much compressed, especially below, where it has sharp anterior (external) and posterior (internal) margins. The pectoral crest is little developed. The internal condyle descends considerably lower than the external one, and the capitellar surface is well developed and compressed. Behind it and the external condylar trochlea is a strongly-marked deep pit, into which fits, like a peg, a sharp conical process developed at the proximal end of the ulna. The epicondylar process is very short, and the depression for the *brachialis anticus* very shallow.

The *radius* is a slender, straight, and cylindrical bone, with its distal end depressed and grooved superiorly.

The *ulna* is much stouter, with its posterior edge sharply keeled, with only slight impressions for the secondary remiges. The olecranon process is short and bluntly triangular. In *Pelecanoïdes* the radius and ulna are considerably compressed from before backwards. The ulna is stout, and develops at its proximal end a slightly curved triangular process, directed upwards, which, as already described, fits into a corresponding socket on the humerus, and so firmly unites the bones together.

The *manus* is very long. The second and third metacarpals are nearly parallel and straight, the third metacarpal being much more slender than its fellows. The pollex has but one phalanx, which is strong and long, about equalling one half of the second metacarpal. The two phalanges of the index are well developed, the basal one, which does not articulate with the third digit, being much dilated posteriorly.

Zool. Chall. Exp. vol. iv. pt. xi. p. 51.

In the Oceanitidæ the radius and ulna are generally stouter and stronger bones than they are in the Procellariidæ; the former is considerably expanded at its distal extremity.

As may be seen by the table at the end of this section (p. 426) the three chief segments of the fore limb are, as a rule, nearly equal in length, this being especially true as regards the arm and forearm.

Pelecanoïdes alone has the latter much shorter than the arm, the proportions here being three to four. In all the others the humerus and ulna are nearly equal in length.

In most of the genera the manus (excluding the carpus) is the longest of the three segments, but this is not the case in the larger forms (*Adamastor*, *Majaqueus*, and *Ossifraga*) of the Procellariinæ, whilst in the Diomedeinæ the manus is very much shorter, as may be seen by the measurements, than either the humerus or ulna.

Pelvic Arch.—The pelvis (*cf.* Pl. XXII. fig. 5, pelvis &c. of *Majaqueus æquinoctialis*) may be described as generally elongated and narrow. The præ-acetabular is about equal to the post-acetabular axis, though in *Cymochorea*, *Procellaria*, *Pelecanoïdes*, and the Oceanitidæ it is considerably longer. In *Puffinus*, on the other hand, the reverse is the case.

The ilia are long and narrow; anterior to the acetabula they are slightly concave plates, with their anterior extremities somewhat rounded off, separated mesially by the sacral vertebræ, the neural spines of which coalesce into a strong median ridge. The antitrochanteric eminences are strong, and stand out conspicuously, the iliac bones attaining here their greatest transverse extent, though each bone is narrow and separated by a wide space, occupied by the bodies and transverse processes of the more posterior sacral vertebræ, from its fellow of the other side. A strongly marked post-acetabular ridge runs from here inwards and backwards to the prominent posterior iliac angle, which lies between the transverse processes of the second and third caudal vertebræ. External to the ridge, the iliac surface is nearly vertical.

The ischia are narrow and compressed plates of bone, usually strongly curved downwards posteriorly to articulate with the dilated posterior ends of the nearly straight, slender, pubic bones, each of which has at the level of the anterior angle of the acetabulum, a slight prepubic spine. The posterior ilio-sciatic margin is first strongly concave backwards, and then convex.

Seen from above, the pelvis preserves its generally narrow shape, the pubes being only slightly inturned at their posterior, cartilaginous extremities. The renal fossæ are narrow, fairly deep, and confluent. In front they are limited by the transverse processes of the 3rd or 4th sacral vertebræ, which, like those of their predecessors, are short and slender, the 7th, 8th, 9th, and 10th of those bones developing transverse processes, which abut against the ilia, and in the larger forms become strong and more or less double.

There is not very much divergence from the general form of pelvis described here amongst the various forms of Petrels. In the Albatrosses it becomes very narrow, especially anteriorly, the renal fossæ being correspondingly narrow and deep. The bones entering into its composition, and supporting it, become extensively pneumatic. Anteriorly the ilia

Zool. Chall. Exp. vol. iv. pt. xi. p. 52.

unite, or nearly so, over the neural crest, whilst posteriorly the foramina between the transverse processes of the sacral vertebræ become reduced to small holes, owing to the increased amount of ossification. A tendency to similar increased ossification in these parts is discernible in the larger forms of Petrels.

In *Pelecanoïdes* the ischia are nearly straight along their posterior margin.

In *Cymochorea* and *Procellaria*, as well as in the Oceanitidæ, the pelvis generally is weaker, with its posterior region more deflexed. But that of the two former genera may be distinguished from that of the Oceanitidæ by the obsolete condition of the posterior iliac spine, the weakness of the post-acetabular ridge, and the smaller size of the ilio-sciatic and obturator foramina.

Posterior Extremity.—The *femur* is short, and more or less curved, most so in *Puffinus*. The head is a little elevated, and set on nearly at right angles to the long axis of the bone. The external condyle descends lower than the internal, and has a well-marked posterior trochlear surface. The femur of the Oceanitidæ is a stronger and better-developed bone, particularly at the two extremities, than it is in the Procellariidæ of corresponding size. The *tibia* is long, especially in the Oceanitidæ, where it is at least twice as long as the humerus. It has a very large and strong cnemial process, best developed in the genus *Puffinus*, for the attachment of muscles, rising high above the articular faces of the femur (*vide* Pl. XXI. fig. 6). Its distal end is more or less antero-posteriorly compressed, and has an osseous bridge for the *extensor communis digitorum.* The ridge for the fibula extends for about one quarter the total length of the shaft of the bone, beginning a little below the external condylar facet.

The *fibula* is a delicate, styliform bone, which may be two thirds as long as the shaft of the tibia.

The *tarso-metatarsus* has a smooth, rounded, interarticular prominence proximally, and a calcaneal eminence, with two deep grooves, which may become converted into canals, for the passage of the flexor tendons. In the Diomedeinæ this calcaneal process is feebly developed, with but a single groove internally, and a broad trochlear surface, with two shallow furrows, externally. The antero-external margin of the bone is sharply keeled. In such forms as *Puffinus* this keel becomes very sharp and prominent, owing to the greatly compressed form of the leg. Internal to it the bone is distinctly grooved.

Of the articular trochleæ at its distal end, the inner is the shortest and most oblique. Those for the third and fourth digits are more nearly equal, that for the third, however, being slightly the longer. There is a small foramen between it and the fourth.

Zool. Chall. Exp. vol. iv. pt. xi. p. 53.

In *Puffinus* there is a distinct osseous bridge, developed on the anterior and distal surface of this bone, external to the impression for the *tibialis anticus*, which I have also seen present (on one side only) in *Diomedea exulans*. Usually the bridge remains tendinous.

The three anterior digits are strong and well developed, the third and fourth being nearly equal in length. They have the normal number of phalanges, of which the basal one is always much the longest. In the Oceanitidæ the phalanx of the middle digit always exceeds the two succeeding ones, taken together, in length, whereas in the Procellariidæ it is always shorter, considerably, than these two.

The hallux is altogether absent in *Pelecanoïdes*, and is present only in the most rudimentary form, as already described (*suprà*, p. 377), in the Diomedeinæ. In the Oceanitidæ and remaining Procellariinæ it is always present, though small, but is peculiar in consisting of only a single phalanx, which bears the claw (*vide* Pl. XXII. fig. 6). It articulates, proximally, with a small metatarsal, which lies in its usual relationship to the cannon-bone formed by the conjoined metatarsals.

In the ordinary Petrels the only pneumatic bones of the skeleton are the skull, lower jaw (around its angle), sternum (very slightly), and the cervical, dorsal, and some of the more anterior sacral vertebræ. The limb-bones are all filled with marrow. In the smaller forms indeed of both families only the skull, lower jaw, and a few of the most posterior cervical vertebræ seem to be pneumatic. As a rule there seems to be a gradual increase in the amount of pneumaticity of the bones correlated with the increase of size in the bird generally.

In the Albatrosses the whole of the axial skeleton (excepting some of the ribs, the scapula, furcula, caudal vertebræ, and uncinate processes) becomes extensively pneumatic, the sternum being especially so. The humerus, moreover, becomes hollowed and filled by air, which enters through the pneumatic foramina developed at the bottom of the infracapitular fossa.

The proportion of the hind, as compared with the fore, extremity, as well as those between different segments of those limbs, are very different, as may be seen from the appended table of measurements (in millimetres), in the Oceanitidæ and the Procellariidæ respectively. In the former the leg, as measured by the combined lengths of the femur, tibia, and metatarsus, and therefore excluding the toes, is longer than the wing (humerus + ulna + manus, omitting the carpals). The tarsus is longer than the mid-toe or ulna, and at least twice as long as the femur. The tibia is at least twice as long as the humerus, and much longer than the manus.

In the Procellariidæ (including the Diomedeinæ and *Pelecanoïdes*) the leg, measured in the same way, is shorter than the wing. The tarsus is not longer than the mid-toe (except in *Procellaria* where it is just) but shorter, and the same is always the case when it is compared to the ulna. Zool. Chall. Exp. vol. iv. pt. xi. p. 54.

It is never twice as long as the femur. The tibia is only a little, or not at all, longer than the humerus or manus.

Name.	Humerus.	Ulna.	Manus.	Femur.	Tibia.	Tarso-Meta-tarsus.	Middle Toe.
Oceanites oceanicus	23	21	34	15	50	35	28
Garrodia nereis	20	17	26 (?)†	14	51	34	25
Pelagodroma marina	27	24	37	18	60	41	35
Fregetta melanogastra	27	23	36	19	56	38	26
Cymochorea leucorrhoa	35	35	42	16	37	24	26
Procellaria pelagica	26	24	33	13	33	22	20
Bulweria columbina	62	62	63	20	42	28	28
"Œstrelata grisea"	81	83	84	31	61	36	43
Majaqueus æquinoctialis	151	154	143	51	116	67	81
Adamastor cinereus	134	132	127	50	108	62	78
Puffinus anglorum	79	72	86	31	79	46	51
—— obscurus	66	63	71	25	66	40	44
Daption capensis	86	84	91	38	80	46	56
Aeipetes antarcticus	98	93	100	44	88	44	56
Thalassœca glacialoides	115	113	118	48	96	57	68
Fulmarus glacialis	118	116	117	50	113	54	67
Ossifraga gigantea	243	236	212	88	184	94	130
Prion desolatus	57	56	56	23	53	32	35
Pelecanoïdes urinatrix	43	33	44	23	46	24	27
Diomedea exulans	428	417	290	110	246	124	168
—— brachyura	281	285	222	76	175	96	122
Thalassiarche melanophrys	259	262	202	80	161	83	118

IV. The Classification of the *Tubinares.*

The propriety of the division of the entire order Tubinares into two main families, which must be termed the Oceanitidæ and Procellariidæ ‡, first proposed by Professor Garrod in 1873 (*vide suprà*, p. 372), has been fully borne out by my further investigations into the structure of these forms. To the differences in the myological formulæ, and in the presence or absence of cæca, may now be added numerous other points, both external and internal.

The Oceanitidæ agree together in having the following peculiarities which are not shared in—with one or two exceptions marked by an *—by any of the Procellariidæ:—

The number of secondary remiges is never more than ten. The tarsi are not uniformly reticulate, but are either ocreate, or covered by large transversely-oblique scutes anteriorly. The claws are very flat, depressed, and lamellar. There are no colic cæca.* (Absent in *Halocyptena* only of the Procellariidæ.) There is a peculiar *expansor secundariorum* muscle. The tendon of the *tensor patagii brevis* is quite simple throughout. The

Zool. Chall. Exp. vol. iv. pt. xi. p. 55.

† Imperfect in the specimen measured. This length is estimated.

‡ *Cf.* Proc. Zool. Soc. 1881, p. 737.

semi-tendinosus muscle has a well-developed accessory head. The *ambiens* muscle, when present, does not pass over the knee, but is lost on the cnemial process of the tibia. The number of cervico-dorsal vertebræ is twenty-one. The clavicles have a long, curved, symphysial process. The leg-bones are longer than the wing-bones. The tarsus is longer than the mid-toe * and ulna, and at least twice as long as the femur. The tibia is at least twice as long as the humerus, and much longer than the manus. The basal phalanx of the middle toe is as long as, or longer than, the next two taken together.

The Oceanitidæ also agree together in having no basipterygoid processes, no uncinate bone, a peculiarly short and stout humerus, radius, and ulna, a single circular nasal aperture, a sternum with its posterior margin quite or nearly entire, a larger *gluteus primus*, as well as in numerous other smaller details already noticed. All these characters never coexist together in any Procellarian form, and, if my observations are correct, the Oceanitidæ further differ from the Procellariidæ by having a *biceps brachii* muscle of the normal form, with no patagial slip.

The Procellariidæ, on the other hand, have the following characters:—

The number of secondary remiges is never less than thirteen, and is usually much greater. The tarsi are pretty uniformly covered with small hexagonal scutella. The claws are sharp, curved, compressed. Short colic cæca are present †. There is no *expansor secundariorum* muscle. The termination of the tendon of the *tensor patagii brevis* is never quite simple, and may become very complicated. There is no accessory head to the *semi-tendinosus*. The *ambiens* muscle (only absent in *Pelecanoïdes*) always crosses the knee. The number of cervico-dorsal vertebræ is not less than twenty-two. The clavicles have only a very small symphysial process. The leg is shorter than the wing. The tarsus is not larger than the mid-toe (except in *Procellaria*), and is shorter than the ulna. It is never twice as long as the femur. The tibia is only a little, or not at all, longer than the humerus or manus. The basal phalanx of the middle toe is shorter than the two next joints. Basipterygoid facets may or may not be present, and the same is true of the uncinate bone. The humerus, radius, and ulna have a shape different from that of the Oceanitidæ. The form of the nostrils, and of the posterior margin of the sternum, varies extensively. The *gluteus primus* is always very

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† *Halocyptena* is apparently an exception to this rule, but as *Cymochorea* has only one cæcum, there is nothing surprising in the reduction being carried a step further. As therefore all the congeners of *Halocyptena* have cæca, it may be safely assumed that their disappearance in it has been very recent, and has occurred since it acquired the rest of its Procellarian characters. This loss of cæca therefore by it does not in any way really approximate it to the Oceanitidæ.

small, and there is a peculiarly formed patagial slip derived from the *biceps* muscle.

Zool. Chall. Exp. vol. iv. pt. xi. p. 56. Thus in spite of the general superficial resemblance of the Oceanitidæ to the smaller forms of Procellariidæ, with which all ornithologists previous to Garrod had confounded them, the differences between the two families are, it will be seen, numerous and important. The special points of resemblance which the Oceanitidæ have with such Procellarian genera as *Procellaria* and *Cymochorea*—such as the general small size, style of coloration, form of skull, comparative simplicity of the *tensor-patagii* arrangement, simple sternum and syrinx (the last three peculiarities being also common to *Pelecanoïdes*)—may best be explained by supposing that these small Procellarian forms are on the whole less specialized than the larger ones (Fulmars, Albatrosses, Shearwaters, &c.), and so retain more of the characters possessed by the primitive and now extinct common form from which both the Procellariidæ and Oceanitidæ must have been derived.

The Oceanitidæ are a small and, on the whole, compact group, with but few differences of importance between the four genera contained in it. Of such differences the most important are the loss of the *ambiens*, and the very flattened nails and feet of *Fregetta*; the lengthening of the foot in *Pelagodroma*; and the acquisition of an ocreate tarsus by *Fregetta* and *Oceanites*. *Garrodia* is, therefore, on the whole, the least modified form of the group. The four genera may be distinguished as follows:—

Garrodia. *Ambiens* present; tarsus scutellated anteriorly; sternum posteriorly entire.

Oceanites. *Ambiens* present; tarsus ocreate; sternum posteriorly slightly excavated; interdigital webs yellow *.

Pelagodroma. *Ambiens* present; tarsus scutellated; sternum and webs as in *Oceanites*; feet very long.

Fregetta. *Ambiens* absent; tarsus ocreate; sternum entire; feet very short, and nails peculiarly broad and blunt †.

The Procellariidæ, comprising as they do by far the greater number of species and genera of the group, show much more divergence *inter se* than is the case with the Oceanitidæ. The Albatrosses are by far the most aberrant forms of this group, with which, however, they have all the characters above noted in common, though in themselves specialized in several points. The discovery of a rudimentary hallux, and of an

* To the genus *Oceanites* belong *Thalassidroma gracilis* (Elliot, Ibis, 1859, p. 391—the type (?) of which, now in the Smithsonian Institution, I have examined) and *Thalassidroma lineata* (Peale, Orn. U.S. Expl. Exped. pl. xxxix. p. 403). *Thalassidroma segethi* (Philippi and Landbeck, Wiegm. Arch. 1860, p. 282) may be the former bird, or, as suggested by Mr. Salvin (Proc. Zool. Soc. 1878, p. 736), *Fregetta grallaria*.

† Besides *Fregetta grallaria* and *melanogastra* there seem to be two other species to be referred here, viz. *Procellaria albogularis*, Finsch (Proc. Zool. Soc. 1877, p. 722), and *Fregetta mæstissima*, Salvin (Proc. Zool. Soc. 1879, p. 130).

aftershaft in these birds, disposes of two of the characters which have hitherto been available for their separation from the other Tubinares, as do the gradations of form that exist in the amount of separation of the two parts of the dorsal tract of another. As peculiarities of the Diomedeinæ may be included :—

The lateral position of the nostrils *. The presence of a distinct *gluteus quintus* muscle. The formation of the *biceps humeri* muscle, which gives off a patagial slip from its coracoidal head. The characteristic sternum. The absence of hæmapophyses on the dorsal vertebræ. The pneumatic *os humeri*. The generally pneumatic condition of the skeleton. The proportion of the manus to the humerus and ulna. Zool. Chall. Exp. vol. iv. pt. xi. p. 57.

The tongue and palate are also more or less peculiar, and in all the genera there are uncinate bones, no basipterygoid facets, and two large distinct accessory wing-ossicles; the right liver-lobe is also distinctly the larger of the two.

There are apparently three good genera of Albatrosses, which may be distinguished, independently of external characters, as follows :—

Diomedea. Tongue very short; uncinate bones more or less styliform. (*Diomedea exulans* and *brachyura.*)

Thalassiarche. Tongue intermediate; uncinate bones styliform. (*Thalassiarche culminata.*)

Phœbetria. Tongue much longer; uncinate bones flattened; hallux better developed than in the other genera, and with an external claw. (*Phœbetria fuliginosa.*)

Neglecting for the present the peculiar diving *Pelecanoïdes*, the remainder of the Procellariidæ forms a natural group distinguished by the following characters from the Albatrosses (Diomedeinæ) :—

The more or less dorsal position of the nostrils, the form of which, however, varies, as has already been described, though they are never lateral. The absence of a *gluteus quintus.* The peculiar form of the *biceps brachii* muscle, which is in two separate parts, the humeral head forming a patagial slip. The presence of hæmapophyses on the dorsal vertebræ, the centra of which are marked by more or less developed pneumatic depressions. The non-pneumatic humerus. The different pterylosis, and the nearly equal size of the lobes of the liver. The greater size of the hallux, which always has a distinct nail externally. (Quite absent in *Pelecanoïdes.*)

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* This feature, in which the Albatrosses are apparently more primitive than are either the Oceanitidæ or the other Procellariidæ, can hardly, if my views about the relationships of these groups to each other be correct, be considered to have been a character of the common Petrel-ancestor. It may be more probably explained as due to arrested development during embryonic life, as a study of the development of the nostrils of other Petrels would probably show that these are actually, at some time, lateral, and subsequently coalesce.

Pelecanoïdes is, in some respects, as much specialized as the Albatrosses, though many of its modifications are distinctly traceable to its diving habits, as, *e. g.*, the compressed form of the wing-bones, the great development of the hypapophyses of the dorsal vertebræ, the elongated sternum and pectoral muscles, the peculiar ribs. But it stands alone (amongst the Procellariidæ) in the absence of the *ambiens* muscle; the peculiar disposition of the femoral vein; the absence of a hallux; and the single interclavicular air-cell. Moreover, as in *Bulweria* only of other Tubinares, its myological formula is A.X., there being no accessory head to the femorocaudal muscle.

Zool. Chall. Exp. vol. iv. pt. xi. p. 58.

But *Pelecanoïdes* shows marks of being in some respects an early form in the simple condition of the *tensor patagii* muscle, in its very simple syrinx, and in the general shape of its sternum. It has the characteristic form of *biceps* muscle found in all the Procellariidæ, except the Albatrosses, and like all those forms, except the *Procellaria*-group, has basipterygoid facets.

Pelecanoïdes is thus, as will be seen, a very well-marked form, though it is somewhat difficult to decide as to whether its peculiarities are such as to entitle it to form a separate subfamily by itself. The presence of basipterygoid facets would seem to indicate that it probably diverged from the general stock of the Procellariinæ at a point when the latter had already developed that feature, and therefore at a period after the ancestor of the *Procellaria*-group—in many ways the least specialized, and therefore presumably more ancient, of the subfamily, and in which there are no such facets—had already acquired its main characters.

According to modern ideas, the object of a classification is not so much to represent morphological facts as to indicate the phylogenetic relations of the different forms concerned. According to the first view, *Pelecanoïdes* might well be placed, as many authors have done, in a special group of its own; but if we admit, as seems on the whole most probable, that it has been derived from the same stock as the *Procellaria*-group after the special ancestor of the latter was developed, I prefer considering it as simply a highly specialized form of the Procellariinæ.

The Procellariinæ so defined fall into a number of smaller groups, distinguishable by good characters.

The "Stormy-Petrels" of the genera *Procellaria*, *Cymochorea*, and *Halocyptena* * form one such minor group, distinguished by their general small size and coloration, comparatively long tarsi, nearly single nasal aperture, simple triangular tongue, simple *tensor patagii*, peculiar skull with no basipterygoid facets or distinct uncinate bone, entire posterior sternal margin, and little specialized syrinx. *Procellaria* has two cæca,

* *Oceanodroma* also, I have little doubt, belongs to this group.

Cymochorea one only, and *Halocyptena*, as already mentioned, has them quite absent.

The position of *Pelecanoïdes* has already been fully discussed ; it stands quite *per se*, though presumably derived from a stem common to it and the remaining Procellariinæ, which must have diverged from the less specialized one now represented by the *Procellaria*-group.

Prion (with which *Halobæna* is probably to be associated) represents a third minor group, much specialized as regards its peculiarly broad beak with its fringe of lamellæ, whilst in its *tensor-patagii* arrangement and syrinx it is not highly developed.

The two genera *Pagodroma* and *Daption* seem very central as regards their relationships, which seem to be with *Prion* (as indicated chiefly by the rudimentary lamellæ of *Daption*) on the one hand, and with the Fulmars on the other, *Aeipetes* * being the less specialized of these, both as regards its imperfect tracheal septum and the number of rectrices. The type of syrinx so characteristic of the Fulmars is foreshadowed, as it were, as has been already pointed out (*suprà*, p. 401) in that of *Pagodroma*, and all four genera (*Fulmarus*, *Thalassœca*, *Ossifraga*, and *Aeipetes*) agree in the general disposition of the *tensor patagii*, which has no ossicles, in the more or less rudimentary *os uncinatum*, in the tendency to anchylosis of the lachrymal and frontal, in the shape of the tongue and of more or less well-developed lamellæ on the bill, and in having four more or less complete, but never deep, sternal emarginations. Zool. Chall. Exp. vol. iv. pt. xi. p. 59.

Aeipetes is, on the whole, the least specialized of the Fulmarine group in the most limited sense. This includes besides *Thalassœca*, *Fulmarus*, and *Ossifraga*, which last, on account of its great size, peculiar syrinx, and sixteen rectrices, may be considered the culminating point in this direction of the Procellariidæ.

The remaining genera, *Œstrelata*, *Puffinus*, *Adamastor*, *Majaqueus*, and *Bulweria*, are also apparently closely related to each other, the first and last named being perhaps least so. All agree in having a deeply four-notched sternum, in having well-developed uncinate bones, in the possession of one or two accessory wing-ossicles developed in the termination *Ibid.* p. 0.

* I propose to make a genus under this name, for the reception of the *Procellaria antarctica* of Gmelin (Syst. Nat. 1788, vol. i. p. 565), which has usually been considered congeneric with *Thalassœca*, the type (and only representative) of which is *Thalassœca glacialoides*. For the latter bird also was instituted Hombron and Jacquinot's genus *Priocella* (*s. c.* vol. iii. p. 148). *Aeipetes* is easily distinguishable from *Thalassœca* by the much shorter and stouter bill, and differently shaped nasal tubes, as will be best understood from the accompanying figures (figs. 31, 32, p. 432). The number of rectrices is also different (twelve as compared to fourteen); the tracheal septum is incomplete, and the structure of the syrinx also quite different (*vide suprà*, p. 404). The coloration of the two forms is quite unlike.

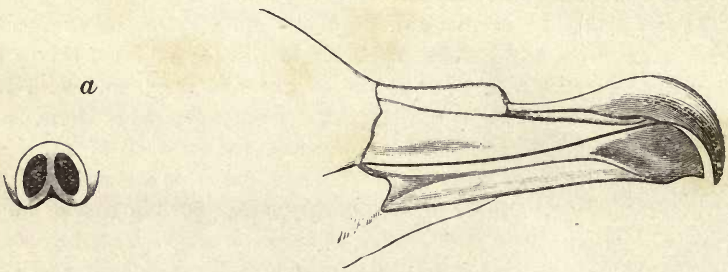
of the *tensor patagii* tendons, in the spiny tongue (? *Adamastor*), and the palatal armature of spines (? *Adamastor*), and in there never being even indications of lateral lamellæ on the beak.

Œstrelata differs from its allies in having only a single ulnar ossicle, there being two in all the others.

Puffinus and *Adamastor* are more closely connected together than they are with *Majaqueus*, easily distinguishable by its more normal nostrils,

Zool. Chall. Exp. vol. iv. pt. xi. p. 59.

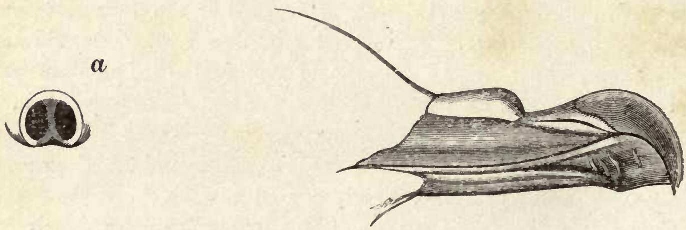
Fig. 31.



Beak of *Thalassœca glacialoides*.

a. The aperture of the nasal tubes, from in front. Natural size.

Fig. 32.



The same parts of *Aeipetes antarcticus*.

Ibid. p. 60.

less compressed tarsi, and specialized (? *Adamastor*) syrinx. *Bulweria* is a peculiar form, with no very close ally, and must be regarded as a highly specialized form, as shown in its myological formula being reduced to A.X., and its peculiar cuneate tail. It has no close relationship at all to the Stormy-Petrels, as already pointed out by Dr. Coues * and Garrod†.

These views on the classification of the Tubinares may be represented in the diagram, p. 436.

* *S. c.* 1866, p. 139. † Coll. Papers, p. 221.

V. The Affinities of the *Tubinares*.

The Tubinares as a group may be shortly defined as follows:—

Holorhinal schizognathous birds with a large, broad, depressed, pointed vomer, and truncated mandible; with the anterior toes fully webbed, and the hallux either very small and reduced to one phalanx, or absent; with a tufted oil-gland and large supraorbital glands furrowing the skull; with the external nostrils produced into tubes, usually more or less united together dorsally; with an enormous glandular proventriculus and small gizzard of unusual shape and position, and with the commencing duodenum ascending; with a completely double great pectoral muscle, and a well-developed *pectoralis tertius*; with the femoro-caudal and *semi-tendinosus* muscles always present, and the *ambiens* and accessory femoro-caudal only exceptionally absent.

Some at least of these characters—the structure of the hallux, the formation of the nostrils*, and the form of the stomach—are quite peculiar to the Tubinares, not being found in any other birds, though of universal presence in these. These features alone would at once suffice to distinguish them from any other Avian order, whilst the combination of other characters is as unique. It is therefore a difficult task to assign to this group a satisfactory position in any arrangement of the class Aves, owing to its much isolated position.

Most previous writers have considered the Petrels as more or less closely connected with the Gulls (Laridæ), but the grounds for any such collocation are very slight in my judgment, now that the structure of the two groups is better known.

Zool. Chall. Exp. vol. iv. pt. xi. p. 62.

The Gulls exhibit no trace of any of the characteristic peculiarities of the Petrels †, and differ widely from them in the important feature of being schizorhinal ‡. The peculiar disposition in two quite separate layers of the great pectoral muscle in the Tubinares is quite unlike anything seen in the Gulls or their allies, whilst the large *pectoralis tertius* of the Petrels is altogether unrepresented in the Laridæ. The character of the cæca in the two groups is also quite different, and there are no special osteological resemblances between the two groups so far as I can see, for the mere schizognathous character of the palate is, we now know, not necessarily a mark of affinity. The character of the young plumage, the

* The Caprimulgine genus *Siphonorhis* (Sclater, Proc. Zool. Soc. 1861, p. 78) perhaps approaches the Tubinares more nearly in this point than any other bird known to me.

† I cannot understand Professor Huxley's remark (Proc. Zool. Soc. 1867, p. 455) that "the Gulls grade insensibly into the Procellariidæ."

‡ *Cf.* Garrod, Coll. Papers, p. 128.

condition of the young birds, and the number, shape, and coloration of the eggs—points on which some stress may be laid in questions of this kind—are totally dissimilar in the two groups, as indeed are the habits of the adult birds themselves, though no doubt both are "web-footed" and more or less pelagic in habit. Such resemblances, however, can hardly be seriously considered as indicating any real affinities*.

L'Herminier, A. Milne-Edwards, and Huxley have all, in describing various points in the osteology of the Tubinares, pointed out similarities of various kinds between their osseous structure and that of various forms of the Steganopodes, though they still kept them close to the Laridæ. Eyton, on the other hand, places the various Petrels he describes in the family "Pelecanidæ," the Gulls forming a separate family by themselves.

But no one will be prepared, I think, to dispute that the Steganopodes are allied to the Herodiones, including under that name the Storks and Herons, with *Scopus*, only. Thus, on osteological grounds alone, there is sufficient ground for placing the Tubinares in the vicinity of the Steganopodes and Herodiones. And, in fact, neglecting the desmognathous structure of the palate—the taxonomic value of which *per se* is becoming more and more dubious as our knowledge of the structure of birds increases—there is little in the characters assigned to the groups Pelargomorphæ and Dysporomorphæ by Professor Huxley (*l. c.* p. 461) that is not applicable to the general Petrel type.

The completely double great pectoral muscle is a characteristic only found, as already observed, in the Ciconiidæ, Cathartidæ, the Steganopodes (except *Phalacrocorax*), and the Tubinares, and in all these forms it is associated with short colic cæca of peculiar shape (absent altogether in the Cathartidæ, as in some of the Tubinares), more or less completely webbed feet, tufted oil-gland (except in the Cathartidæ), holorhinal nostrils, a tendency of the palatine bones to unite behind the posterior nares, truncated mandible, broad, strong, well-developed sternum, and strongly curved, well-developed clavicles. These birds also agree together in being "Altrices," the young birds being quite helpless after birth, and requiring to be fed for a long time by their parents—and in generally laying eggs of a white, or nearly white, colour.

Zool. Chall. Exp. vol. iv. pt. xi. p. 63.

The group so constituted, of which the Ardeidæ and Falconidæ must also be considered as aberrant members,—the first family being closely

* No views regarding the affinities of the Petrels other than that to the Laridæ already discussed, and that to the Ciconiiform birds, have, so far as I know, been seriously advanced by ornithological writers, Professor Garrod having abandoned his early idea that the Tubinares were probably related remotely to the Anseres and their allies (*cf.* Coll. Papers, pp. 220 and 521).

related to the Ciconiidæ through *Scopus*, whilst the Falconidæ are probably, though much more remotely, connected with the Steganopods, —corresponds to the Ciconiiformes of Garrod *, with the addition, as he had already himself suggested †, of the Tubinares.

But his earlier definition of that group, in so far as it relates to the absence in it of the accessory femoro-caudal muscle (B), will have to be modified, inasmuch as this muscle is, as shown above, generally present in the Tubinares. These, too, differ markedly from the other Ciconiiformes in the well-developed *pectoralis tertius* (very small or absent in the others), in the large size of the vomer, and the non-desmognathism of the palate, though as regards this latter character it has already been pointed out that the Albatrosses are nearly desmognathous, whilst the desmognathism of the Cathartidæ is of a different kind to that prevalent in the other forms concerned.

The two existing groups of Petrels are clearly related to each other so much more nearly than to any other group of birds that it is evident that they must have had a common ancestor that possessed the peculiar features characterizing the Tubinares as an order. Such a form may therefore be safely assumed to have had—

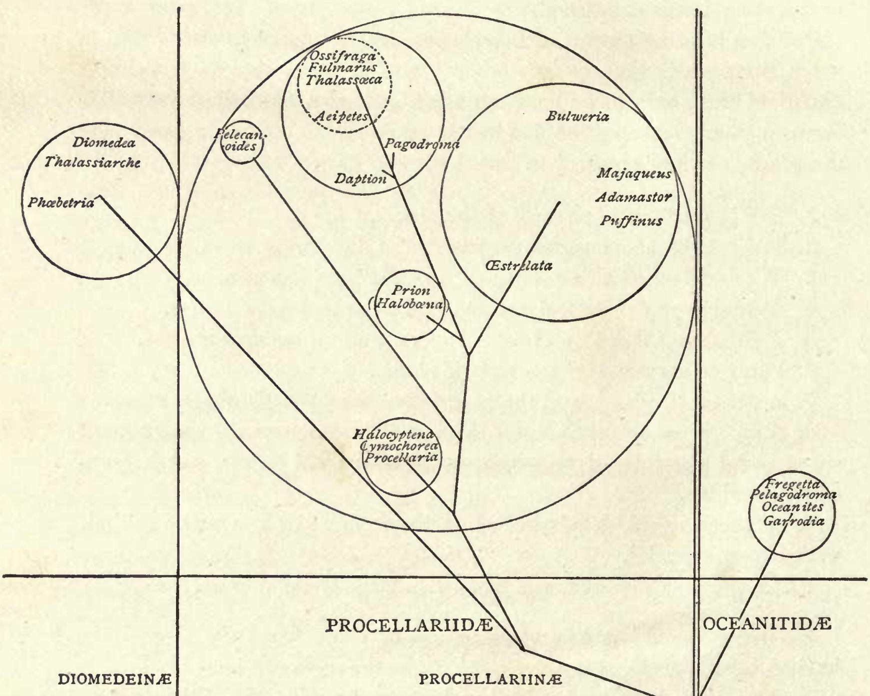
1. The characteristic nostrils of the group.
2. The equally characteristic stomach and duodenum.
3. Webbed feet, with a small hallux of a single phalanx.
4. A double great pectoral muscle, and large *pectoralis tertius*.
5. A formula AB.XY, a *gluteus primus*, and an *ambiens* muscle.
6. Short colic cæca of characteristic shape.
7. A tufted oil-gland, and the pterylosis characteristic of the group.
8. A holorhinal schizognathous skull, with large depressed vomer, great supraorbital glandular depressions, no basipterygoid facets, and a truncated mandible.
9. A short, broad, deeply-keeled sternum, more or less entire behind, with strong clavicles.
10. A peculiar humerus, and tibia with large cnemial crest.

No living Petrel has this combination of characters; the Oceanitidæ having lost their colic cæca, the Procellariidæ the accessory semi-tendinosus (Y) muscle, and both groups having become specialized in other ways. Zool. Chall. Exp. vol. iv. pt. xi. p. 64.

Such an ancestral form as here indicated may be supposed to be an early, and in some respects—as shown by the large vomer, schizognathous palate, large third pectoral muscle, and formula AB.XY—more primitive form, that diverged from the common stock of the Ciconiiform birds

* Collected Papers, p. 218.
† *Loc. cit.* p. 521.

very early, when the latter had only acquired the most prevalent of the characters now existing in the various groups of that suborder. One branch of this stock has since become greatly modified in the Tubinarial direction, whilst the other branch, losing " B " and the large vomer, and becoming desmognathous, split up and gave origin, at different times and in different ways, to the remaining families of the group. The definiteness of the characters of these, and the amount of specialization they show, indicate not only a great antiquity for the whole group, but also the great amount of extinction that has gone on amongst its members in the past, in the process of which nearly all the intermediate and less specialized forms have disappeared.



DESCRIPTION OF THE PLATES.

Plate XII.

Zool. Chall. Exp. vol. iv. pt. xi. pl. i.

Fig. 1. Head of *Oceanites oceanicus*. 1 *a* leg and 1 *b* foot (from before) of same.
2, 2 *a*, 2 *b*. The same of *Garrodia nereis*.
3, 3 *a*, 3 *b*. The same of *Pelagodroma marina*.

PLATE XIII.

Fig. 1. Head of *Fregetta grallaria.* 1 *a* leg and 1 *b* foot (from before) of same.
2, 2 *a*, 2 *b*. The same of *Procellaria pelagica.*
3. Bill of *Bulweria columbina.*
4. View of external nares of same, from before, to show their two distinct openings.
5. Nostrils of *Oceanites oceanicus*, from before.
6. The same of *Procellaria pelagica.*
Figs. 4–6 enlarged. The others are of the natural size.

PLATE XIV. Zool. Chall. Exp. vol. iv. pt. xi. pl. ii.

Fig. 1. Liver, stomach, and duodenal loop of *Majaqueus æquinoctialis*, viewed from in front. L. Liver; *pr.* Proventriculus (the letters are placed on its fundus); *g.* Gizzard; *p.* Pancreas; *g.b.* Gall-bladder; *r.h.d.*, *l.h.d.* Right and left hepatic ducts; *v.p.* Vena portæ; *h.a.* Hepatic artery.
2. Palate of *Pelecanoïdes urinatrix.*
3. Palate of *Œstrelata lessoni.*
4. Palate of *Fulmarus glacialis.*
5. Palate of *Prion banksi.*
6. Palate of *Oceanites oceanicus*, enlarged. (The line shows the natural size.)
7. Colic cæca of *Majaqueus æquinoctialis*, enlarged slightly.
All the figures, except figs. 6 and 7, are of the natural size.

PLATE XV.

Fig. 1. Tongue of *Oceanites oceanicus.*
2. Tongue of *Pelecanoïdes urinatrix.*
3. Tongue of *Diomedea brachyura.*
4. Tongue of *Phœbetria fuliginosa.*
5. Tongue of *Cymochorea leucorrhoa.*
6. Tongue of *Aeipetes antarcticus.*
7. Tongue of *Daption capensis.*
8. Tongue of *Pagodroma nivea.*
9. Tongue of *Ossifraga gigantea.*
10. Tongue of *Prion banksi.*
11. Tongue of *Majaqueus æquinoctialis.*
12. Tongue of *Œstrelata lessoni.*
13. Tongue of *Larus*, sp.?
14. Tongue of *Puffinus brevicauda.*
15. Outline of stomach, &c., of *Fregetta grallaria.*
16. Gizzard of *Fulmarus glacialis* laid open, to show the character of its epithelium.

PLATE XVI. *Ibid.* pl. iii.

Fig. 1. Left pectoral region of *Majaqueus æquinoctialis*, to show the double *pectoralis major* (seu *primus*) muscle; its superficial layer (*p.* 1 *a*) has been for the most part removed, its cut origin from the sternal crest and furcula (*F.*) being reflected: *p.* 1 *a'*, its insertion into the humerus, also cut and reflected; *p.* 1 *b*, the deep layer; *p.* 2, fascia covering the *pectoralis secundus* muscle;

t.p. Belly of *tensor patagii* muscles; *t.p.l.* Their tendon, joined by *b.s.* (*biceps* slip) formed by the humeral head of the *biceps humeri* muscle; *b.* Main belly of *biceps* muscle, formed by the coracoidal head; *S.* Body of sternum, bare of muscular fibres.

Fig. 2. Dissection of left pectoral region of *Diomedea brachyura*, to show the two layers of the *pectoralis primus* muscle (*p.* 1 *a*, *p.* 1 *b*), which have been cut and removed in large part, and the compound *pectoralis secundus*; *p.* 2, its sternal origin; *p.* 2′, its coracoid origin; *p.* 2″, its furcular origin; *p.* 2‴, origin from coraco-furcular membrane (*c.f.m.*); *p.* 3. *Pectoralis tertius*; *C.* Coracoid bone; *F.* Furcula, at symphysis; *S.* Sternum. (The line above it shows the limit of origin of the deep layer of the *pectoralis primus.*)

Plate XVII.

Fig. 1. Left shoulder-joint, inner side, of *Ossifraga gigantea*, to show the peculiar *biceps* muscle: *c.* Its coracoid head, continuous below with the belly of the muscle (*b*); *h.* Its humeral head, which forms a *biceps* slip, joining the tendon of the *tensor patagii* (*t.p*); *p.* 1. Insertions (cut) of the two layers of the *pectoralis primus* muscle; *e. Extensor*; *t. Teres*; *c.b.l. Coraco-brachialis longus*; *c.b.b. Coraco-brachialis brevis.*

2. Dissection of right wing of *Oceanites oceanicus*, to show the peculiar *expansor secundariorum* muscle. *e.s.* Tendinous portion arising from the last remiges (*S.*); *e.s′.* The other moiety, arising from the last scapular feathers (*Sc.*); *p.* 1. *Pectoralis primus* muscle, to which the *expansor secundariorum* is attached; *H.* Humerus; *Pat.* Patagial membrane; *v.n.* Vessels and nerves to wing.

3. Left shoulder-joint, inner side, of *Thalassiarche culminata*: *c.*, *h.* Coracoid and humeral heads of *biceps*, here uniting below into the common tendon of that muscle (*b*); *b.s. Biceps* slip, largely tendinous and joining the *tensor patagii* near the elbow, derived from the coracoid head of the biceps.

Plate XVIII.

Zool. Chall. Exp. vol. iv. pt. xi. pl. iv.

Fig. 1. Dissection of right elbow of *Œstrelata lessoni*, to show the disposition of the *tensor patagii* muscles, as seen from above.

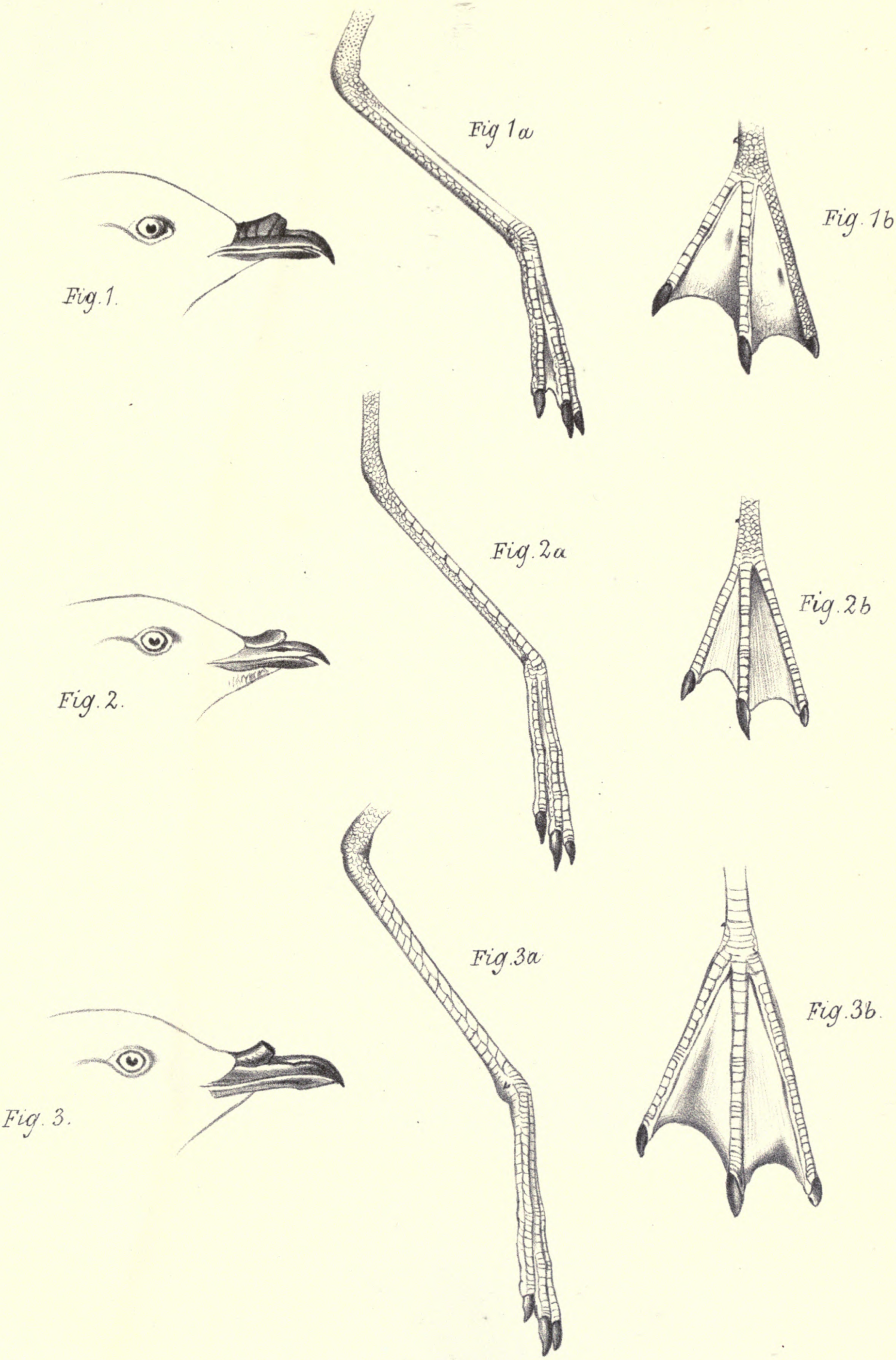
2. The same in *Ossifraga gigantea.*

3. Dissection of right wing of *Majaqueus æquinoctialis*, to show origin and general disposition of the *tensor patagii* muscles. Lettering as in Pl. XIX. fig. 2; also *t.p.* Common belly of *tensor patagii longus* and *brevis*; *t.p.l.* Cushion of elastic tissue, developed in the tendon of the *tensor patagii longus* (*t.p.l.*) at its origin from the humerus; *e.* Elastic pad, developed in the marginal tendon of *tensor patagii longus*, opposite the elbow; *d.* Deltoid muscle; *l.d. Latissimus dorsi* (insertion); *n.* Circumflex nerve.

Plate XIX.

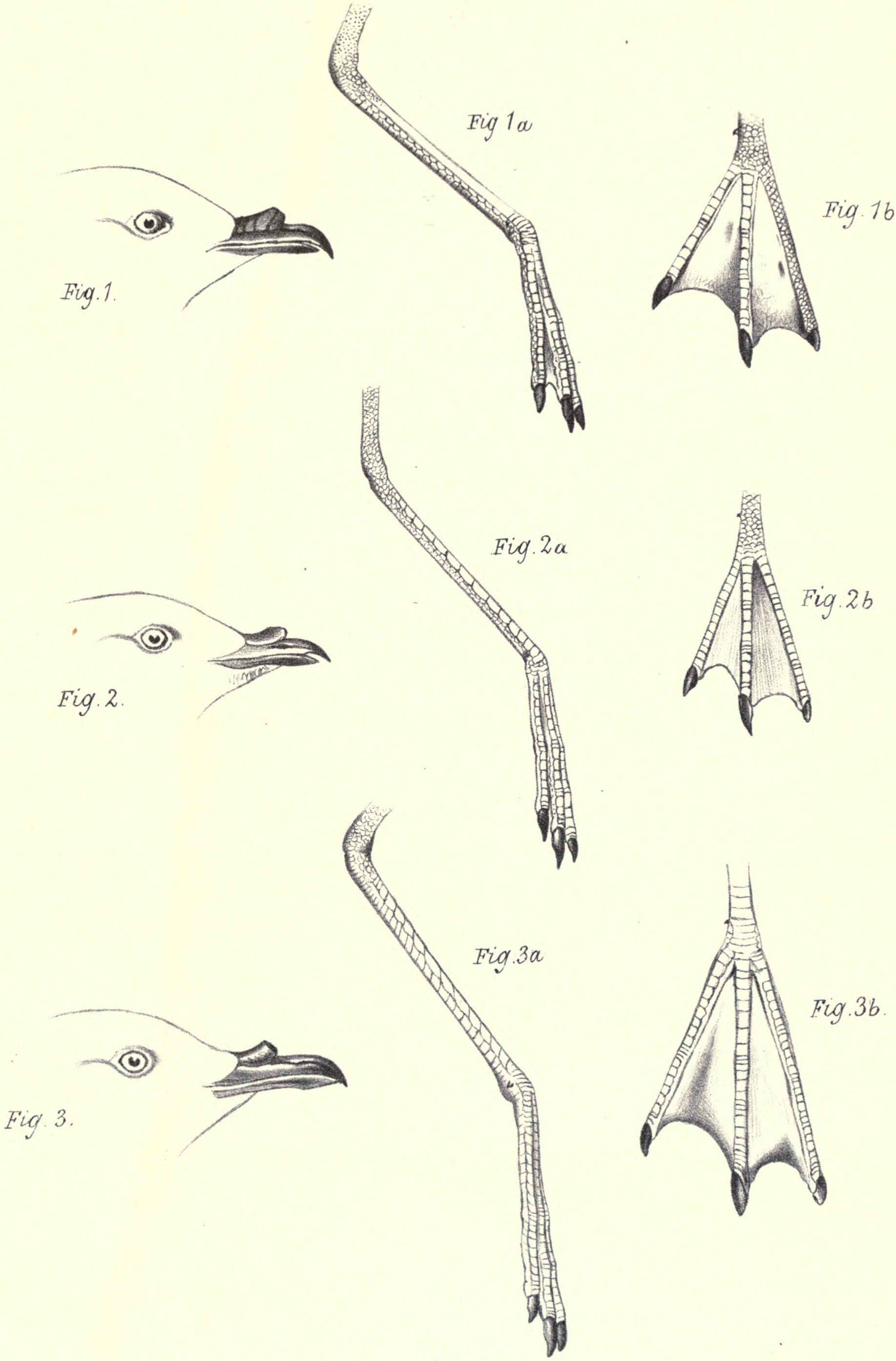
Fig. 1. Dissection of right elbow of *Prion desolatus*, to show the disposition of the *tensor patagii* muscles, as seen from above.

2. The same in *Pelecanoïdes urinatrix. H.* Humerus; *R.* Radius; *b. Biceps* muscle; *t.p.l. Tensor patagii longus*; *t.p.b. Tensor patagii brevis*; *e.m*, *e.m′.* Superficial and deep bellies of *extensor metacarpi radialis longior*; *e.m.** Inner of twin tendons of origin of its superficial belly; *b.s.* (in fig. 3). *Biceps* slip;



J. Smit lith. Hanhart imp.

EXTERNAL CHARACTERS OF PETRELS.



J. Smit lith.

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EXTERNAL CHARACTERS OF PETRELS.

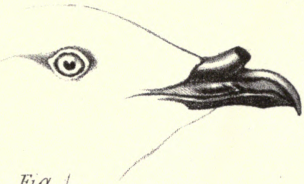


Fig. 1.

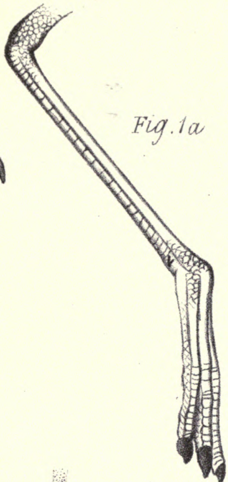


Fig. 1a

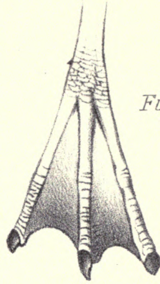


Fig. 1b.

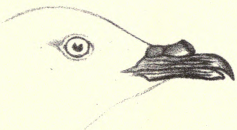


Fig. 2.

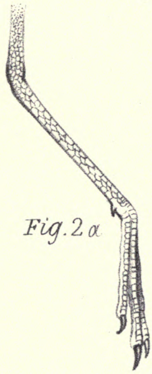


Fig. 2a

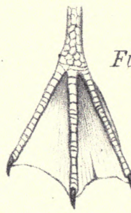


Fig. 2b

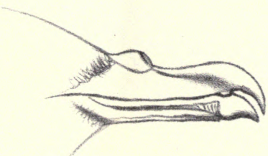


Fig. 3.

Fig. 4

Fig. 5.

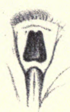


Fig. 6.

J. Smit lith. Hanhart imp.

EXTERNAL CHARACTERS OF PETRELS.

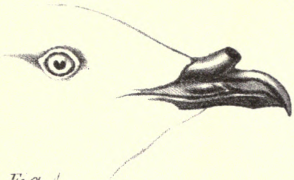
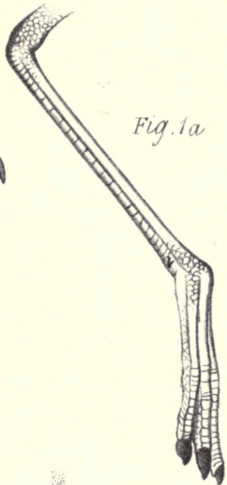


Fig. 1.



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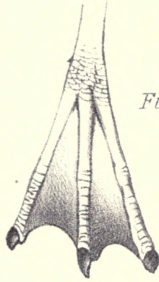

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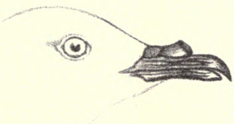
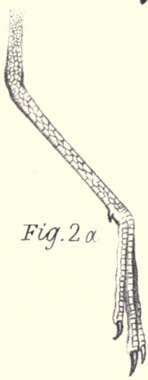


Fig. 2.



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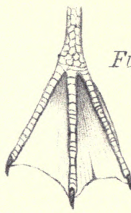

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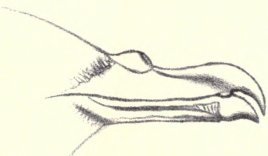


Fig. 3.

Fig. 4

Fig. 5.

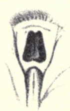
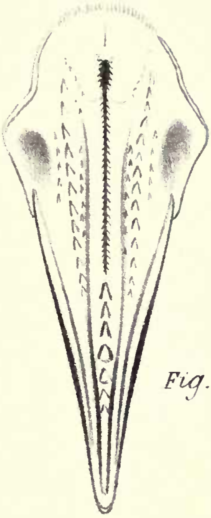


Fig. 6.

J. Smit lith. Hanhart imp.

EXTERNAL CHARACTERS OF PETRELS.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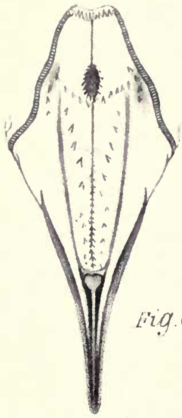
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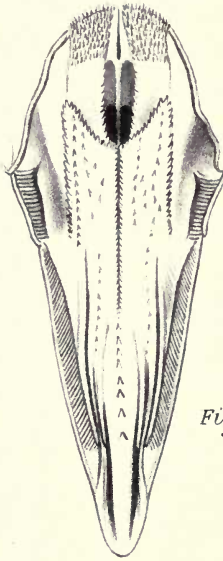


Fig. 4.


Fig. 7.

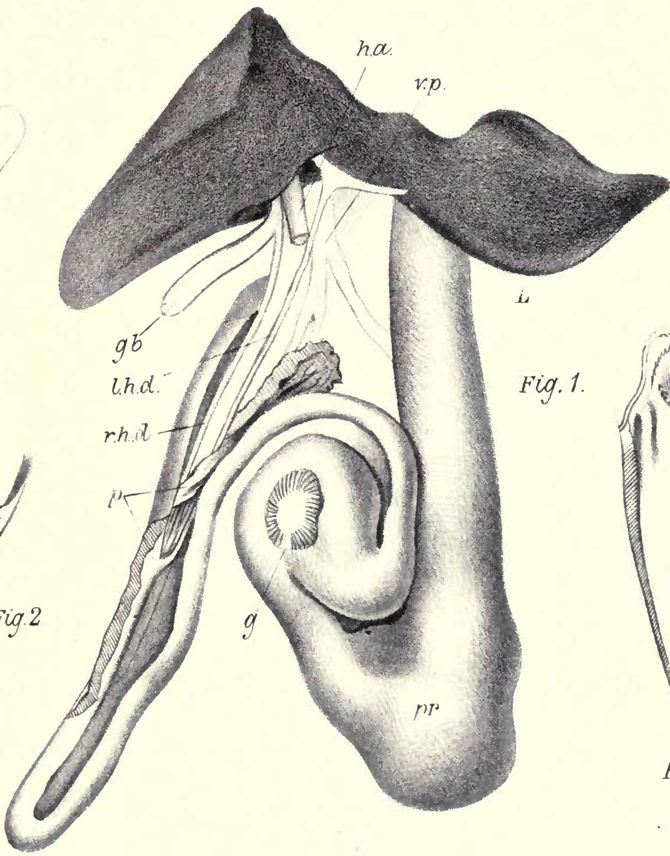


Fig. 1.


Fig. 2.

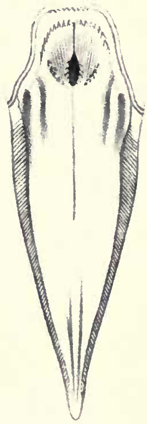


Fig. 5.

J. Smit lith.

Hanhart imp.

ALIMENTARY CANAL & PALATE OF PETRELS.

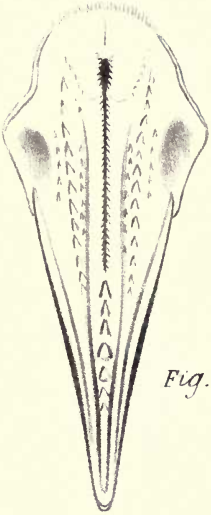
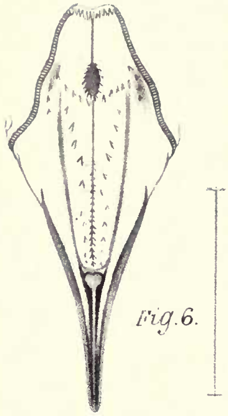


Fig. 3.



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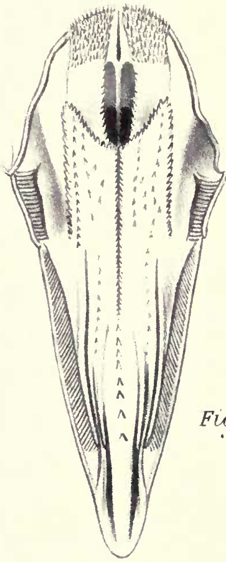

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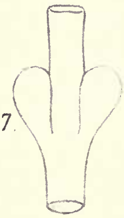

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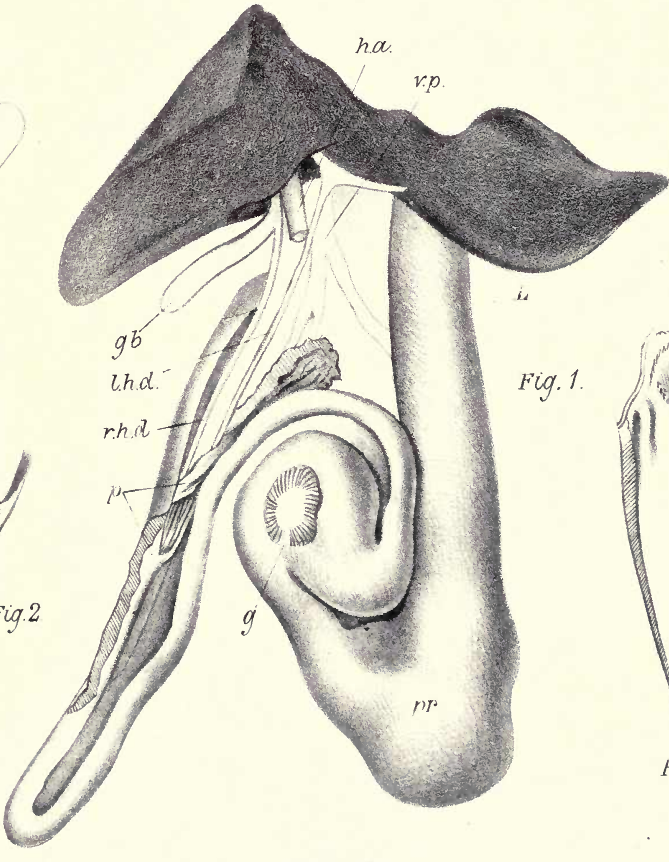


Fig. 1.

Fig. 2

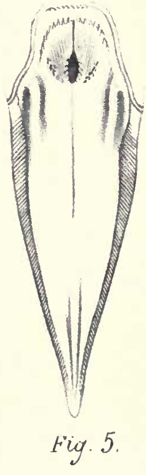
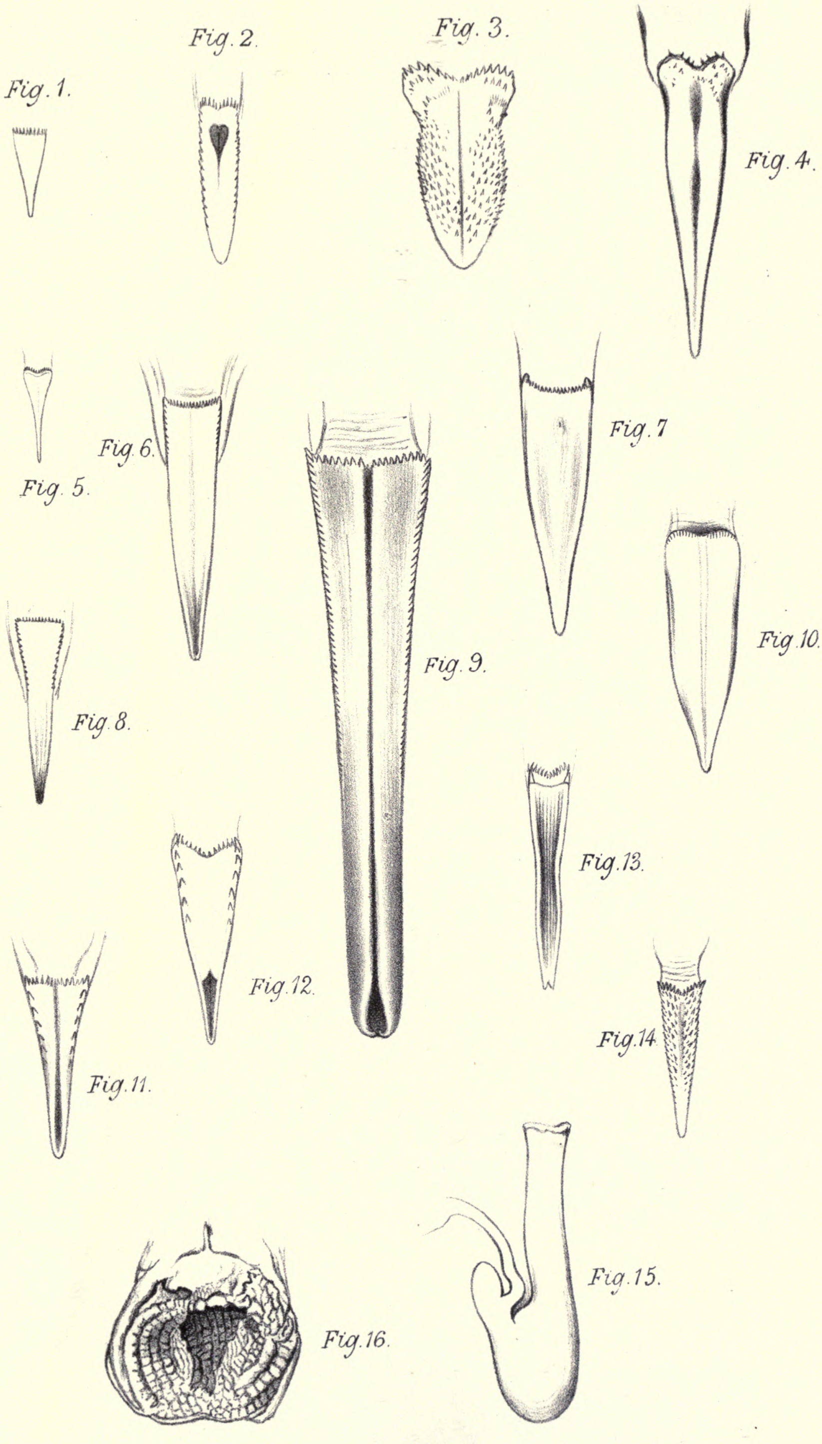


Fig. 5.

J. Smit lith.

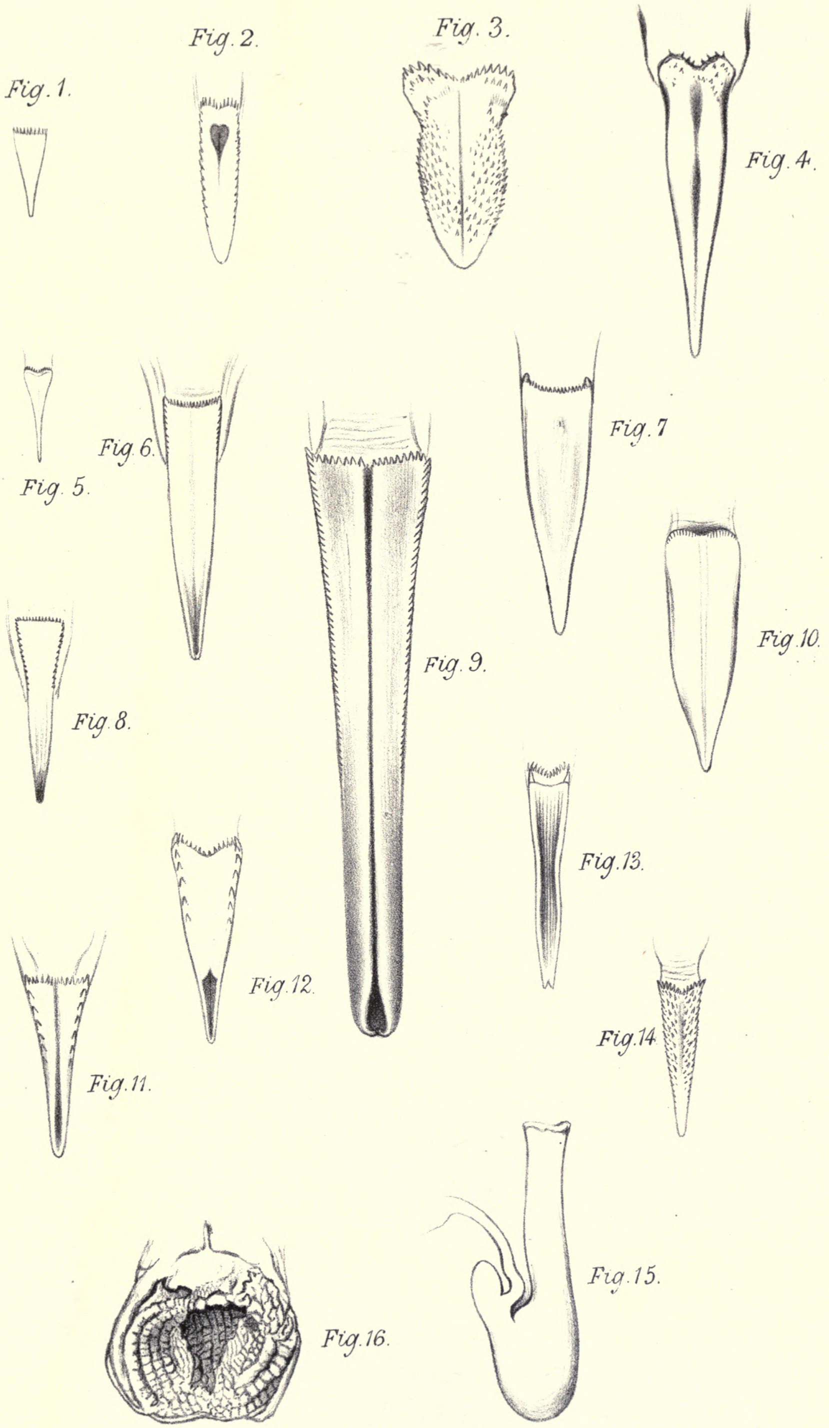
Hanhart imp.

ALIMENTARY CANAL & PALATE OF PETRELS.



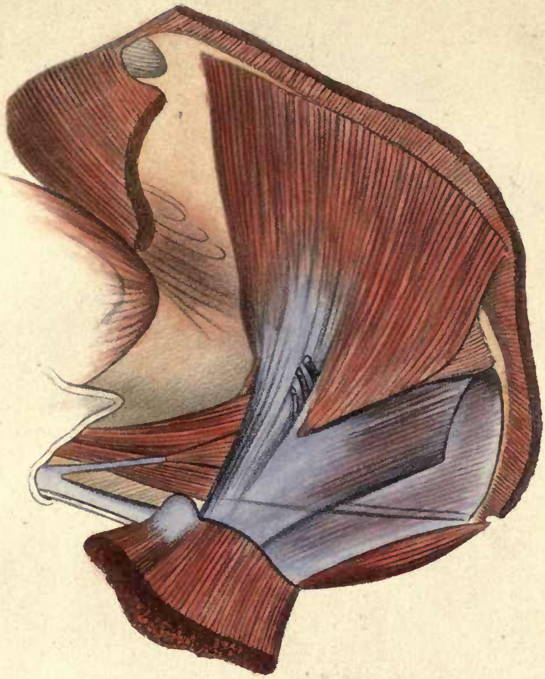
J. Smit lith. Hanhart imp.

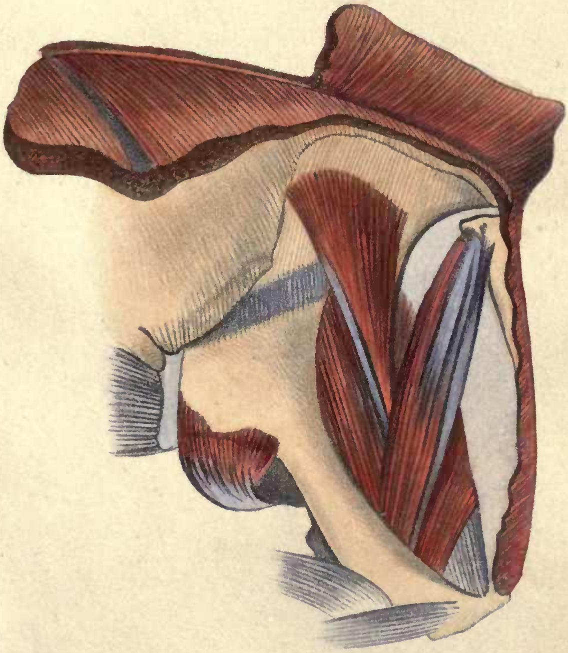
ALIMENTARY CANAL AND TONGUE OF PETRELS.



J. Smit lith. Hanhart imp.

ALIMENTARY CANAL AND TONGUE OF PETRELS.





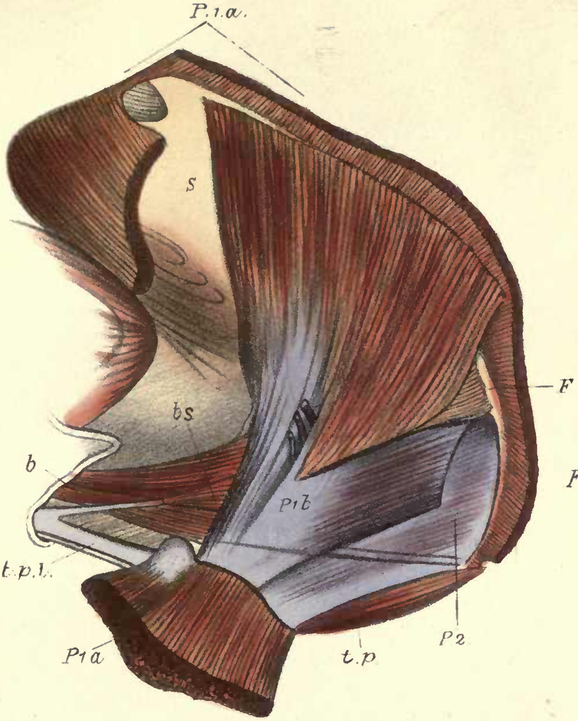


Fig. 1.

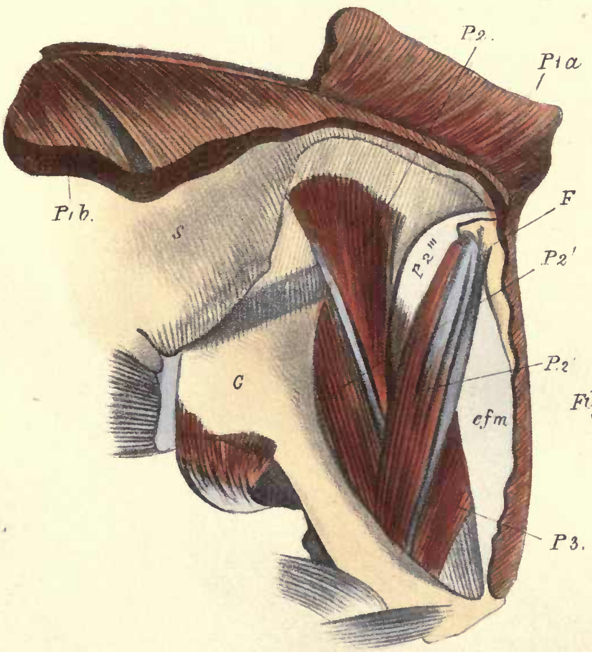
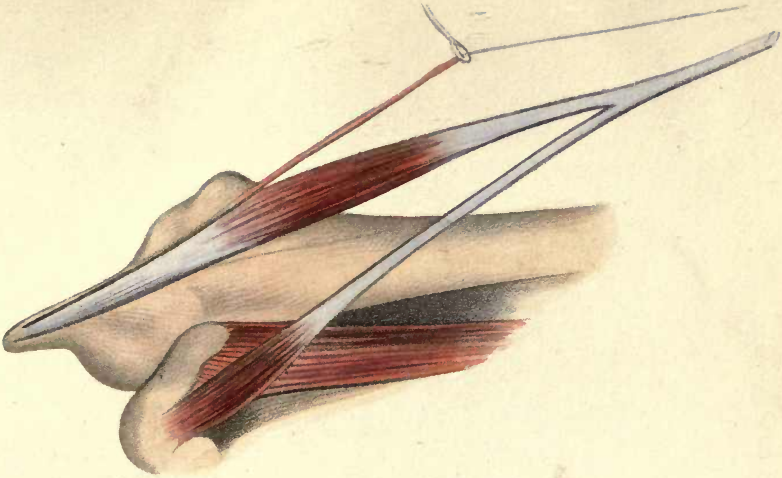
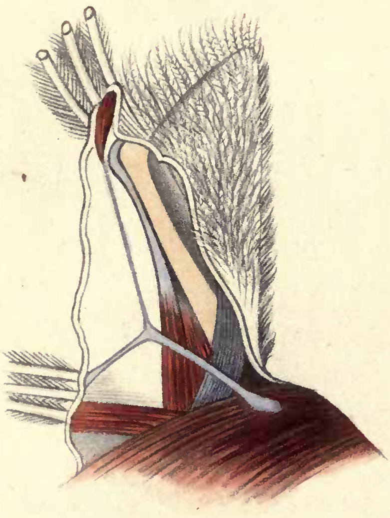


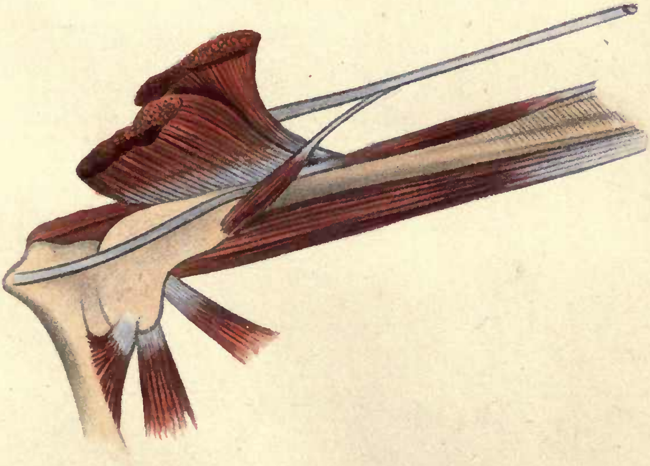
Fig. 2.

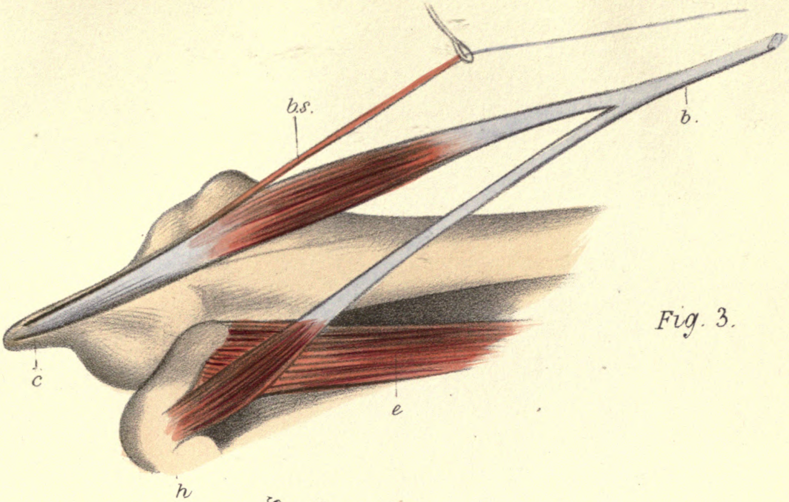
J. Smit lith.   Hanhart imp.

MYOLOGY OF PETRELS.
Anterior Extremity.









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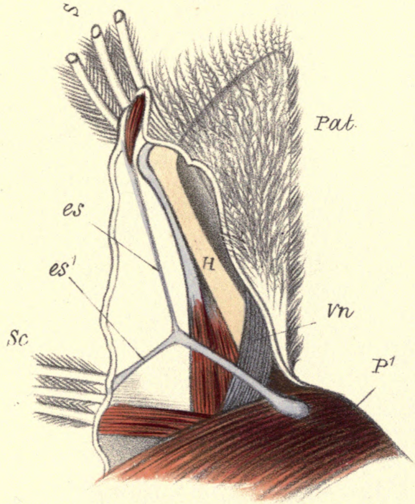

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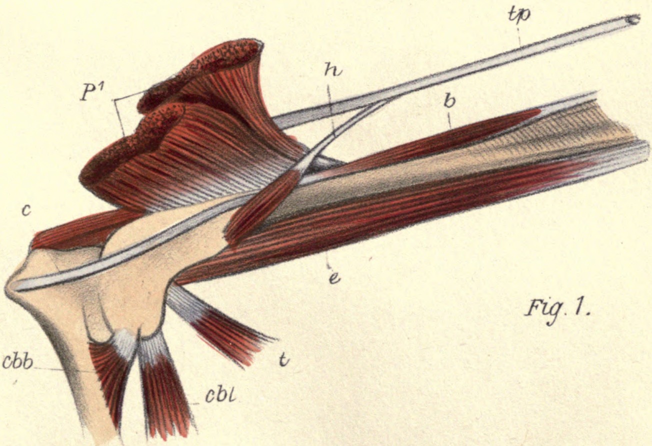
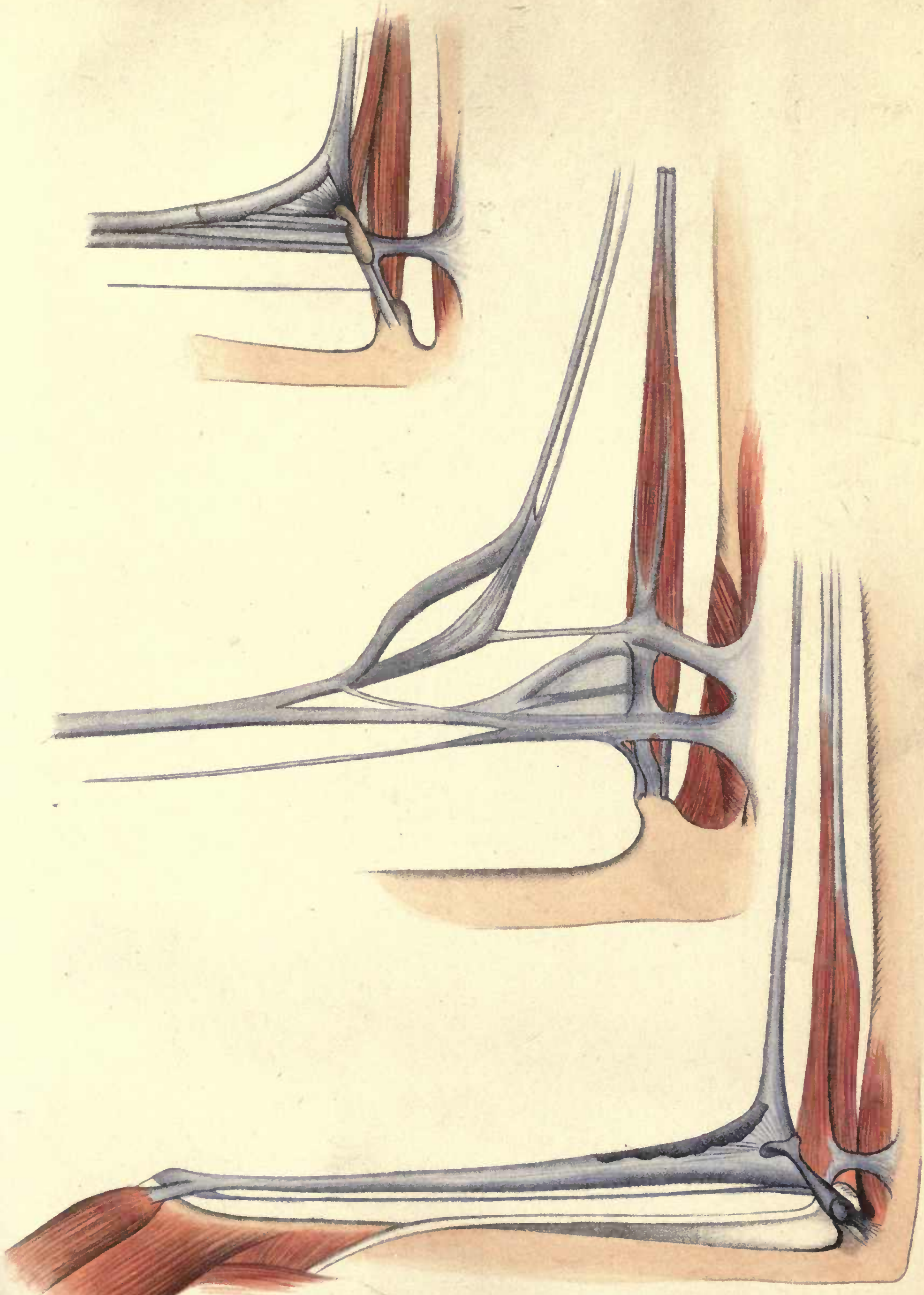


Fig. 1.

J. Smit lith.   Hanhart imp.

MYOLOGY OF PETRELS:
Anterior Extremity.



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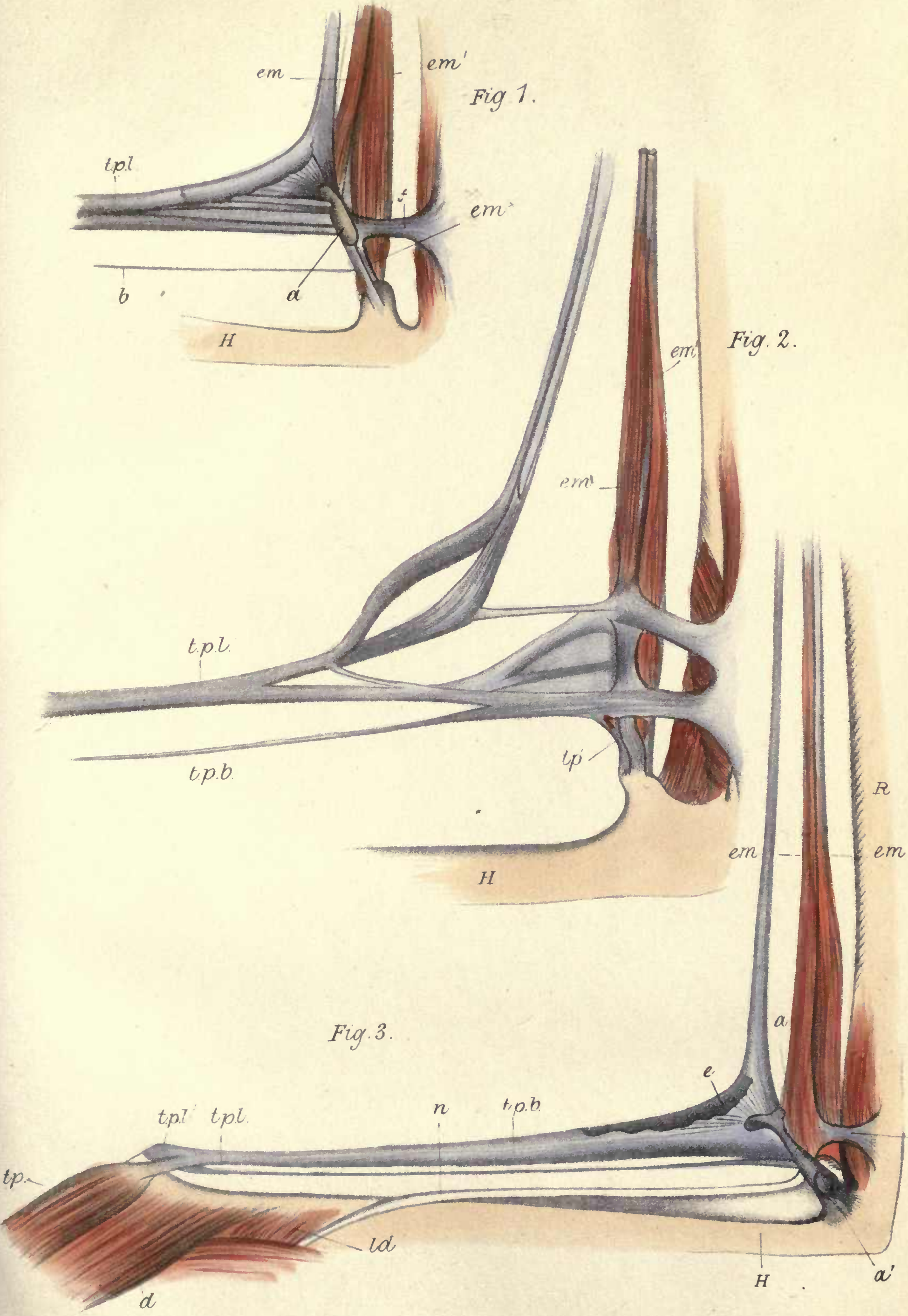
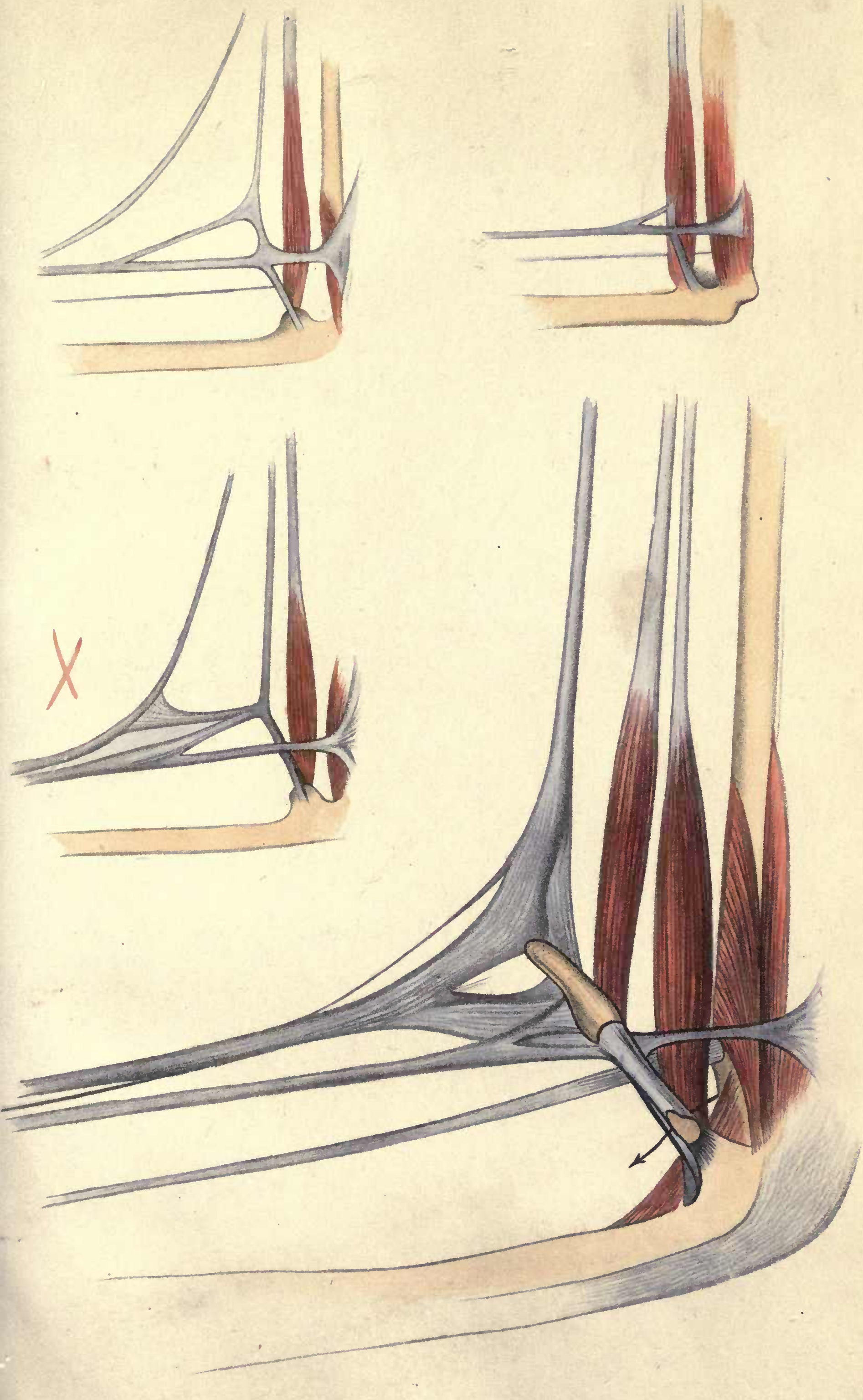


J. Smit lith.

Hanhart imp.

MYOLOGY OF PETRELS.
Tensor Patagii muscles.



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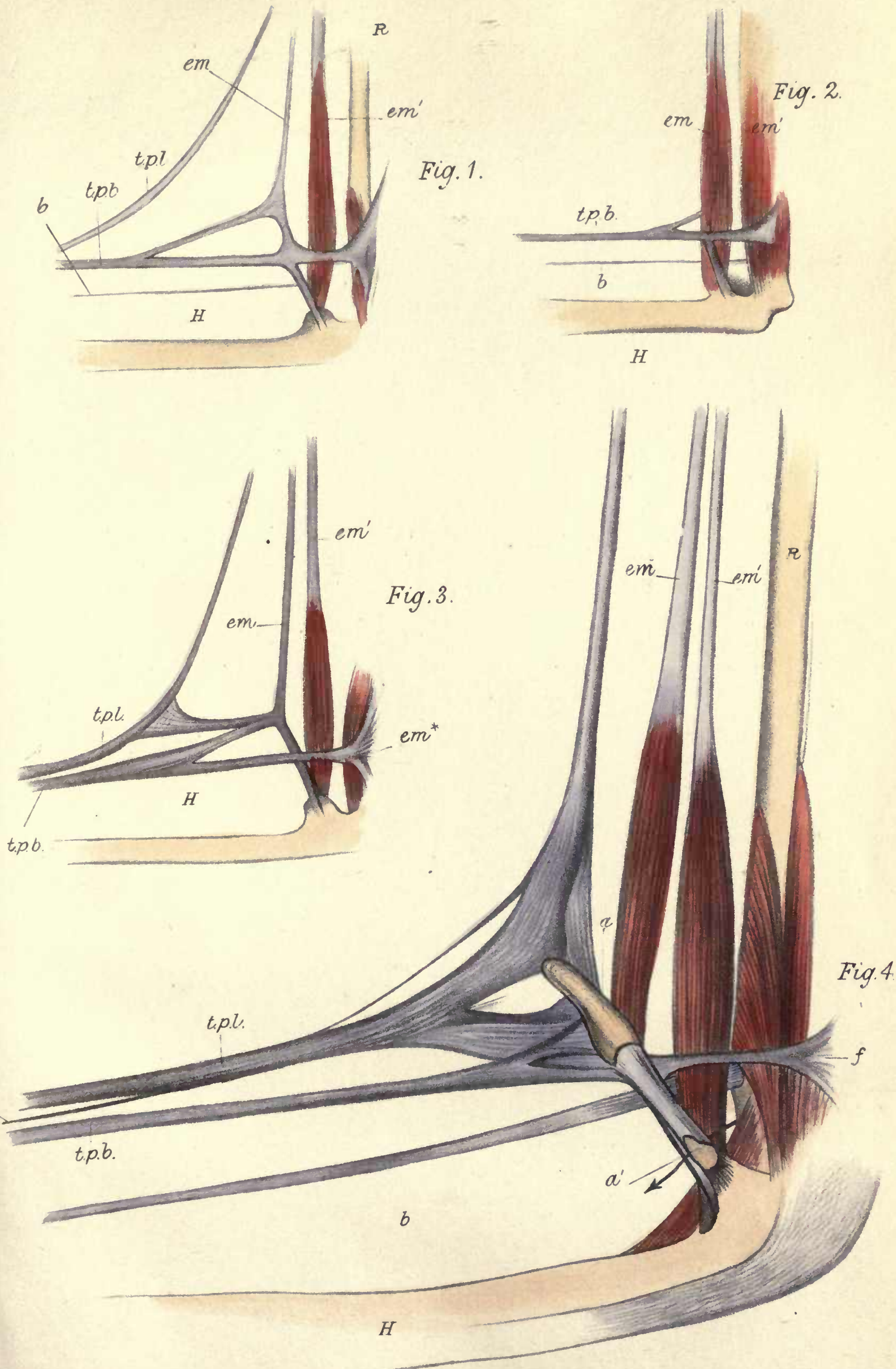

J. Smit lith.

Hanhart imp.

MYOLOGY OF PETRELS.

Tensor patagii muscles.

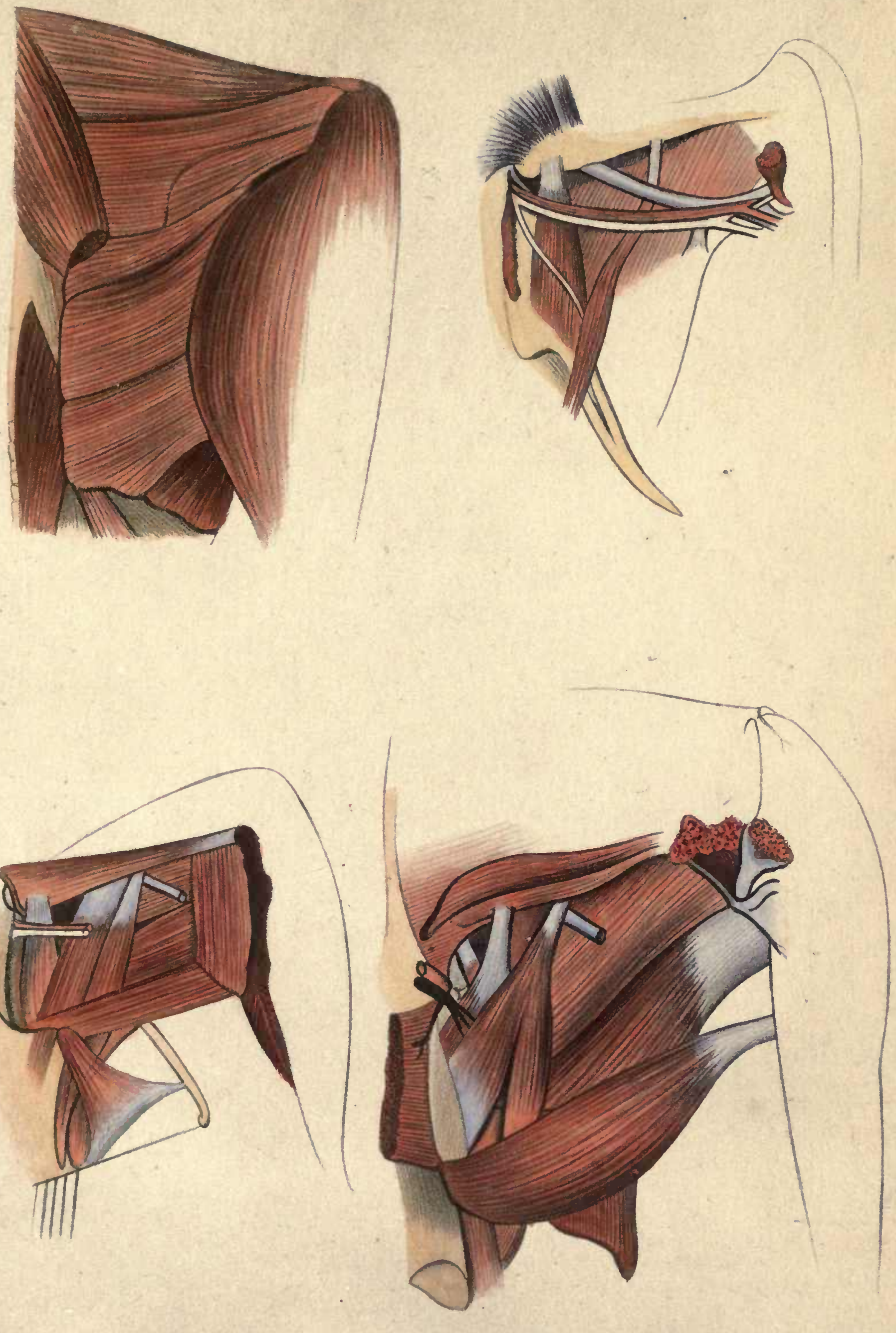

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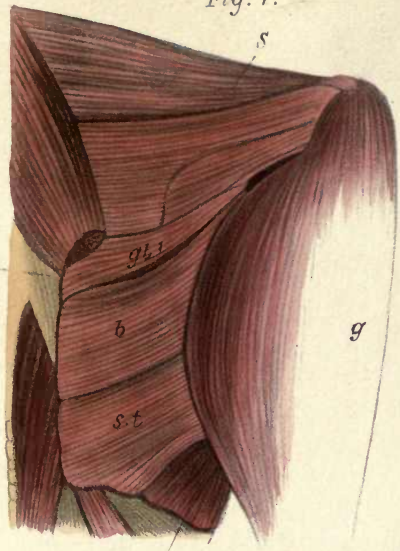
Fig. 1.



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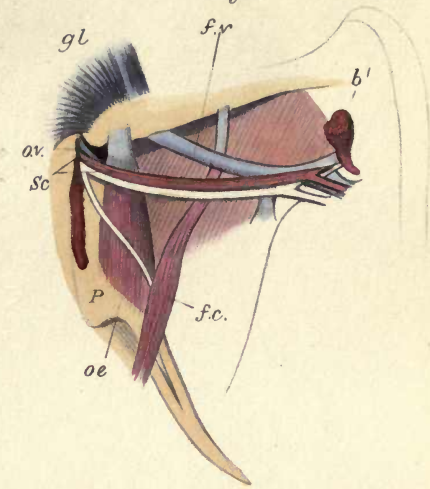

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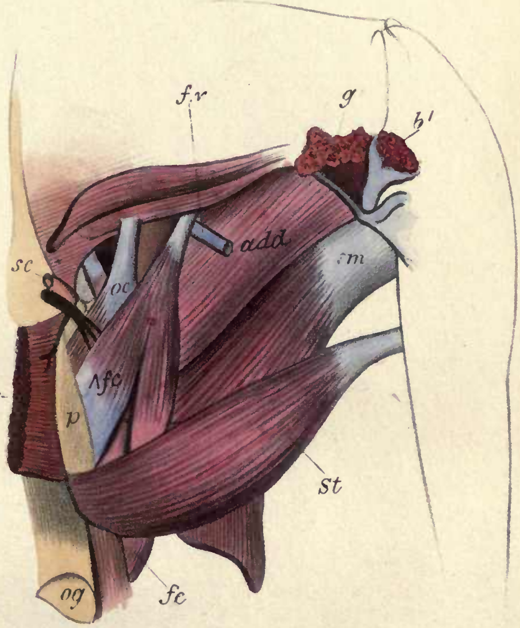


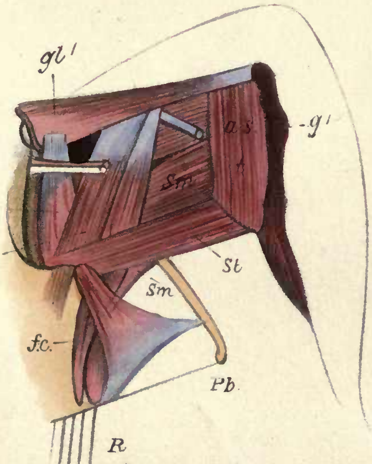
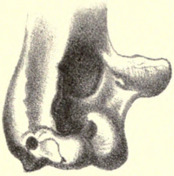


Fig. 3.

J. Smit lith.　　Hanhart imp

MYOLOGY OF PETRELS.
Hinder Extremity.

UNIV. OF



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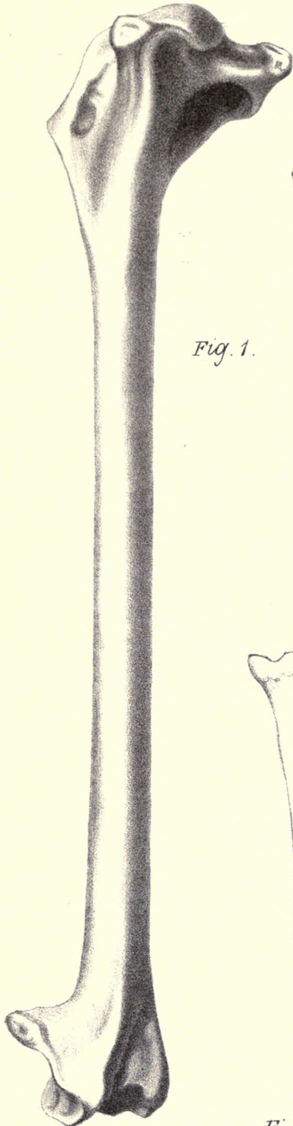


Fig. 1.

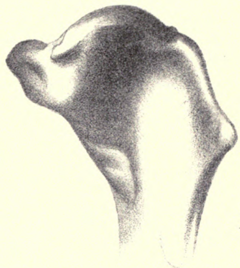


Fig. 3.

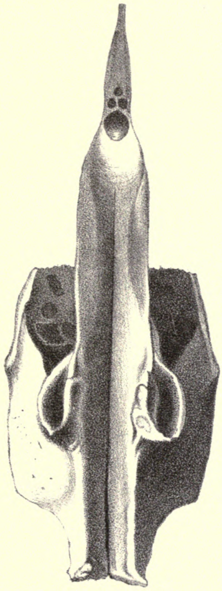


Fig. 4.

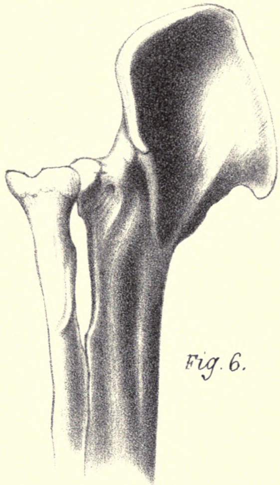


Fig. 6.

Fig. 7.

Fig. 8.

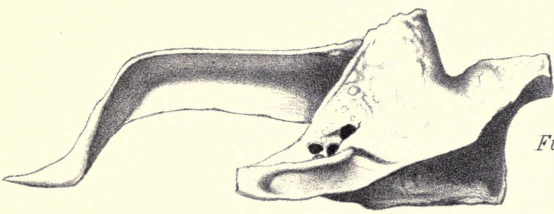


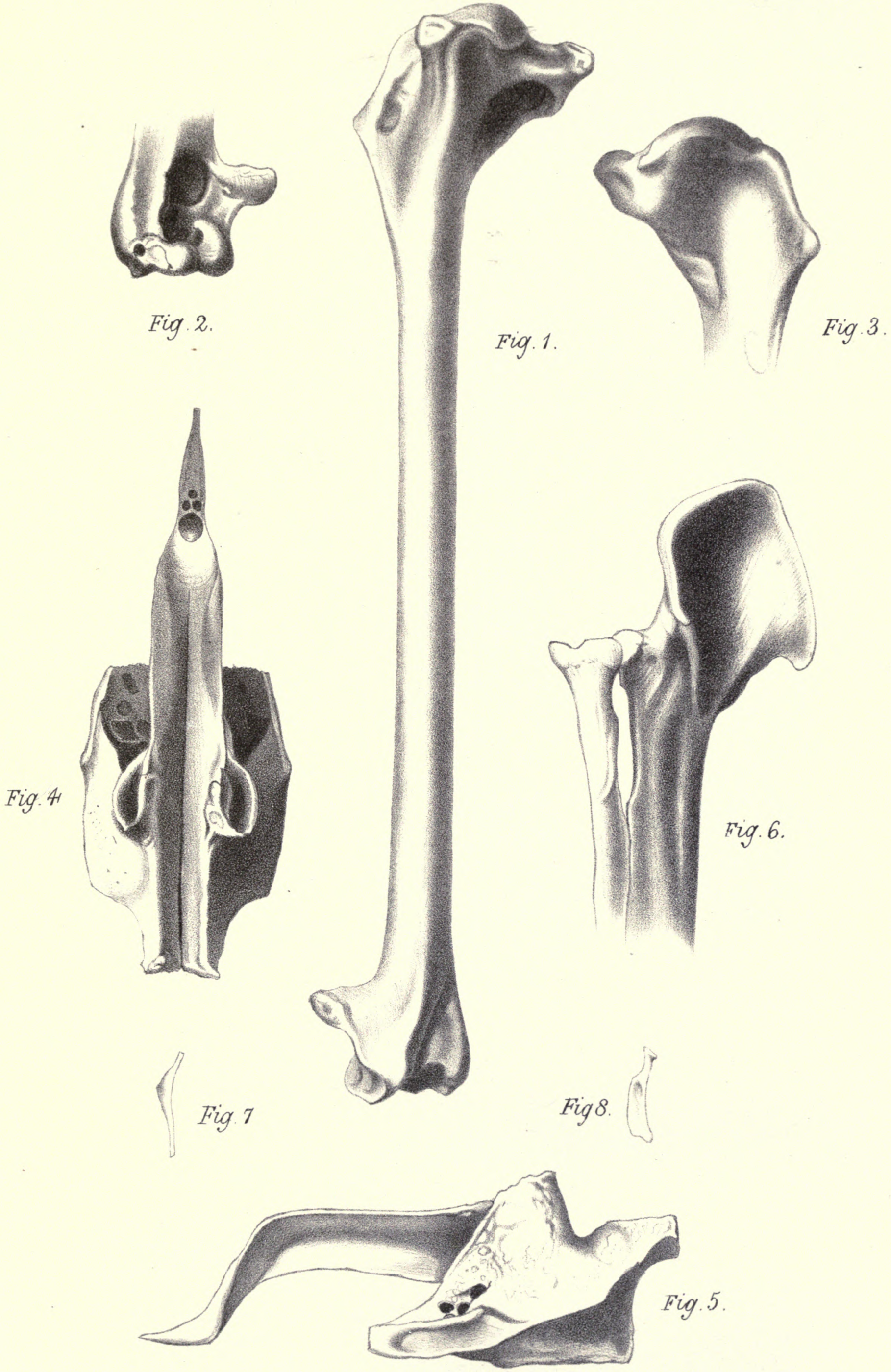
Fig. 5.

J. Smit lith.

Hanhart imp.

OSTEOLOGY OF PETRELS.

Skull and limb bones.



J. Smit lith.

Hanhart imp.

OSTEOLOGY OF PETRELS.

Skull and limb bones.

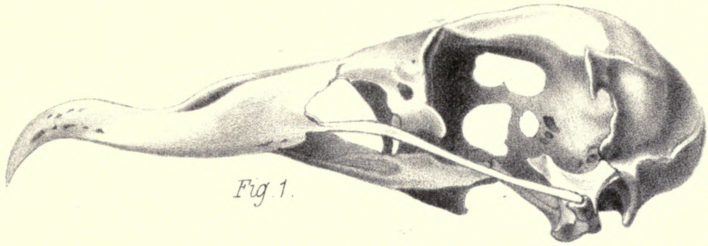


Fig. 1.

Fig. 2.

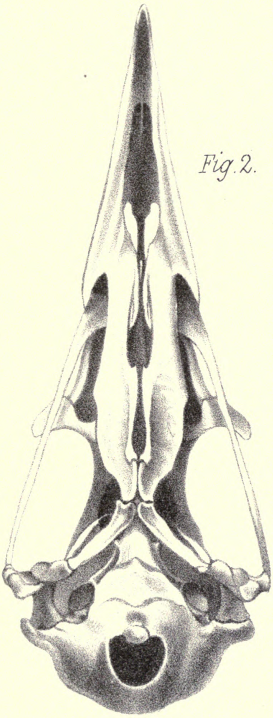
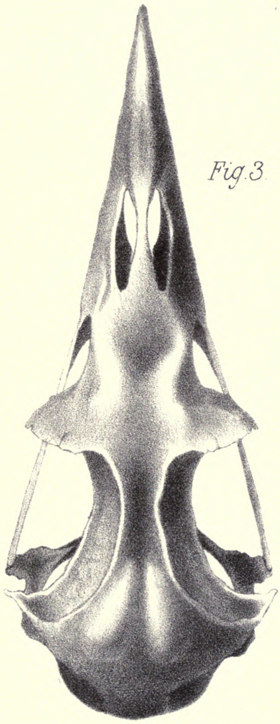


Fig. 3



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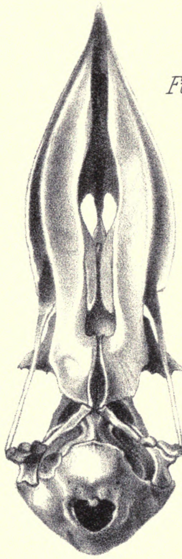

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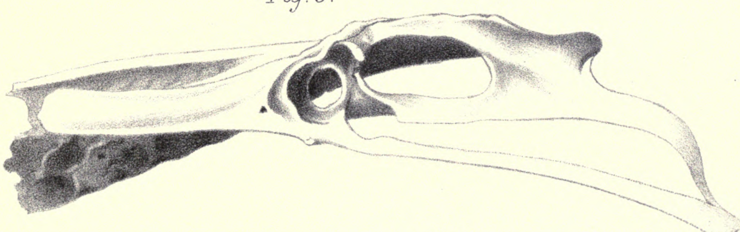


Fig. 6.

J. Smit lith.

Hanhart imp.

OSTEOLOGY OF PETRELS.
Skull Pelvis and limb bones.

UNIV OF

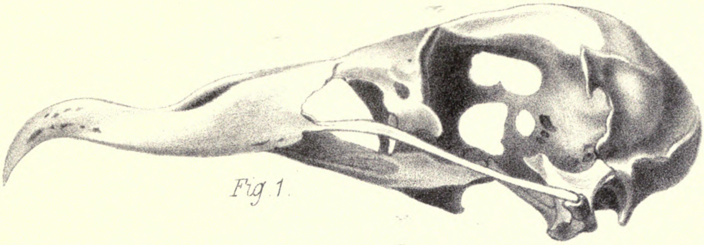
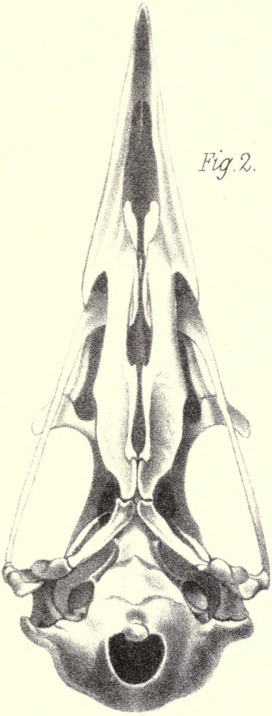


Fig. 1.

Fig. 2.



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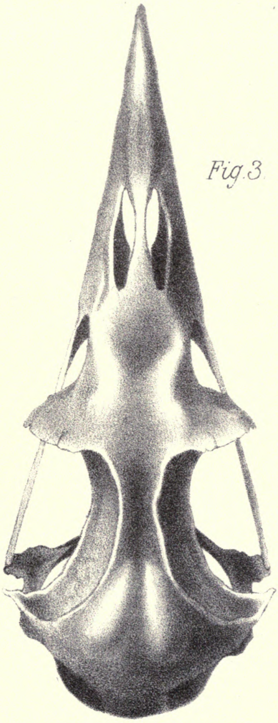

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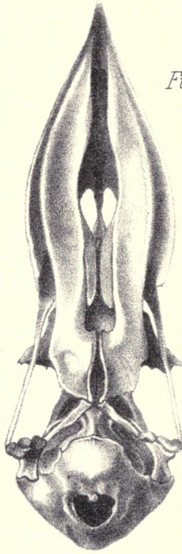

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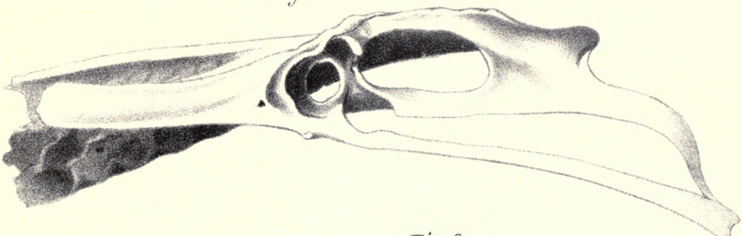
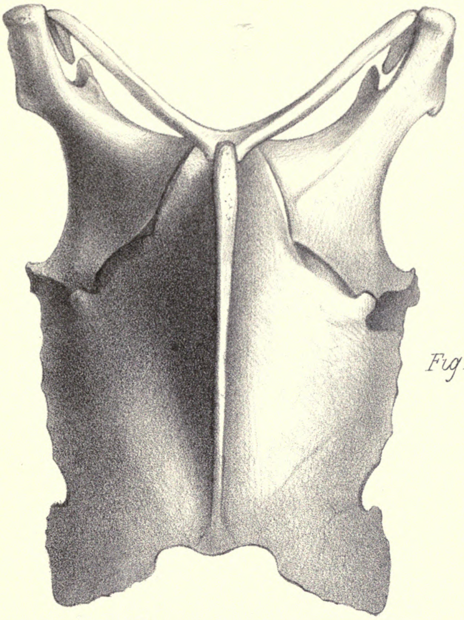


Fig. 6.

J. Smit lith. Hanhart imp.

OSTEOLOGY OF PETRELS.
Skull Pelvis and limb bones.



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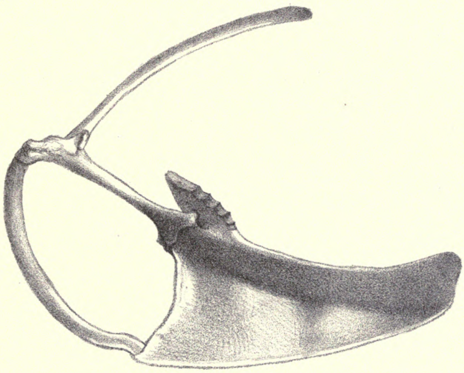

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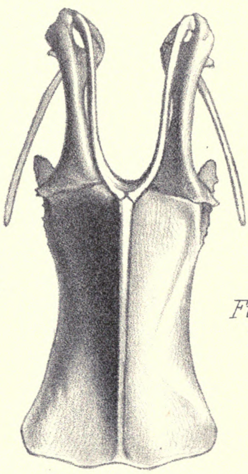

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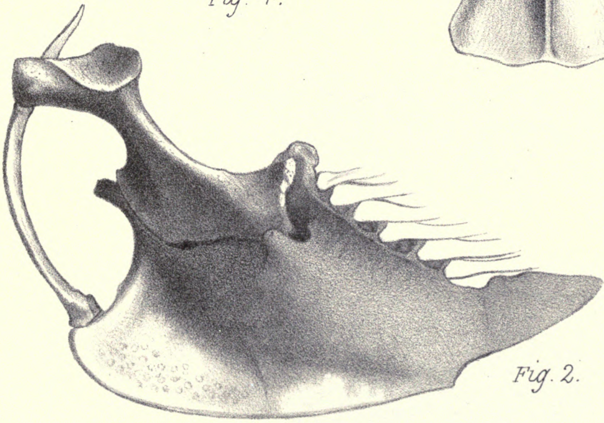


Fig. 2.

J. Smit lith.   Hanhart imp.

OSTEOLOGY OF PETRELS.

Sterna.

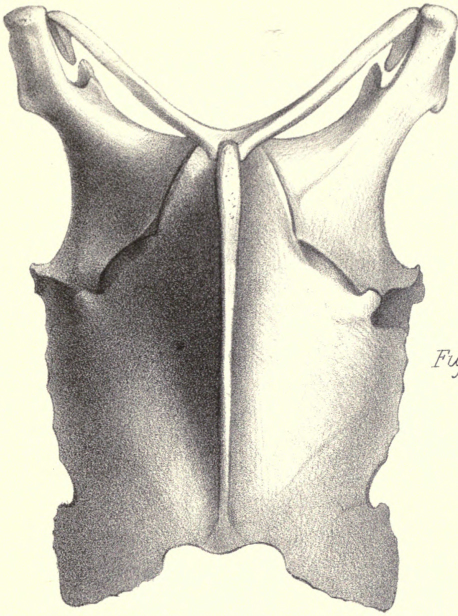


Fig. 1.

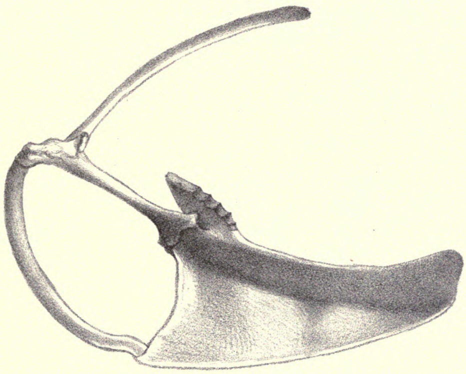


Fig. 4.

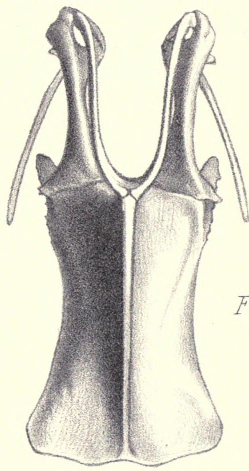


Fig. 3.

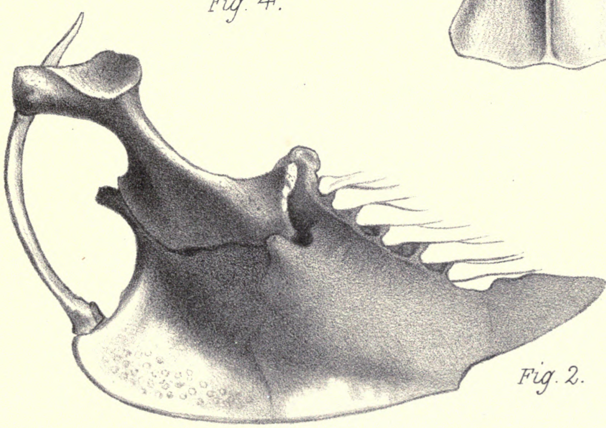


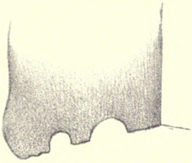
Fig. 2.

J. Smit lith. Hanhart imp.

OSTEOLOGY OF PETRELS.

Sterna.

Fig. 1.



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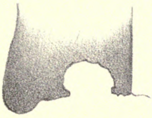

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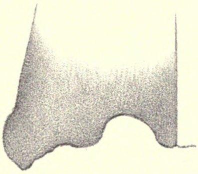

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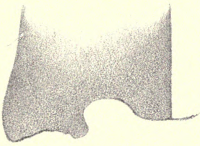

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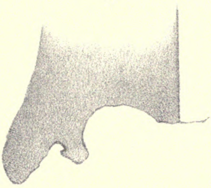

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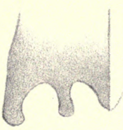

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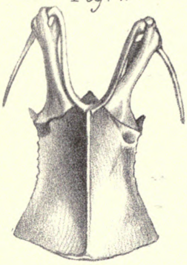

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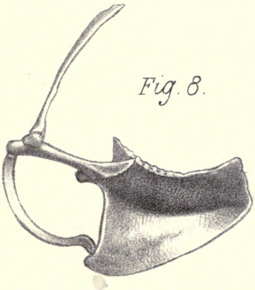

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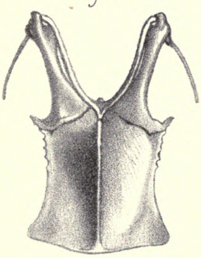

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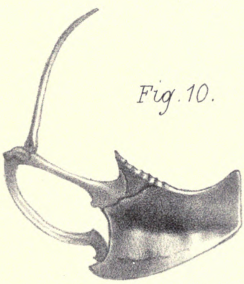

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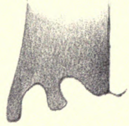

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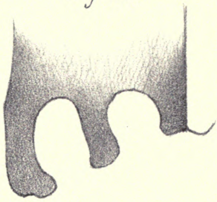

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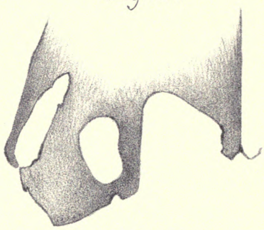
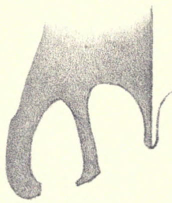


Fig. 14.

Fig. 15.



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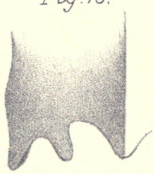
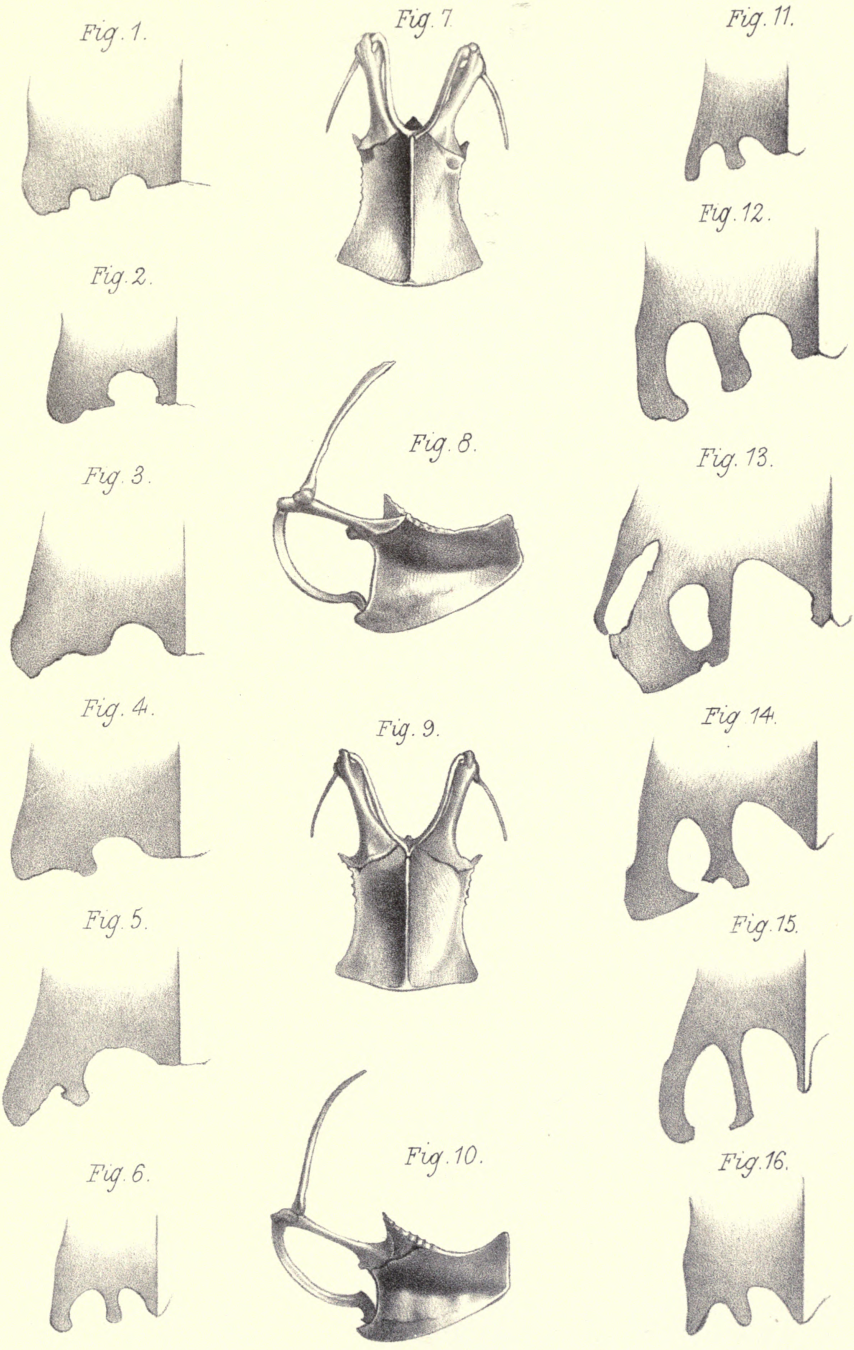


J. Smit lith.

OSTEOLOGY OF PETRELS.
Sterna.

Hanhart imp.



J. Smit lith.

Hanhart imp.

OSTEOLOGY OF PETRELS.
Sterna.

f. Fasciculus of patagial tendons continued on to ulnar fascia; *a, a'.* Ossicles developed at origin of the *extensor metacarpi radialis longior*; *t.p'.* (in fig. 5). Special slip from patagial tendons to deep belly of *extensor metacarpi radialis longior.*

Fig. 3. The same in *Œstrelata brevirostris.*

4. The same in *Diomedea exulans.* An arrow is passed between the twin tendons of origin of the superficial part of the *extensor metacarpi radialis longior.*

PLATE XX.

Zool. Chall. Exp. vol. iv. pt. xi. pl. v.

Fig. 1. View of superficial muscles of right thigh of *Majaqueus æquinoctialis*; *P.* Pelvis; *s. Sartorius*; *gl.* 1. *Gluteus primus*; *g. Gastrocnemius*; *b. Biceps*; *s.t. Semi-tendinosus*; *s.m. Semi-membranosus.*

2. View of deeper thigh-muscles of the same bird; the *gluteus primus, biceps,* and *gastrocnemius* (*g'.*) muscles cut and reflected to show the deeper parts. Lettering as above; also *b'.* cut end of *biceps* passing through the tendinous loop formed by the origin of the *gastrocnemius*; *f.c.* Femoro-caudal muscle; *a.f.c.* Its accessory head; *o.e. Obturator externus*; *add.* Adductor muscles; *f.v.* Femoral vein; *s.c.* Sciatic nerve and artery; *o.g.* Oil-gland.

3. The same parts in *Oceanites oceanicus*; *a.s.t.* Accessory semi-tendinosus muscle; *Pb.* Pubis; *R.* Rectrices.

4. Dissection of thigh of *Pelecanoïdes,* to show the absence of the accessory femoro-caudal muscle, and the abnormal course of the femoral vein, this passing over, instead of under, the femoro-caudal muscle; *o.i. Obturator internus*; *gl.* Glutei.

PLATE XXI.

Ibid. pl. vi.

Fig. 1. Left humerus of *Majaqueus æquinoctialis,* from above.

2. Proximal, and fig. 3, distal extremities of the same bone, inferior surface.

4. Vomer—with the ascending plate, anchylosed to it, of the palatine bones—of *Diomedea exulans,* from above.

5. The same, from the side.

6. Proximal end of right tibia of *Ossifraga gigantea,* to show the cnemial crest.

7. Left uncinate bone ("os crochu" of Reinhardt) from behind, of *Thalassiarche culminata.*

8. The same of *Phœbetria fuliginosa.*

PLATE XXII.

Fig. 1. Skull of *Œstrelata lessoni,* viewed from the side. All the figures are of the natural size.

2. The same, from below.

3. The same, from above.

4. Skull of *Prion vittatus,* from below.

5. Pelvis, seen from the side, of *Majaqueus æquinoctialis.*

6. Hallux of *Ossifraga,* with its metatarsal. The single phalanx of which it consists is vertically bisected, to show the hollow interior.

PLATE XXIII.

Ibid. pl. vii.

Fig. 1. Sternum, with coracoids and furcula, of *Thalassiarche melanophrys,* from in front. Reduced.

2. The same, from the side.

3. Sternum and pectoral arch of *Pelecanoïdes urinatrix,* from in front.

4. The same, from the side.

PLATE XXIV.

Fig. 1. Outline of posterior margin (right side) of sternum of *Ossifraga gigantea.* Reduced.
2. The same of *Daption capensis.*
3. The same of *Fulmarus glacialis.*
4. The same of *Aeipetes antarcticus.*
5. The same of *Thalassœca glacialoides.*
6. The same of *Prion desolatus.*
7. Sternum and pectoral arch of *Cymochorea leucorrhoa*, from in front.
8. The same, from the side.
9. The same of *Fregetta melanogastra*, from in front.
10. The same, from the side.
11. Outline of posterior margin (right side) of sternum of *Bulweria columbina.*
12. The same of *Œstrelata lessoni.*
13. The same of *Adamastor cinereus.*
14. The same of *Majaqueus æquinoctialis.*
15. The same of *Puffinus anglorum.*
16. The same of *Pagodroma nivea.*

Ibis, 1882, p. 386.

66. ON THE VARIATIONS FROM THE NORMAL STRUCTURE OF THE FOOT IN BIRDS.*

"In all birds, even in *Archæopteryx*, the fifth digit of the pes remains undeveloped . . . . Many birds have only three toes, by suppression of the hallux. In the Ostrich, not only the hallux, but the phalanges of the second digit are suppressed . . . . hence the Ostrich has only two toes."

"The normal number of the pedal phalanges in birds is (as in ordinary *Lacertilia*) 2, 3, 4, 5, reckoning from the hallux to the fourth digit. Among the few birds which constitute exceptions to the rule are the Ibis, 1882, p. 387. Swifts, in which the third and fourth toes have only three phalanges each (2, 3, 3, 3), and the Goatsuckers and the Sand-Grouse, in which the fourth toe only has the number thus reduced (2, 3, 4, 3)."

Prof. Huxley has described in these words † the nature of the variations from the normal structure of the Avian *pes*, as regards the number of digits and phalanges composing it, exhibited by various

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* Ibis, 1882, pp. 386–390.

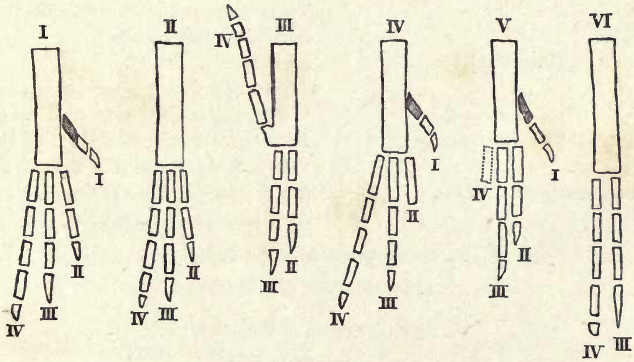
† 'A Manual of the Anatomy of Vertebrated Animals,' pp. 296, 297. London, 1871.

members of that group. As, however, the account here quoted is, in some points, incorrect, and in others incomplete, and as other errors occur in other authors' works on this subject, I have thought that it might be useful to draw up as complete a list as possible of the differences in these two points of structure now known to exist amongst birds.

I. *The Number of Digits.*

The ordinary number of toes in birds is four, representing the first, second, third, and fourth digits of the normal pentadactyle foot (fig. 1, I).

Fig. 1.



A number of birds, however, are three-toed, the reduction in nearly all cases being effected by the suppression of the hallux (fig. 1, II). This may be the case even in birds belonging to zygodactyle groups (fig. 1, III); so that we have three-toed Woodpeckers (e. g. *Picoides* *) and Jacamars (*Jacamaralcyon*) †. It is not always, however, the hallux that is thus absent in tridactyle birds. In the Kingfishers of the genera *Ceyx* and *Alcyone* the foot is three-toed, but the hallux is well developed; the Ibis, 1882, p. 388.

* By some error Nitzsch (Osteograph. Beitr. p. 102) describes *Picoides* as lacking the fourth ("letzte") toe. As I have lately shown, however (P. Z. S. June 1882), there is a rudimentary hallux, with its metatarsal, in these birds, though it is quite concealed under the skin, and has, in consequence, been overlooked by previous observers. The existence of a similarly concealed rudimentry hallux in many other birds apparently tridactyle is therefore rendered highly probable.

† The specific name of *Loxia tridactyla* (Gmel. Syst. Nat. i. p. 866; *Phytotoma tridactyla*, Daud. Tr. Orn. ii. p. 366) seems to be a mistake, founded on Bruce's drawing of a bird met with by him in Abyssinia, and mentioned by Buffon (Hist. Nat. Ois. iii. p. 471) under the name of "Le Guifso Balito." This is usually identified as a well-known Abyssinian Barbet (*Pogonorhynchus abyssinicus*, Marshall, Mon. Capit. pl. 9), with feet of the normal structure.

second digit, on the other hand, is reduced to its basal phalanx (fig. 1, IV), thus appearing externally merely as a wart-like eminence on the side of the digit next to it, in a way very similar to that exhibited by some Edentata, in which the fifth digit of the manus is greatly reduced.

In the curious Passerine genus *Cholornis*, on the other hand, which is also said to be three-toed, the reduction is brought about by the absorption of the most external, or *fourth*, digit (fig. 1, V) *.

In the Ostrich, finally (fig. 1, VI), only two digits are present, both the first and second having entirely disappeared.

List of Tridactyle Families and Genera of Birds.

A. By suppression of the hallux.

Rheidæ.
Casuariidæ.
Calodromas † [Tinamidæ].
Tinamotis † ,,
Ibis, 1882, p. 389. *Pelecanoides* [Procellariidæ]‡.
Phœnicoparrus [Phœnicopteridæ].
Otididæ.
Œdicnemididæ (incl. *Esacus*).
Cursorius.
Turnicidæ (excl. *Pedionomus*).
Syrrhaptes [Pteroclidæ].
Alcidæ.
Charadriidæ (many genera, e. g. *Charadrius*, *Hæmatopus*, *Hoplopterus*, *Calidris*).
Rissa (at least generally; *cf.* Saunders, P. Z. S. 1878, pp. 162, 163) [Laridæ].
Sasia, *Picoides*, *Tiga* [Picidæ].
Jacamaralcyon [Galbulidæ].

B. By suppression of the 2nd digit.
Ceyx, *Alcyone* [Alcedinidæ].

C. By suppression of the 4th digit.
Cholornis [Oscines].

II. *The Number of Phalanges.*

The normal number of phalanges in birds is, as already stated, 2, 3, 4, 5, in the respective digits, counting from within outwards (fig. 2, I). In all the Tubinares §, so far as I have seen, except *Pelecanoides* (where the
Ibis, 1882, p. 390. hallux is quite absent), the number of joints in the hallux is reduced to one, which is quite short, and covered by the spur-like claw; the digital formula therefore becomes 1, 3, 4, 5 (fig. 2, II).

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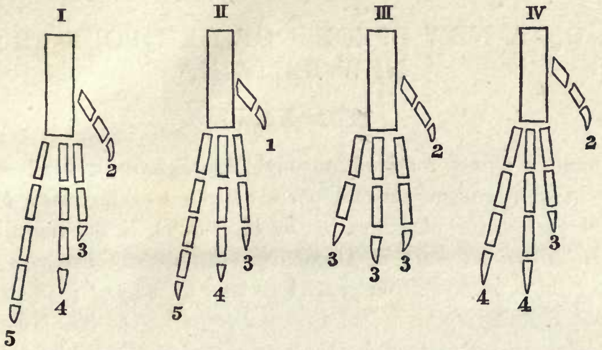
* I have not myself yet had an opportunity of examining *Cholornis paradoxa*; my authorities for the statement here made are MM. David and Oustalet (Oiseaux de la Chine, p. 205), who describe this bird as having the external digit reduced to a "simple moignon." It would be interesting to know how far the reduction here has progressed.

† Sundevall places these two genera, with some doubt, amongst his "Otidinæ" (Tentamen, p. 128). A skull extracted from a skin of *Calodromas* in my possession shows, however, that it, at least, is undoubtedly a Tinamou, the palate being perfectly "dromæognathous."

‡ The *Diomedeinæ*, often described as three-toed, have a very minute and rudimentary hallux (*cf.* P.Z.S. June 1882).

§ *Cf.* Coues "On the Osteology of *Colymbus torquatus*" (Mem. Bost. Soc. Nat. Hist. i. p. 161, note).

Fig. 2. Ibis, 1882, p. 389.



In the true Swifts (*i. e.* the genera *Cypselus* and *Panyptila*) *, though not in the rest of the Cypselidæ, the number of phalanges in each digit external to the hallux is three, the formula thus becoming 2, 3, 3, 3 (fig. 2, III). In the other genera of Swifts the normal number of phalanges obtains, as already correctly stated by Mr. Sclater †. Ibis, 1882, p. 390.

In the Pteroclidæ and true Caprimulgidæ, finally, the formula is 2, 3, 4, 4 (not 2, 3, 4, 3, as stated by Prof. Huxley‡), the fourth digit being one short of the normal number of phalanges (fig. 2, IV). The anomalous genera *Steatornis*, *Ægotheles*, *Nyctibius*, &c. are normal as regards the structure of their feet §, as also are *Thinocorus* and *Attagis*.

Nitzsch, who must have been misled by a badly articulated skeleton, ascribes *four* joints each to all the toes, both of *Struthio* and *Casuarius* ‖. He was in doubt therefore as to which digits were represented in these forms. As a fact, I need scarcely remark, the normal number of phalanges (4, 5 and 3, 4, 5 respectively) is present in both these birds, though in museum specimens a joint or two is often missing. In many Ostriches, however, the *nail* of the outer toe is quite absent, and in others very small; so that their foot is evidently tending to become, like that of the Solipeds, reduced to a single toe, in this as in other cases the third.

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* Nitzsch, so long ago as 1811, pointed out this fact, as well as the reduction in *Caprimulgus* ("Ueber die Gliederung der Fusszehen, besonders im Ziegenmelker und in der Mauerschwalbe," Osteogr. Beitr. pp. 101–105).

† P. Z. S. 1865, p. 596.

‡ Possibly misled by an error in the figure of the skeleton of *Syrrhaptes* in Prof. Parker's memoir "On the Osteology of the Gallinaceous Birds and Tinamous" (Tr. Z. S. v. pl. 38), where the outer toe is represented as consisting of *three* joints only, though in the text (p. 203) the correct number is accurately stated.

§ *Cf.* Sclater, P. Z. S. 1866, p. 124.

‖ Op. cit. p. 102.

Ibis, 1882, p. 428.

67. ON A NEW SPECIES OF HEMIPODE FROM NEW BRITAIN.*

(Plate XXV.)

A few months ago I received, through Mr. Sclater, a small collection of birds in spirit from various parts of the world, which had been forwarded to him for identification by Herr J. D. E. Schmeltz, Curator of the Godeffroy Museum in Hamburg. Amongst these was a single specimen (which on dissection proved to be a female) of a small *Turnix* from New Britain, where it had been collected by the late Herr Kleinschmidt, who was murdered by the natives of that inhospitable island shortly afterwards.

I at first thought that this bird was referable to the Australian *Turnix melanonota* of Gould; but having compared it with Gould's types of that species, now in the collection of the Academy of Sciences in Philadelphia, as well as with a series of ten specimens in the British Museum, I am inclined to consider it specifically distinguishable from the Australian bird, and propose therefore to call it

Turnix saturata. (Plate XXV.)

Affinis T. melanonotæ, *sed rostro crassiore magisque curvato, superciliis magis rufescentibus, et colore subtus omnino (præsertim in mento, gula et pectore) intensiore distinguenda.*

Long. al. 3·2, *tars.* ·85 *poll. Angl.*

Ibis, 1882, p. 429. Besides my specimen I have seen two quite similar ones, also females, one kindly lent me by Canon Tristram, the other in the collection of the British Museum. Both these were collected by Mr. Layard in Blanche Bay, New Britain.

Turnix saturata differs from the Australian *T. melanonota*, to which it is closely allied, in its generally darker colour above, as well as in the greater intensity of the rufous colouring of the underparts, this being not only of a much deeper hue, but extending quite onto the throat and chin, the latter being almost white in *Australian* examples of *T. melanonota.* The rufous eyebrows are also much more conspicuous, and, as so often happens in insular forms as compared with their continental representatives, the beak is much larger and thicker, besides being more curved and of a dirty yellow colour, as opposed to the generally horny colour of the beak of *T. melanonota.*

T. saturata as yet appears to have been only found in New Britain and

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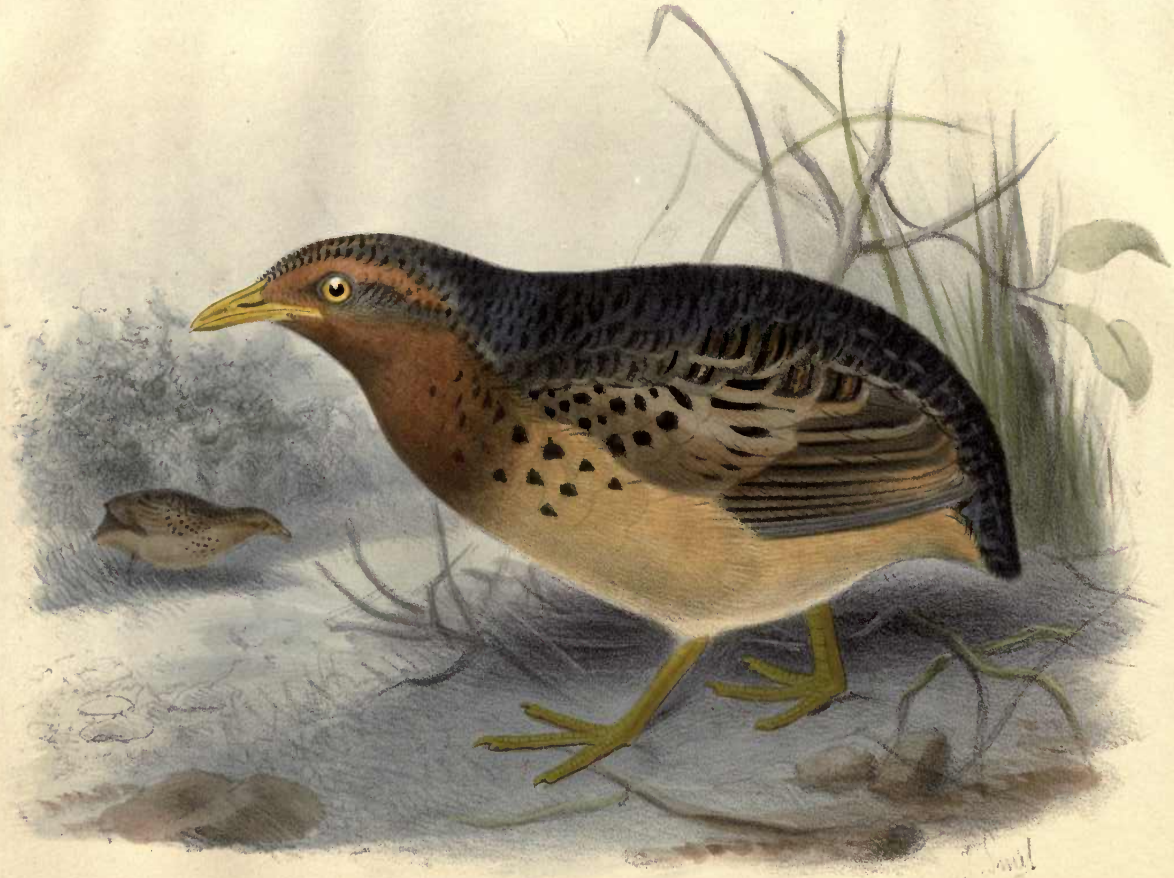
* Ibis, 1882, pp. 428–431, Pl. XII.



J. Smit lith.

Hanhart imp.

TURNIX SATURATA.

J. Smit lith.

Hanhart imp.

TURNIX SATURATA.

UNIV. OF CALIFORNIA

the Duke-of-York group*, in which latter locality it was met with by Mr. Layard, Jun. ('Ibis,' 1880, p. 302). It is, I believe, the only species of the Turnicidæ yet known as inhabiting the Papuan Islands, eleven altogether of that group being found in the Australian region. Of these the following is a complete list. Of all of them, except *T. scintillans*, I have seen skins in the collections of the British Museum.

1. Turnix melanogaster.

Turnix melanogaster, Gould, B. A. v. pl. lxxxi.; Handb. ii. p. 178.

Eastern Australia (*Gould*).

2. Turnix varia (Lath.).

Turnix varia (Lath.), Gould, B. A. v. pl. lxxxii.; Handb. ii. p. 179.

New South Wales, Victoria, S. Australia, and (?) W. Australia (*Gould*); Rockingham Bay &c. (*Ramsay*).

3. Turnix scintillans. Ibis, 1882, p. 430.

Turnix scintillans, Gould, B. A. v. pl. lxxxiii.; Handb. ii. p. 181.

Abrolhos Islands, W. Australia (*Gould*).

4. Turnix melanonota.

Turnix melanotus, Gould, B. A. v. pl. lxxxiv.; Handb. ii. p. 182.

Moreton Bay (*Gould*); Cape York (*H.M.S.* '*Challenger*'); Lizard Island (*Jukes* in *B.M.*); Wide Bay, Richmond and Clarence River districts, N. S. Wales, and interior (*Ramsay*).

5. Turnix saturata, mihi.

New Britain (*Layard*, *Kleinschmidt*); Duke-of-York group (*Layard*).

6. Turnix rufescens.

Turnix rufescens, Wallace, P. Z. S. 1863, p. 497.

Samao Island, Timor (*Wall.*).

This species I only know from a single specimen obtained by Mr. Wallace, and therefore probably the type of his description (*s. c.*), in the British Museum. This skin is in poor condition; but the species, though near to *T. melanonota*, is apparently a good one, distinguishable by the scapularies having no edging of creamy buff, as in the last-named bird. A further series of specimens will be necessary to decide the question. Mr. Wallace describes the irides as being brown, whilst in Jukes's specimen of *T. melanonota* from Lizard Island they are called "white," as also they are in Layard's skin of *T. saturata* from New

* It remains to be seen what species it is which, according to Mr. Ramsay (*apud* Salvadori, "Prodromus," Ann. Mus. Civ. Gen. xviii. p. 9), occurs near Port Moresby.

Britain. According to Blyth ('Ibis,' 1867, p. 162) *T. rufescens* also occurs in Java; he compares it to the Indian *T. tanki* (= *T. dussumieri*, apud Jerdon, B. India, iii. p. 599).

7. Turnix castanonota.

Turnix castanonotus, Gould, B. A. v. pl. lxxxv.; Handb. ii. p. 183.
Northern and North-western Australia (*Gould*).

8. Turnix velox.

Turnix velox, Gould, B. A. v. pl. lxxxvii.; Handb. ii. p. 185.
Ibis, 1882, p. 431. Australia, from Swan river to New South Wales (*Gould*); Port Denison, Wide Bay, and Clarence River districts (*Ramsay*).

9. Turnix pyrrhothorax.

Turnix pyrrhothorax, Gould, B. A. v. pl. lxxxvi.; Handb. ii. p. 186.
East Australia (*Gould*).

10. Turnix rufilatus.

Turnix rufilatus, Wall. P. Z. S. 1865, p. 480.
Celebes: Macassar (*Wall.*).

11. Pedionomus torquatus.

Pedionomus torquatus, Gould, B. A. v. pl. lxxx.; Handb. ii. p. 187.
Plains of Central Australia (*Gould*).

Ibis, 1883, p. 494.

68. THE LAST JOURNAL OF W. A. FORBES.*

July 19th, 1882. Left Liverpool in S.S. 'Bonny,' 797 tons register, Captain Haltje, getting off about noon. Sea rather rolling. Passed Skerries about 6 P.M., and off South Stack at 9 P.M.

July 20th. Showery and dull, with a rolling sea. 40 miles south of Tusker at breakfast. Run 130 miles from Skerries.

July 21st. Showery, but finer. Ship still rolling a good deal. Run 214 miles.

July 22nd. Finer and sea smoother. Run 231 miles. A few *Oceanites* behind ship.

July 23rd. Fine and bright. Swell gone down. Run about 238 miles. Many Petrels behind ship.

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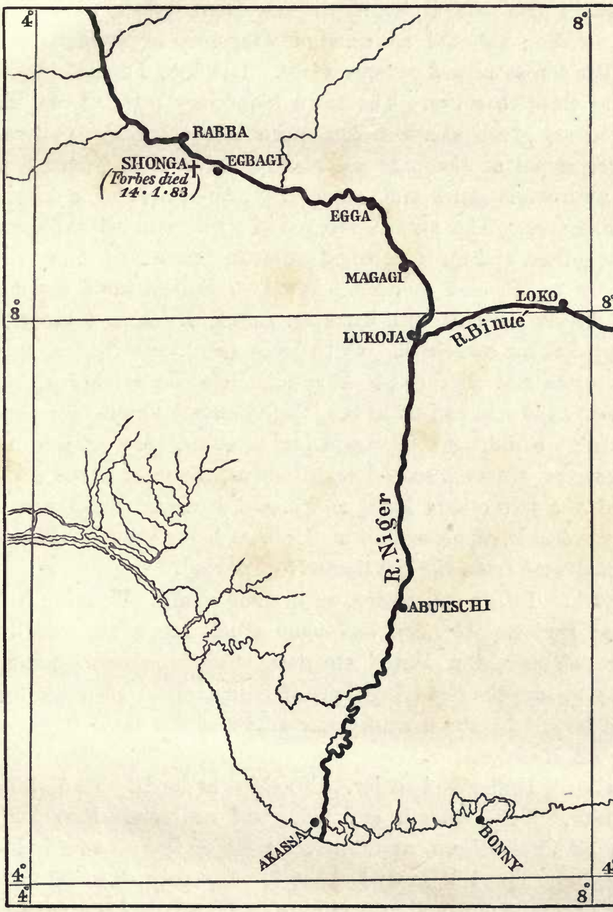
* 'Ibis,' 1883, pp. 494–537.

July 24th. Fine and bright, much warmer. Sea smooth. A number of Petrels behind ship, their yellow webs clearly seen. The legs are carried straight out behind, extending a little beyond tail, and only lowered when "coming-to" on the water. I have not yet seen one clearly settle. The flight Fulmar-like, the wings being rapidly beaten to get up Ibis, 1883, p. 495.



Map of Lower Niger, showing Forbes's Stations.

speed, the bird then gliding with wings stretched for some time. Run 256 miles. 289 miles from Madeira at noon, in latitude of Cape St. Vincent.

July 25th. Sighted Porto Santo about 10 A.M. on port, and Madeira, about three hours later, on starboard. There is a deep sea (over 100 fathoms) between the two, whereas the Desertas, nearer Madeira, Ibis, 1883, p. 496.

are connected to that by a bank. From Porto Santo to the lighthouse at Madeira is 23 miles. Between the two islands I saw many *Bulweria*, two quite close to the ship, settle on the water. The flight is strong, *Puffinus*- or Swift-like. Besides the *Bulwerias*, a good number of a brownish-grey *Puffinus*, with belly and rest of underside pure white; head, breast, and tail like the back. There were a number of these just off Funchal; also some Gulls, apparently *Larus affinis*, with yellow feet, darkish mantle; patagial margins of wings, tip of secondaries, and an oblique bar across second coverts white. Got into Funchal about 5 P.M., anchoring close to shore. The town looks very pretty from the sea—white houses, green shutters &c., quite like other Portuguese towns. The lower slopes of the hills are much cultivated in terraces, the tops wooded with stone-pines and, apparently, *Erica arborea*, a bright green conifer-like tree. The streets are paved with rounded pebbles, closely packed together, and quite polished from the friction of the cow-sledges, there being no wheeled vehicles. Went to Miles's hotel and had some dinner. Pretty garden, with bananas, palms, *Hibiscus*, *Cannas*, &c. &c., and many *Sphinx convolvuli*. Only birds seen were Swifts, apparently *Cypselus apus*, and a yellowish Wagtail, *Motacilla sulphurea*. On ship again about 8.30 P.M. and off at 9. The 'Conway Castle' for Cape came in just after we did, and left again just after us, soon passing us. The three Desertas are well seen from Madeira, the most northern low and truncated, the two others high, rocky, and barren. All the group are obviously volcanic, some section of Madeira being seen in coast-cliffs as we steamed west from the lighthouse to Funchal.

July 26th. Duller and cooler, with some swell. Running before the north-east trades. At noon had come about 150 miles from Funchal. In afternoon passed a Dutch steamer, schooner-rigged, going north. About 9 P.M. saw the revolving light of Palma, about 15 miles distant on starboard bow. In the morning saw a few of the same *Puffinus* as we had seen off Madeira.

Ibis, 1883, p. 497.

July 27th. Duller and cooler. No ships or birds. Run 235 miles.

July 28th. Very smooth and fine, but not hot. Run 228 miles. 50 miles off Cape Blanco at dinner. A lot of *Oceanites* behind ship till dusk. A large Hawk appeared about 7, when ship about 50 miles from land, striking apparently at something (? a Petrel) and not reappearing.

July 29th. Cool and smooth. Run 235 miles. A few flying-fish seen in the evening.

S. July 30th. Cape Verde in sight at breakfast-time. A high cliff with lighthouse on top, rising rather suddenly from a low wooded flat coast. No palms visible on shore from ship at 10 miles off. A lot of *Oceanites* after ship all day; and in afternoon a flock of *Puffinus* fishing with a school of Bonitas. Run 251 miles. Some rain towards evening.

July 31st. Showery in morning, cloudy, with a slight sea. Commenced casting about 10. Run 215 miles. Roughish all day.

Aug. 1st. Heavy rain in morning. About 10 A.M. a flock of about ten of a *Sula* behind ship, nearly all white, and apparently *Sula bassana*. Run 220 miles. Sea smoother. Cleared up at noon. In afternoon, about 4.30, sighted the high hills (Sierra Leone, s. str.) to south of Freetown. Close to land by 6 P.M., and anchored in river off lighthouse by 9.

Aug. 2nd. Up early on deck to see Sierra Leone; raining hard, but cleared up after breakfast. The high hills lie south of the town, which is small and very English-looking with brick houses, and the barracks &c. on higher ground behind town. The land on north of river is flat and bushy; an island above town on south bank also. Some traces of forest left on highest range of hills; the rest pretty nearly entirely cleared, with a few scattered big trees and bushy undergrowth, and numbers of palms close to shore. I took two photos, one of the lighthouse at point (west of town about 4 miles), the other of breakers, just to right of it; the second Gallinia interfered with, exposing it too long. Ibis, 1883,
Got our "boys," and left by noon. Rather rough outside with heavy p. 498.
rain. Saw a number of *Oceanites* in Sierra-Leone river just behind ship; and the water being smooth, could watch them well. They never settle, but paddle in the water with fluttering wings, and also "duck-and-drake" along by bounds, the wings being kept steady and horizontal and the tail spread, the legs depending vertically. On shore could see some pensile long nests hanging from cocoa-palms (? of *Hyphantornis*), and a Tern or two, but too far off to make out the species.

Aug. 3rd. Warmer and finer, with sea smooth. Run 200 miles from Sierra Leone. Men painting ship and "boys" making themselves generally useful, cleaning donkey-engine, brass-work, &c. Land at 12. About 5 P.M. off Cape Mount, a thickly wooded high rounded promontory, apparently of black basalt, rising abruptly from the rest of the coast, which is flat, well wooded, and extends as far as one can see both east and west of it. About 10 P.M. saw the light at Monrovia.

Aug. 4th. Fine and smooth, with cool breeze. Still off the Liberian coast, here flat and low still. Mangos taste like tamarinds with a dash of turpentine. Alligator-pears like vegetable-marrow, or inferior cucumber, but pulp softer and sweeter. About 11 A.M. saw a whale spouting inshore, not a large one, apparently. The evening before passed close to a shoal of dolphins just off Cape Mount—pale grey above, below and side-stripes white; a long nose. Half-speed all day.

Aug. 5th. Off Grand Sestres at daybreak, and shipped seven boys and some others as passengers. The town consists three fourths of patches of mud and palm huts in cleared patches on the beach. The men are bigger and finer than those we shipped at Sierra Leone, and

much browner in colour, as a rule, though varying much. Many have a broad line tattooed down forehead to tip of nose, and two arrow-shaped marks on face, one on each side, with apex just below outer centres of eyes. Most wear only a loin-cloth, with bracelets, bangles, and necklace of
Ibis, 1883 p. 499.
brass wire, with keys &c. as pijues. Some have a few tattooed marks on back in stripes, or on breast just above nipples -;-. Hair very short and woolly on head, and some quite shaved there; little or no beard or whiskers; a good deal of short curly hair on abdomen, chest, thighs, &c. Saw a couple of whales, apparently very big and greyish in colour, about an hour after leaving Grand Sestres. An *Oceanites* off ship at Grand Sestres. Saw Cape Palmas about 9.30. Coast low, flat, and wooded densely, with sandy beach, and black (? basalt) rocks in places. The Grand Sestres canoes are dug-outs, with $\frac{3}{4}$ cross thwarts, and rounded away stem and stern. The men, one third sit or kneel on bottom and paddle with both hands on one side, the paddle being short, with a rhomboidal blade. Besides this usually a wooden scoop to bale out. Canoes and paddles often mended by being sown up with some creeper, also used for making thwarts fast at side of boat. Had come about 100 miles at noon from position day before. Saw Cape Palmas and wreck of 'Joriba.' Lost land in afternoon.

S. Aug. 6th. Fine and smooth, with bright sun. Just after breakfast two steamers hove in sight, steering to the north. They turned out to be the 'Volta' and 'Coanza;' the latter in tow and disabled, having been on shore at Porto Seguro (close to Little Popo), and carried away stern-post, rudder, and three blades of propeller. Communicated and sent letters, papers, &c. on board, and then proceeded on our course. At noon 80 miles west of Cape Three Points. Run 261 miles. One or two *Oceanites* still occasionally seen off ship. In afternoon off Assinie hills and "Hummocks of Apollonia." At 10 P.M. in sight of the light at Cape Three Points. Got two photographs of our Kru boys; the second Ashbury exposed by lifting the slide.

Aug. 7th. Cool, fine, and smooth. Passed Cape Coast Castle at 1 in the morning. Accrà at about 7.30. Coast beyond Volta, which we passed about 1, with sandy beach and low scrubby bush; no thick forest apparently. Off Popo coast in afternoon. 'Congo' at anchor off Little (?) Popo, with captain down with fever. Passed Whydah about 11.30 P.M.

Ibis, 1883, p. 500.
Aug. 8th. Off Lagos about 7 A.M. Quite a fleet of steamers there—'Corisco' (homeward), 'Kinsembo' (west coast), 'Malembe' and 'Winnebah' (Hamburg), also one or two smaller branch and bar boats. Rowland gone to Accrà. Quite cool and cloudy, with slight swell.

Aug. 9th. Cool and cloudy still, with calm sea. Land in sight at daybreak, low and flat. Anchored in Bonny river off the town about

1.30. Coming in on a sandy spit below "Rough Corner" (the white-men's burying-ground) is a great colony of a large grey-mantled Tern, *Sterna melanotis* [*S. caspia*]. Went on shore about 3 P.M. with Ashbury and John Jumbo's clerk and brother-in-law (white). Interviewed J. J., who gave us a guide through the town to show us the juju-house (much neglected), church, and other sights. Many of the unmarried girls up to 17 or so quite nude, as are all the children up to 10 or 12. Men wear a loin-cloth, or a shirt, drawers, &c. of European stuffs, and married women clothed below navel. Many of the children and girls stencilled, often very beautifully and elaborately, all over with a native dye from a green pomegranate-like fruit, simulating tattooing. The street very narrow and in part paved with a large *Cardium*. The houses of wattle, the interstices filled up with mud, and the roofs palm-thatched or corrugated zinc. Some fine old forest-trees on outskirts of town, also bush, with many ferns (especially a large *Osmunda*, with fertile apex only of pinnules of fronds), and mangrove-swamps. Saw an *Elaphocerium* growing on a big tree. In Jumbo's garden a fine frangipani shrub in flower, with *Merium*, or yellow papilionaceous shrub, roses, *Carica*, &c. In the mangrove-swamp an *Anophthalmus* in swarms, going on *land* when disturbed, and hopping, duck-and-drake-like, *over* water like a lot of tadpoles. Many land-crabs also. Of birds saw *Vidua principalis*, a *Nectarinia*, a *Drymœca* (?), and others.

Aug. 10th. From ship in morning saw a large flock of Pelicans on sandy spit on right of river, also a largish white *Ardea*, and a black-and-white Eagle flying over water (? *Gypohierax*). Went on shore about 10, and took about twelve photos of town and natives, juju-house, church, and mission-station. At latter saw Archdeacon Crowther, son of the Bishop. Ibis, 1883,
In the compound was a fine shrub in full flower of the orange-yellow p. 501.
Lilias (*fide* Gallinia), of which I had seen flowers before. The natives organized a grand dance of three or four men, including the chief juju priest, to a band of two or three tomtoms. Some of the girls and children entirely covered with a red dye (camwood), whether for ornament or for curing "craw-craw" (a skin-disease) is doubtful. Caught a few butterflies, including a black-and-yellow *Papilio* and an *Acrœa*; the latter common and flying slowly in afternoon over a pink heliotrope, or allied shrub, and accompanied by a mimicking *Geometer* with pectinated antennæ. Saw a few grey Parrots flying in twos and threes high and fast overhead.

Aug. 11th. Wet in morning. Went on shore about 11, with Watson and Gallinia. Wet, but cleared up in evening. About 4 P.M. went off with J. J., W., and G. to try and shoot some Pelicans. Only got within 400 yards, and missed two shots at that distance; then went up a creek on other side of river and got into a warm corner with Curlews, Sandpipers, a few Parrots, &c. Killed a few *Totanus hypoleucus* and a couple of large Terns (? *Sterna melanotis*), the best of which I skinned. Came on to rain hard before we got back to ship.

Aug. 12th. Wet in morning. Left Bonny about 11 and went ashore with Ashbury to photograph. Took photos of a big tree (? a *Bombax*), and three of a so-called "albino" girl (Ibo), belonging to a black named Hart, who sent us (it having got very wet) aboard the 'Adriatic' hulk in grand style in his canoe, with about thirty paddlers, double-banked. On board 'Adriatic' for the night.

Aug. 13th. On board 'Adriatic' with Captain Gillies and C. de Certi, a Corsican trader, formerly at Opobo. Wet all morning, and did not leave ship till about 4 P.M., when left with Ashbury and Greenshields for Akassa in 'Dodo.' Ship rolled horribly during the night.

Aug. 14th. Off the mouth of the Nun at 8 A.M., but did not reach Akassa till three hours later, owing to the difficulty of sighting the bar-buoy, the land being hazy. River about a mile or a mile and a half broad at mouth, 12 feet of water on bar, passage being surrounded by breakers on both sides, and particularly on the west. Akassa is situated on the right bank, a few miles above mouth. Two dwellings, a billiard-room, some sheds, native huts, and further up the shops. About 180 hands employed, all, except three, black. Mr. W. A. Earnshaw in charge, Sargent and Macintosh being away. A lovely yellow bushy *Hibiscus*, with big leaves, behind the house; also saw a black *Papilio*, a male *Chalcosia*, crowds of *Anophthalmus*, land-crabs of several species, one with asymmetrical chelæ (? *Callianassa*), and a black lizard with red head and tail. The natives had strings of a large *Achatina* hanging up for sale to eat, and with them a *Cinixys*. Had some chops at the house and left about 5 in the 'King Massaba,' Captain Charles Macintosh, for Abutschi, a station just below Onitscha. For some miles steamed through nothing but half-flooded mangrove-swamps, in which gradually a few bushy palms appear, these increasing in number as banks get a little higher and land firmer. Anchored for night about 10. In swamps about 5.30 P.M.; saw half a dozen live *Scopus*, also a grey Parrot or two, and a large black-and-white Kingfisher.

Ibis, 1883, p. 502.

Aug. 15th. Under steam all day from about 5.30 to 8. Out of the mangroves at daylight; they do not extend very far up. Ashbury photographing the banks, with village, all day. Towns in this part hostile. Passed in afternoon place where 'Sultan of Sokoto' got ashore and was plundered, a few miles below a largish village called Emblama. The banks are covered with not very thick forest and jungle, a large cotton-tree being the most conspicuous plant, also oil-palms in numbers. In afternoon saw several of a moderate-sized tree, with white smooth stem and splendid large scarlet flowers. Many plantains, a few cassavas, and a large *Calodium*-like plant called "coco" are grown by the natives. The banks are low, with many sand-banks in places, all apparently a light yellow or greyish loam, apparently quite recent and fluviatile. Saw in morning a few deep-blue small Swallows, with white on tail (? *Atticora fasciata*), and a small *Motacilla*, very white. In afternoon a small *Buceros* or two, solitary, black, with white belly, high black beak, and casque with large white mark (? *Buceros fistulator*). The flight is an alternation of heavy flapping with smooth gliding. Lots of *Pratincola* flying like Swallows just over surface of river below Emblama—white tail and below, with large square white patch on primaries. Saw a flock of three of a green *Treron* fly over river, and got a shot at a crocodile lying on a bank. Macintosh had previously killed one about 8 feet long. Ibis, 1883, p. 503.

Aug. 16th. Fine morning. Started at 6, and at 7 were near to Wari creek, the head of the delta leading to Benin, and about 200 miles from sea (in ship's course). Saw a *Buceros* and a couple of Cuculine birds, chestnut with black cap and white throat (probably *Centropus*). On a bank just at Wari creek saw a great number of *Gypohierax* (both in young and adult plumage) and a solitary *Ardea goliath*. A little above saw two Hippopotami; but Macintosh failed to hit them. *Ardea flavirostris*, and another smaller grey species, on sand-banks above. The coco and palm-nut trees near the villages are crowded with compact circular pensile nests of a Weaver-bird, first seen yesterday. The banks are about 18 feet high where exposed by river-section, of a reddish-grey or yellowish loam, obviously stratified, but not always horizontally. About 12 got to Aboh, where there is a factory and the hulk 'Arran Isle.' The native town is inland about an hour's walk. Got about twenty butterflies near bank, chiefly *Acræa* of two or three species. Shot a male *Hyphantornis* and a female *Estrelda*—eyes pale brown-olive, beak rosy red marked with black, feet dirty flesh. On shore about three quarters of an hour. After lunch landed on a large sandy bank to stalk two crocodiles, and got within about 150 yards, but missed mine as it was going into the water. Greenshields did not get his shot. Walked about on bank and shot a male *Vidua principalis*, also saw several of the *Glareola* walking about on bank. In morning shot a crocodile from steamer at about 800 yards with the captain's Martini, and made fine practice at a bottle, a cartridge, or two inches of pipe put upon fore davits.

Aug. 17th. Passed Osomari, Alenso, Atani, and about noon got to Abutschi. In morning, just above Osomari, met Captain Macintosh in the 'Jessie' from Lukoja. He came on board for a few minutes and went on to Akassa. Abutschi is about 270 miles by river from Akassa, a little way below Onitschi, on the left bank of the river. Caught a few butterflies about the steamer on landing at factory, and in afternoon went down to a large sand-bank with Captain D. Macintosh and succeeded in shooting a hippopotamus from the bank. He sank, but his body could not be found, though we sent a boat and boys to watch for Ibis, 1883, p. 504.

its rising. I shot a *Glareola cinerea* (legs and base of beak bright red), a *Hyphantornis personatus*, male, and one of another species (eyes orange-brown) which was nesting on the acacia-bushes on the bank. The nests are of grass, nearly circular, of the size of one's two fists, with the aperture vertical to one side. An egg was bluish green, thickly freckled with red-brown blotches, forming a zone round larger pole. Captain D. Macintosh also shot a *Rhynchops* for me; we had seen large flocks of it on the banks coming up. When settled on the ground looks peculiarly small. Saw also *Corvus curvirostris*, which has a *caw* like our crow.

Aug. 18th. At Abutschi. Captain D. Macintosh out shooting in the morning and brought me in six or seven birds, including a nice *Centropus* and a *Pogonias*. Caught a most peculiar pale glaucous-green *Homopteron* in garden, flying about amongst shrubs, like a *Geometer*, which it was, I thought, till I pinned it. In evening shot two *Euplectes flammiceps*, these and *Vidua macrocerca* being very common in grass-lands behind factory amongst their plantations.

Aug. 19th. Went out in morning with young Macintosh along bank. Shot thirty of the orange-headed *Hyphantornis*, an *Estrelda*, and a *Pluvianus ægypticus*, of which I had seen plenty before (bill black, eyes dark brown, legs beautiful pale greyish blue, claws black). Started to get ready for Onitschi; but a heavy shower came on just after we started, so Greenshields and I turned back, Ashbury going on. After lunch at Abutschi on 'King Massaba' we went out after birds, D. Macintosh shooting *Hyphantornis luteus* (eyes orange-brown), *Hyphantornis personatus* ?, *Spermestes cucullatus*, a Timeliine bird, and a *Telephonus* (eyes deep smalt-blue). Also saw *Euplectes oryx* or *ignicolor*, several of a *Buceros* and *Psittacus erithacus*. About 5.15 P.M. started on horses for Onitschi factory, which we got to in three quarters of an hour's ride through a sandy grass-covered country, with scattered trees and termite-hills 6 feet high. Swarms of a Lampyroid glowworm outside factory. Some nests of the *Hyphantornis* on beach (? *Hyphantornis aurifrons*) had callow young, and one an egg of uniform pale chocolate-brown colour. Beautiful little purse-like nests of vegetable fibres in long grass made by the little *Estrelda*.

Ibis, 1883, p. 505.

S. Aug. 20th. Started about 9 for a creek on left bank of river, a little above Onitschi, with Greenshields in a canoe with five boys. Saw no Hippopotami (native "Itabo"), but shot a Manati, and saw several monkeys, apparently *Cercopithecus mona*, and a black one. One of the former I wounded, but did not secure. Saw several *Plotus*, and shot a female, its stomach just as in *Plotus melanogaster*: gastric epithelium to top of and covering proventricular area, and no V-shaped ridge distinct. Stomach full of nematodes, but none penetrated (apparently) past plug, numerous ones being caught and detained in it. Food was apparently entirely freshwater prawns. Saw several fine *Haliaetus vocifer*, several

Neophron pileatus (very tame), a large *Buceros* with high casque, *Psittacus erithacus*, a greyish-blue *Campephaga*, a steely-blue *Progne* with white throat, a *Butorides* with orange legs, dark cap, and pale chestnut gular streak, *Ceryle rudis*?, a beautiful small blue *Alcedo* with black bill, orange legs and underside, and white ear-spot, the *Centropus*, &c. Got a lot of orchids and a *Platycerium*, amongst which was a caterpillar (? *Noctua*) with large black yellow-bordered ocelli on sides of fourth segment. A fine grey Hawk-Eagle at factory, with black-and-white barred tail, elongated nuchal crest, yellow bill and feet, and pale greyish-yellow eyes. Also saw on banks a small chocolate Dove, with red beak and slaty-blue cap.

Aug. 21st. After chop went over to Onitschi (town) with Greenshields; he with gun, I with net. At first through fields of grass and yams, then to town, enclosed in a stockade neatly kept, with fine big trees, coco-palms, undergrowth, and red clay houses. *Papilio merope* abundant, and caught a pair in copulation, the male with a black-and-white *Diadema*-like female. Several species of *Terias* and *Pieris* very abundant in outskirts. Shot a pair of the *Lagonosticta* (eyes olive-brown) in fields, a glossy green Swallow, a *Nectarinia*, *Hyphantornis castaneofuscus* (eyes yellow, legs dark livid flesh), and a *Sycobius* with red head, which frequented the palms, and was in company with a similar, but black-headed bird. Also saw several of the smaller yellow-billed *Buceros* in trees of town. On return to factory (Mr. Taylor, a Sierra-Leone man, is "boss"), found our "Manati" of yesterday was an immense crocodile, about 15 feet long, with nuchal scutes just separated from dorsal, of which there were six, strongly keeled in each series, diminishing to four on tail, with indication of another row on flanks. A male with tracheal loop (? *Crocodilus acutus*). Stomach contained fish and stones, some of the latter much rounded. Saved skull, nuchal plate, and trachea. Rode back with Greenshields to Abutschi in evening, after "liquoring up" with M——, the agent of the French factory at Onitschi. Ibis, 1883, p. 506.

Aug. 22nd. Skinning birds and reloading cartridges nearly all day. In afternoon shot a *Hirundo senegalensis* in garden, one of several perching on a high tree and hawking insects. Also got a female Ploceine bird (? female of an *Euplectes*). Boy brought in one of the common house-lizards, which change colour most remarkably, head and middle third of tail becoming brick-red, basal third and middle of back metallic bluish green when excited, after a long rest entirely dull blackish. The *Buceros* here is apparently *Buceros cylindricus* or some closely allied form, shy, and not easy to approach.

Aug. 23rd. Out with Greenshields in morning in plantations behind factory. Shot a male *Euplectes franciscanus*, three *Hyphantornis textor* (irides red), which had nests in a colony on a small tree over some water. Ibis, 1883, p. 507.

(nests purse-like, *not* pensile, strangely), mixed up with a smaller black-fronted species, and a *Crithagra chrysopyga*, which is not at all rare (in twos and threes) and has rather a pretty song. D. Macintosh on the 'Fulah,' with the 'Jessie' in tow, turned up on return; and about 12 we started off up the river for Lukoja on board the 'Fulah.' Passed Onitschi, the town quite invisible from the river, and Asaba, and had shots at some Hippopotami on way.

Aug. 24th. Met the 'Busybody,' with Mr. Ashcroft on board, about 8. He was fixing up a new station, and had been collecting birds for me, amongst them two *Glareola cinerea*, which he gave me. The banks here are about 15 feet high, nearly vertical, of a compact reddish-yellow or grey loam, not obviously stratified; in other parts only sections of recent sand-banks are seen. Saw a large flock of *Psittacus*, some Hornbills (? *Berenicornis* or *Buceros elatus*), some *Plectropterus*, *Ardea*, &c. Banks thickly wooded with pretty dense, but not big, forest, with but few big trees or *llianas*. Heard some leopards miauling in bush at night.

Aug. 25th. Up to Idda about 9, a large town on left bank of river on a high bluff, with vertical cliffs towards river, perhaps 120 to 150 feet high, apparently of an unaltered sandstone of a red colour, laminated or stratified in places, with contemporaneous veins (?) running nearly horizontally. Saw a number of white Egrets and *Plotus* on a high tree. Towards noon got in amongst the high country, with flat-topped hills, apparently remains of a continuous tableland.

Aug. 26th. Amongst the hills still, just below Beaufort Island, apparently of a much jointed compact yellowish sandstone, weathering out into large boulders. Some of the hills conical and nearly isolated, others flat-topped; Mount d'Or, one of the highest, rounded. Saw apparently a couple of *Chenalopex* on a sand-bank, also some Hornbills. Lukoja mountain, long, low, and flat-topped, to left of river, ascending. Saw a couple of *Balearica* on a bank, here called crown-birds. The country here, above Beaufort Island, seems to fall away and become less hilly
Ibis, 1883, p. 508.
and flatter, the hills running transversely across the river on both banks. Got to Lukoja, passing Tybebe on left bank just before, about noon, and left again in an hour's time for Magagi, the country above Lukoja being a high tableland, coming down to river by steep inclines, more or less wooded. Got to Magagi by dark.

S. Aug. 27th. At Magagi, discharging and loading cargo, with some difficulty in getting alongside, the water being shoal. Went on shore; but though I saw lots of birds, shot vilely, losing or missing all but a *Platystira* (eye-wattle vermilion, tarsal planta pseudo-mesomyodian, but syrinx oscinine). A *Toccus* rather common; and also saw from steamer a *Berenicornis*, with head and tail, except two median rectrices, white. Saw lots of *Euplectes franciscanus*, *Spermestes cucullata*, the *Ixos*, a

Turtur, &c. Lots of butterflies. Saw a black-and-white *Motacilla* and a yellow-wattled and legged *Lobivanellus* (*senegalensis* ?). Macintosh got for me a *Cercopithecus* alive from factory, quite young, with long fur, fleshy face, smutty nose, tipped ears, and a black facial ring (? *Cercopithecus nisnas*). They also had a *Cercopithecus sabæus* and a *Cynocephalus*, apparently *Cynocephalus sphinx*, both young. Lots of *Pluvianus*. Got photos of nests of *Hyphantornis textor* in town. Returned quickly to Lukoja, and before dark went on shore and shot a Waxbill, apparently *Rhodopyga rhodopsis*, not at all rare in town. *Pluvianus* on beach walking about or flying over water in numbers.

Aug. 28th. Went on shore early to hills behind town and got a lot of birds amongst small bushy trees, a *Picus*, *Chrysococcyx*, *Turtur senegalensis* (in town and compound), *Estrelda melpoda*, *E. minima* ?, *E. nigricollis*, two species of *Nectarinia*, a *Hirundo*, and two or three others. Saw also *Scopus*, *Euplectes franciscanus*, *E. flammiceps*, *Urobrachya macroura*, in grassy hills &c. outside town. Hill volcanic, quartzite- or felsite-looking, or metamorphic, cleared, with grass. Got a bright yellow-red antelope-skin from Macintosh. The commonest birds in town of Lukoja are *Passer simplex*, *Neophron*, *Spermestes cucullata*, *Hypochera*, and *Estrelda senegala* or *minima*. After breakfast again on shore and saw a beautiful red-black *Nectarinia* singing quite sweetly in a gingeri-tree, which has an agreeable drupaceous fruit. In old factory *Spermestes cucullata* is very common; a nest I found was built on ground, of grass, lined with feathers, contained a pure white egg and three newly-hatched down-covered young. The red- and green-headed lizards both common round houses. *Hyphantornis textor* in great swarms in trees of town, the *Spermestes* also nesting in a mango in the compound of factory, where the *Turtur* was also walking about quite tame. Got away about 1 and went up the Binué, passing a large town on right as you enter the Binué, called Gandi, with the tableland behind and to left of us. Wooded banks on both sides.

Ibis, 1883, p. 509.

Aug. 29th. Steaming up, the Binué running very rapidly against us, with lots of *Pistia* and floating drift-grass. This river rises a little earlier, even more rapidly, than the Niger; only navigable by steamer for about three months; for the rest of the year very low and full of snags and sand-banks. The French have factories at Lukoja and Loko. The banks generally low and wooded; saw some high land in distance to left in morning, and earlier passed an isolated rising facing river by a steep bluff, apparently due to a thick, slightly inclined (dip?) basalt bed, overlying a compact yellow sandstone. Saw several *Plectropterus* (nearly certain *gambensis*, but ? head), and five or six Hornbills, apparently *Buceros buccinator*, with white wings and tail. "Arthur" down with fever, temperature 103°·8; mine, Greenshields's, and a boy's about 99°·6. Only passed two towns on left hand (or bank), Rumasha and

Amàrà; there used to be a station at former. Above it we passed Mr. Watson in the 'Rosie' launch with a large boat in tow.

Aug. 30th. At Loko by 8. Went on shore shooting and again after chop, getting back by 4. Got a lot of birds, including an *Indicator*, *Turtur*, a *Pogonias*, *Drymœca*, *Ixos* and young?, *Hypochera* (common), *Crithagra*, *Estrelda phœnicotis*, a fine *Pytelia* (one out of a lot in a tree), a male *Hyphantornis* (? *textor*, male in non-breeding dress, the bird being
Ibis, 1883, p. 510.
common here), a black *Pœoptera* ?, a Muscicapine form, and others, also *Euplectes franciscanus*, *Spermestes cucullata*, and *Vidua principalis*, as also *Passer simplex*, the first and last in numbers; also one *Ciconia episcopus*, a long-tailed Pigeon, a Woodpecker, &c. The country is flat, with corn- (? Guinea) fields and grassy lands, with 10- or 12-feet high termite-hills of red clay, everywhere interspersed with small trees; no thick bush or big trees anywhere. The town is like other towns here, surrounded by a mud wall, with regular gate of square shape, and bee-hive-roofed circular huts, the entrance-gate with two facing doors, enclosed in a palm or wicker fence. People (Mahometan) usually clothed in white or blue cloth. King tributary to Sokoto. Some higher land visible to south beyond left bank of river, here perhaps twice as broad as the Thames at Westminster and with a strong current. Ivory comes from Ademawa country, thirty days off.

Aug. 31st. Left Loko about 9, and going down Binué rapidly reached Lukoja about 5. Saw a few *Plectropterus* on banks of river, and a pair of *Balearica*. The *Neophron* very abundant at Loko. Took up our quarters in old factory.

Sept. 1st. Looking after things in factory, not much done. Caught a Bat and a Gecko in house, the former escaped. Curious ants' nest in mango-tree in factory compound, with the leaves all spun together with abundance of silk. Got female and workers. Male much smaller than latter.

Sept. 2nd. In morning shot an *Emberiza* (? *forbesi*), a couple of male *Nectarinia pulchella*, a *Lagonosticta*, and a *Motacilla*. Afterwards went down to old factory and into bush on hill, catching a few butterflies &c. Ashbury photographed M—— and natives. Got some fish, three species —a Clupeoid and a broad Cyprinoid, both with red fins, and a Percine form. Native dance by men—flowing garments, baggy trousers, and tobes. Got an antelope's head from chief, shot here two days ago, apparently *Alcelaphus tora*.

Sept. 3rd. Out shooting in morning and got a new species, an *Ortygospiza*, a *Corythornis*, an *Elminia* ?, and a *Platystira*; also *Estrelda*
Ibis, 1883, p. 511.
melpoda and the *Saxicola*. Saw *Urobrachya macroura*, same as already shot, with yellow interscapulars; *Nectarinia pulchella* quite common. A female antelope, bright yellow-brown colour, paler below, with black patches on fore legs, was brought in, apparently *Cervicapra bohor*.

Sept. 4th. Arthur disappeared. Went up the Lukoja hill with Greenshields and five men. We started at 8.30 and took 55 minutes, including stops, to top a tough climb over a rocky and pebbly path in bush. The top is a fine park-like plateau, with more or less long grass and wooded, not thickly, with scattered trees (sometimes big), acacias, &c. Saw some of the red-flowered tree. Numerous "spoor" of buffalo, antelope, and pig, but none seen. The hill consists of metamorphic oolitic sandstone and a breccia-like conglomerate, or agglomerate, of red colour, with included rather angular fragments. Shot a *Drymœca* on top, and saw some Guinea-fowl (? *Numida rendalli*), but few other birds. Greenshields caught some butterflies, dragonflies, and two moths. Left about 2, and took 30 minutes, without a stop, to return to old factory. Found that Arthur's body had been recovered, having been found in the river a little way above white mission house, the trousers and shirt on bank close by. Got a small snake and a *Calotes* from Ankrah.

Sept. 5th. Shot four Sunbirds in morning from lime-tree in compound, including examples of two species new to me. Afternoon skinning and looking after spirit-specimens. At 4 buried Arthur in bush just below model farm, and close to graves of Consuls Fell and Maxwell, who died here in 1867, the former the last white who had died here. Mr. Jones, a Sierra-Leone black, of Church Missionary Society, performed the service, Ashbury, Greenshields, and self, and about twenty blacks assisting. The soil is a reddish clay, apparently of half-decomposed basalts and igneous rocks; no solid rock seen in grave. Abiga shot several "deer" to-day and day before, close to town. Got five of the green-headed lizard from a boy at old factory. Saw a couple of *Agapornis* feeding on long grass on the banks of the creeks intersecting the town.

Sept. 6th. Went out with Abiga in morning down river after "deer;" Ibis, 1883, p. 512.
but though we found lots of spoor, both of them and of buffalo, only saw one and did not get a shot. Saw some green- and yellow-backed *Pœocephali*. Abiga gave me the horns of a "deer" he had shot the day before close to town, described as rather small and red and white, apparently *Tragelaphus scriptus*. Got six of the common smaller green-striped-headed lizard from a boy; and a woman brought a large, but mutilated, *Clarias*-like Siluroid, with free maxilla? About 4.30 the 'Formoso' arrived, bringing Mr. Sargent and a newspaper of July 29th. Ashbury very low, determined to leave per 'Formoso' for Egga; Greenshields and self stopping here. Man brought a young Rail of uniform sooty black, with bright yellow-green beak, red legs, crimson eyes and orbits (? *Limnocorax niger*).

Sept. 7th. Out all day from 8.30 to 5.30 in the bush with Abiga down as far as opposite Igbebe, but got nothing, though I had two shots at an antelope, apparently a reddish gazelle, with black patches on the feet. Saw *Haliaetus vocifer* and lots of spoor of buffalo, antelope, and leopard quite fresh. The country is an undulating or nearly level grassy plain, with small isolated trees, with thicker bush only along the streams. In many places fine cairns of big boulders of granite or gneiss, the former with very large crystals of felspar and a good deal of hornblende. Many of the rocks obviously waterworn, and the whole valley clearly old valley of river.

Sept. 8th. Out for a couple of hours, 8 to 10, in morning with gun. Got an *Anthus* in too bad plumage (moulting) to skin (? *Anthus gouldi*), a female *Urobrachya macroura*, and a male *Hyphantornis* (? *atrogularis*) with nearly white eyes. Saw a fine adult *Helotarsus* flying high overhead, the white under wing-surfaces very conspicuous, and the legs apparently behind, short tail. At Abiga's house saw several antelope-skins, two dodoka (? *Hippotragus equinus*), mana (? *Adenota*), kanki (*Alcelaphus*), and mazo (*Tragelaphus scriptus*), of which latter he had given me the horns. Got a pair of horns of *Bos brachyceros*, and of what he said was a young kanki, from him, and a skin. Later went out shooting up valley. Got very hot and only shot two birds, a *Drymœca* (same as that shot on top of Mount Patter), and two young Ploceine birds of uncertain species. (This is certainly young of *Spermestes cucullata*; I saw several of it next day in company with adults.) A heavy rain and thunder-storm came on just before sunset.

Ibis, 1883, p. 513.

Sept. 9th. Out shooting early up valley, but only got a male *Estrelda rara* (one of two) and a *Turtur* (? *semitorquatus*), same as seen at Loko. Saw a yellow-bellied *Laniarius*, a *Tchitrea*, and some others, including *Thamnobia frontalis*, a *Ruticilla*, apparently all young. Picked up a *Mus*. In afternoon got a few butterflies in lane close to factory, and in fields adjoining some birds, including the *Elminia* (?), a young *Vidua principalis*, of which I saw several, two specimens of *Drymœca*, and *Estrelda rufopicta*, which occurs here with *Estrelda minima*, but is rarer, female much redder, and male has pale bluish eye-ring. Abiga brought in a skin of a female *Tragelaphus*.

Sept. 10th. Skinned birds in morning. Felt seedy, and about 3 a sharpish attack of fever came on. Piled on a lot of blankets and sweated profusely. Felt better in evening and cooler; slight headache and pains in leg.

Sept. 11th. In bed, more or less, all day. Felt better, but still weak, with little appetite. A slight recurrence of fever in afternoon. Greenshields went out in morning and shot three birds, a *Nectarinia* (*cuprea*?), a *Lamprocolius* (one of a flock), and a *Timelia*. In evening brought in male and female *Urobrachya*, a *Spermestes cucullata*, and one of the thick-billed *Drymœca*.

Sept. 12th. Still feverish, but better. Wet all day.

Sept. 13th. 'Fulah' arrived with A. Macintosh, Shitta, and the consul. Felt decidedly better. Got a letter from mother, and news of Balfour's death.

Sept. 14th. On 'Fulah,' more or less well. The valley is wider up here, the hills only appearing in the distance. Macintosh tells me that at Abutschi very lately he found, on the rocks exposed by the very low water, freshwater mussels, edible and "spiny;" also that a shark was killed there lately and another at Egga. Ibis, 1883, p. 514.

Sept. 15th. Got to Egga about 9 and landed at factory in a barge, the water being too low for steamer to come alongside, the passage up a very narrow channel. Saw some Jaçanás close to town, also a *Sterna*, *Plotus*, *Balearica*, *Pluvianus*, *Euplectes abyssinicus*, and *Hyphantornis personatus* in acacia bushes by river. The town is well built of round mud huts, in mud-walled compounds and very narrow streets. Got a toad in factory and head of big fish ($31 \times 24\frac{1}{2}$ inches in girth, $17\frac{1}{2}$ lbs.). Adipose fin; ventral fin rather thoracic, very bony; white flesh. There is a tree in yard crowded with *Hyphantornis textor*, and a large tree (?*Adamsonia*) outside more so, with, I should say, near 1000 nests.

Sept. 16th. Convalescent. Repacked my baggage. There are lots of the two common house-lizards here, and a pair of *Corvus curvirostris* came to the big tree outside. Greenshields left for Tchunga.

S. Sept. 17th. Went out shooting with Macintosh down the river, but only got one *Chenalopex*, though we saw lots of it, and a Duck, apparently a *Dendrocygna*. On one of the banks *Glareola cinerea* was in thousands, with a few of a darker one (? *nordmani*), one of which I got; also lots of *Pluvianus* and several flocks of *Rhynchops*. Also saw several *Balearica*, the large white black-billed *Ardea*, a *Merops*, *Vidua principalis*, and shot a *Chrysococcyx*.

Sept. 18th. In about factory all day. Got from Mr. Bishop a fine pair of horns of an *Alcelaphus*, apparently *Alcelaphus tora*.

Sept. 19th. Out with Macintosh in morning. He shot a *Chenalopex*, and we saw plenty; also a pair of *Balearica* and some *Plectropterus*. He shot for me also a pair of a deeply-forked-tailed Swallow (? *Atticora melbina*), very common on the sand-banks; and I got a Sandpiper on canoe as it lay on beach. Saw a *Porphyrio*; *alleni*, I suppose. Shitta brought in one of the large "singing" snails (?a *Paludina*), and later another still larger. The canoe-boys believed in it, and pointed out the *Paludina* as the performer. Had a ride in evening.

Sept. 20th. Shooting in the morning on the island. Got five birds, male and female *Euplectes abyssinicus*, a *Campephaga*, a *Drymœca*, and a female *Hyphantornis* of a species new to me. Saw also *Laniarius barbarus*?, a *Merops*, and a Kingfisher, with lots of *Vidua principalis* (female or young), *Lagonosticta*, *Hyphantornis personata* ?, *Turtur semitorquatus* and *T. senegalensis*, and another smaller species with no white on tail. Macintosh and consul left about 4 for Wanengi, en route for Ibis, 1883, p. 515.

Bidda, I remaining here with Ashbury, who is better to-day, the 8th of his attack. In morning saw four or five *quite black* Hornbills. Heavy rain in night.

Sept. 21st. Showery in morning; so did not go out till after breakfast, when I shot a *Centropus* (same as at Abutschi) and a couple of *Merops*, both with bright crimson irides. Saw *Euplectes franciscanus* on island, and saw several *Euplectes melanogaster*. Got a mail per 'Wanderer,' which had arrived in the night.

Sept. 22nd, 23rd, *S.* 24th, and 25th. Fever.

Sept. 26th. Ashbury left in 'Formoso.' Consul back.

Sept. 27th. Better. Still about factory. Dog caught a couple of rats, a blackish moderate-sized species. Also found another *Gecko* (same species as at Lukoja), and found a dead brown rat of another species in factory-yard. Saw Barber.

Sept. 29th. Macintosh back from Bidda about 10. Discharged 'Jane' at Egga. Started up river for Rabba on 'King Massaba' (Macintosh, Flint, Lever, and self) about 3, and steamed till dark.

Sept. 30th. Fine and bright in morning; about 5.30 saw a magnificent comet, altitude about 20° about E., apparently twice as big as that of 1881, and with splendid tail. Saw an adult *Xenorhynchus* on a bank; C. M. had already described it to me at Egga, and Lever had shot at a young one there. Saw also *Gypohierax* and *Ardea goliath* and *A. flavirostris* (yellow beak, clear). About 9 off the Rennell Mountains, 1200 feet high (900 feet above river), flat-topped, but very detached, with only some remains of hills, much lower laterally, just above the river; the cliffs and lower (only) hills are composed of a pale whitish-
Ibis, 1883, and-pink stratified sandstone, said by Macintosh to be very clayey.
p. 516. About noon got to Egbagi, a factory on left bank. Afterwards the banks are low and grassy, with the flat hills still in distance when visible. About 5 off Kaduna river, and took a photograph of left bank covered with bush. Saw lots of Hornbills in evening, apparently of two species, a *Toccus* and *Buceros atratus* (♀?), flying high in air to resting-places.

S. Oct. 1st. Got aground twice in morning, and 'Jessie' got damaged. Distant hills on left bank still quite flat-topped; banks low and grassy. Hills recede going up river, and only seen on horizon. Banks alternate with grass and thick bushy (low) forests, with oil and a flabelliform palm; the latter more in grassy lands, and has a fusiform stem. About 4 P.M. got to Tchunga creek, on right bank of river; very narrow. Just before entering saw a single fine *Cercopithecus mona* in trees. A good number of birds in Tchunga creek, including *Plotus*, a nearly uniform brown-grey *Schizorhis* (? *concolor*), lighter beneath and with yellow bill (three in a tree), the smallish black-capped orange-legged *Butorides*. Shot a large Owl from ship (*vide* description at end of Hartlaub) as we were anchored for night two-thirds way up to Tchunga.

Oct. 2nd. Started at 10 in 'Jessie,' with Macintosh, Lever, and Flint, for Rabba. Saw three *Balearica* in main river. Got to Rabba about 3. Factory in ruins, and town almost deserted. Strolled up river a short way. The surface is river-gravel, derived from a metamorphic (?) fine-grained sandstone conglomerate, generally with rounded quartz-pebbles, only occasionally angular.

Oct. 3rd. Left Rabba about 5, and got down to Massaba by 8. The country is low, except about Rabba (left bank), generally grass-covered, with scanty dwarf-looking trees scattered about or in clumps. *Plotus* abundant in creek, and saw several other birds coming down, including an *Ardetta*, *Metopidius* (in creek), *Balearica*, a brown Ibis (? *Ibis hagedash*), a pair of blue-winged red-beaked *Halcyon*, and a large black-and-white *Ceryle*, also a blue-green *Nectarinia* with long tail; these two last from Massaba. A large fulvous Bat was common along banks, flying out from trees or margins. Very bad night, with fever and mosquitos. Ibis, 1883, p. 517.

Oct. 4th. Feverish all day; on 'Massaba,' at anchor in creek, Macintosh &c. being busy in rowing down stream from factory. About 4 left Massaba, and went up creek in canoe to factory; in charge, Mr. Bishop. Creek very narrow latterly. Settled myself in factory. Saw *Estrelda* on tree close to landing-place; also *Hyphantornis textor*, *Hypochera*, *Passer*, *Neophron*, *Balearica*, *Lagonosticta*, &c.

Oct. 5th. Good night, and felt much better in morning. Took a short walk up to town, situated on hill beyond factory. Saw many birds —*Ixos*, *Turtur vinacea* (?), an *Ardea* (either *A. cinerea* or *A. atricollis*), *Hoplopterus*, *Coliopasser*, *Chrysococcyx*, several *Drymœca*, a new Timeliine, a large grey Pigeon, &c. In afternoon went up hill behind factory. Good view of town, surrounded by castellated mud walls, and of river-valley, very wide; the hills (? on the other side) apparently in distance. Hill covered with rounded flint-pebbles, with occasional blocks of sandstone conglomerate of dark colour. Is this rock *in situ*? Saw *Estrelda melpoda*, *Nectarinia pulchella*, and a dark species, *Spermestes semitorquatus* and *S. senegalensis*, *Centropus*, a *Treron*, &c. About twenty *Neophron* settled for night in tree outside factory. Greenshields arrived from Rabba about 9. Very bad night, and feverish again.

Oct. 6th. In factory all day, feeling seedy and weak, with no appetite. Took a short walk in evening up to town. Greenshields had a touch of fever. Good night.

Oct. 7th. Better and stronger. Greenshields left again for Rabba, feeling better. In and about factory. Walked up to Egga in evening. Good night.

S. Oct. 8th. Decidedly better, but appetite still very poor. Shot a white-rumped Swiftlet, already, I think, seen at Egga (? *Cypselus abyssinicus*, in spirit), and a red-rumped Swallow (? *Hirundo melanocrissus*) in factory-yard. In morning's walk saw *Estrelda rufopicta* close to factory, and a peculiar-looking *Hyphantornis*—top of head, back, wings, and tail olive-brown; lores and part of face black; very broad eyebrows (?*Euplectes melanogaster* changing, or a distinct species). Shot a *Turtur senegalensis* in morning in yard for "chop."

Ibis, 1883, p. 518.

Oct. 9th. In factory all day, labelling birds &c. till 4, when I went up hill to back of factory. Got a few butterflies, including a nice-looking Erycynid; but I was awfully tired and dazed; so came down, and was back by 5.30. Slept well.

Oct. 10th. Went out shooting with Marma at 6.30 to Egga and back by road along back of hill. Got a *Drymœca* and a *Centropus*, and shot also *Hyphantornis textor* (♀, spoilt) and *Turtur senegalensis* for "chop." Got fearfully dazed by light; so came back about 8, without having seen any thing new. In evening took a short stroll along track. Got a few *Cetonias*, a *Lycus*, and a very curious grasshopper, all on grass-stems; also some *Noctuæ*, flying round the grass-flowers, of two or three species.

Oct. 11th. Went out in the morning on hill behind town to Egga. Shot an *Anthus* (? *campestris* ♂), and saw a *Budytes flava* on cleared ground near farm. Further on shot a male *Francolinus* (? *bicalcaratus*) on top of a termite-hill: food, dipterous larvæ. Got dazy, so returned by 8; very tired all day. Skinned birds; slept and sat in chair. In evening found a remarkable humpy-looking spider, which on being put into spirit dissolved, there being hundreds of young ones, which were closely applied to limbs, thorax, and abdomen of mother, and so carried about.

Oct. 12th. Slept till about 8, and felt much better. Shot *Budytes* (which turns out not to be *B. raii*) just outside factory-door, and saw several more in old disused factory-yard. In evening took a new walk, past landing-place parallel to creek. Got several *Lycus*, one or two pairs *in cop.*, the male being the form with dilated elytra; also a few *Acrœas* &c.

Oct. 13th. Went out about 6.20 along same path after birds, but got very wet in long grass. Shot a *Hypergerus* and a *Timelia* (same as that Greenshields got at Lukoja), and saw *Laniarius barbarus* quite close, a *Merops* (? *viridissimus*), and a black Cuckoo (nearly certainly *Oxylophus ater*), also *Estrelda melpoda* and a single *Pœocephalus* (I think, *P. senegalensis*), and others. Several *Budytes* in old factory. Very sleepy all day, with headache. Good night.

Ibis, 1883, p. 519.

Oct. 14th. Out shooting about 6.30; back again by 8. As weak as a cat, and could hardly carry gun; got very dazed, but managed to shoot two out of five *Merops nubicus* in a large tree back of factory, and saw three of a new noisy *Timelia*. Saw a yellow-billed dull brown *Milvus* outside factory in morning, apparently same species as the live one at Abutschi.

S. Oct. 15th. Did not go out all day, feeling very lazy and pulled-down.

Marma forgot to call me for dinner, and I slept till 11 and admirably afterwards.

Oct. 16th. Went out about 6.30. Saw a pair of *Hypergerus*, several *Oxylophus*, an *Emberiza*, and shot a *Trichophorus* and a *Halcyon*, both new to list. Bad night.

Oct. 17th. Went out and soon came back, the sun being too hot for me. Saw a *Cossypha*, and blew a *Laniarius barbarus* to bits. Got a fine green *Treron* out of the "fig-tree," and shot a *Passer*: is it *P. simplex*?

Oct. 18th. Took a stroll in old factory-yard. *Budytes* still abundant, apparently all young birds. Saw two or three *Œna capensis*, quite tame, and lots of two other species of *Turtur*. The day before somebody brought a very peculiar scincoid lizard, pale pink above, lighter beneath, with black spots; head much damaged. Rained heavily in night.

Oct. 19th. Got a few butterflies and other insects, the latter chiefly at night. Went out in the morning, but got no birds.

Oct. 20th. Spent most of the day in labelling and repacking birds' skins. Did not shoot in morning.

Oct. 21st. Went out in morning and shot a white *Ardea*, one of three or four, from the top of a big tree in village. Saw a small *Phylloscopus* in fig-tree; but very little done, though I worked along top and bottom of hill.

S. Oct. 22nd. Took things easily; poor breakfast. In evening took constitutional up to town. Bad night.

Oct. 23rd. Continued lying-up, so did not go out in morning. Christmas-day here; so in morning a great procession of horsemen Ibis, 1883,
coming from mosque, gorgeously arrayed, especially as regards umbrellas, p. 520.
with much furious galloping and explosion of petards. Greenshields arrived in evening from Rabba, very weak, having been very ill with fever, dysentery, worms, &c. Goodish night.

Oct. 24th. Lying-up. Greenshields quite invalided. Re-made cartridges. Dreadful night.

Oct. 25th. Still lying-up. Greenshields slightly better. At Rabba he got some birds for me (see end of book), but *Prionops* was the only new one. He also got a couple of an *Astacus*, which reached me badly preserved. Marma's attempts at shooting hitherto rather feeble, resulting in a couple of *Pluvianus*. Been here three weeks; on the whole a very bad time as regards "chop," sleep, and strength, and no spirit for specimens.

Oct. 26th. Had a better night, having taken a strong dose of chlorodyne. Felt sleepy all day in consequence, and did not get up till 10. Greenshields not so well again. Took a constitutional up to town in evening. Wretched night again, with impossible dreams.

Oct. 27th. No change. Greenshields considerably better. In evening went out for a short time, and shot a *Budytes raii* in old factory-yard (a young bird, moulting) and a *Phylloscopus* (apparently Willow-Wren) out of fig-tree; also an *Ixos* and the female *Hypochera* (spoilt). Took a strong dose of chlorodyne at night, and slept better.

Oct. 28th. Did not get up till 10. Skinned birds. Appetite seems better. In evening went out and shot a *Cypselus* (? *abyssinicus*), a Swallow (*Hirundo melanocrissus*), and one of the dark *Nectarinias*. Slept very badly.

S. Oct. 29th. Very poor appetite. Skinned birds shot the day before. In evening went out and got a female *Hyphantornis textor* and a fine *Schizorhis* (sp. inc.). Slept better.

Oct. 30th. Did not go out all day. Skinned birds. Very weak still, with poor appetite. Slept wretchedly.

Oct. 31st. Did not go out all day. Slept much better, having taken a strong dose of chlorodyne.

Ibis, 1883, p. 521.

Nov. 1st. Greenshields went out before breakfast, and shot a young *Ardea atricollis*, in the stage with the neck behind grey and in front white and buffy (upper mandible black, lower bony, and ringed at base and apex with yellow and along tomiæ with blackish; lores naked, yellow, as is space round eye; a leaden streak below eye leads to beak; iris bright yellow; legs black). In factory all day.

Nov. 2nd. Lots of *Milvus parasiticus* about factory in morning; also saw a *Merops nubicus* or two. Skinned a *Pluvianus* which Greenshields had shot the previous evening. About 4 we went down creek in canoe, but did not get much (only a *Corythornis* and another of the yellow-chinned *Trichophorus*), though we saw lots of birds, Wishie-wishies, and apparently another kind of Duck (no, it is *Œdicnemus*), an *Oriolus*, King-fishers, &c.; *Schizorhis* we saw several of; *Merops nubicus* was common, hawking in the air, flying slowly, with alternate flapping of wings and gliding, and uttering a low repeated note. Saw lots of *Parra*.

Nov. 3rd. Shot a *Neophron pileatus* in morning from factory for a skeleton. Appetite decidedly better. In afternoon went down creek again, but without very great results. Got a young *Parra* (for coloration, see Hartlaub), a *Merops erythropterus* in bad plumage, a *Ceryle rudis*, and an *Ixos*. Went ashore amongst some really big forest-trees, but no second-growth or creepers, and only long grass &c. below. Quite a swarm of *Merops nubicus* flying very high over trees.

Nov. 4th. Saw five of the brown Ibis in morning in front of factory. They have a loud mewing Hornbill-like cry, and fly like Cranes with extended downwardly directed head and neck. Appetite much better, and made a heavy breakfast, which kept me asleep most of the day. Skinned the *Ixos*. Did not go out in the evening, Greenshields being busy with his accounts.

Nov. 5th. The weather the last few mornings has been remarkably cool and fresh. Going on well. Went down creek in afternoon in canoe alone, rather earlier than usual, and got a long way down. Shot an adult Jaçanà, an *Ispidina cyanotis*, one of the smaller Flycatchers so common along creek, a couple of *Merops* (very common all along lower part), as well as a couple of the orange-winged Bats. All the wing-membranes are cadmium-yellow; the muzzle, nose-leaf, and ears light orange-yellow (diaphanous); fur yellowish grey. Saw also *Ceryle maxima*, the Greenshank of Egga, the small grey Heron, and apparently also *Ardea purpurea*, or perhaps young *A. goliath*. A good-sized *Monitor* tumbled off a tree into the boat, but got away. Ibis, 1883, p. 522.

Nov. 6th. Appetite still good. Went out in evening down creek. Shot a *Peristera afra* and *Halcyon cinereifrons* or *dryas* (upper mandible scarlet, blackish at apex; lower black, shaded with red; feet red; iris brown), a *Merops*, *Schizorhis*, *Hyphantornis personatus* (in change), and a Swallow of the species so common at Lukoja. Saw *Ceryle maxima* again, and the *Monitor* in the same place; also saw plenty of *Merops nubicus* and *M. castus*.

Nov. 7th. Spent day as usual. In evening went down other branch of creek. Got three birds—*Halcyon senegalensis*, *Corythornis cæruleocephala*, and *Œdicnemus*, the latter being what we had taken for young of *Hoplopterus*. Saw also a Heron (size of *Ardea cinerea*) with yellow legs and beak, in brown striated plumage; nearly sure it is *Ardea purpurea*, jr. In creek saw several *Ceryle gigantea*, but could not shoot one; also lots of *Plotus*. Young *Merops nubicus* was in thousands, in great swarms high in air, flying over the fields, and in forties and fifties on the trees; mixed with it a good number of *M. castus*. Got a shot at a pair of Ibis, but missed. Also saw an Eagle, apparently a young *Spizaetus occipitalis*. Plenty of *Merops erythropterus*, *Euplectes ignicolor*, &c.

Nov. 8th. Skinned birds in morning, and filed down brass cartridges to fit shot-gun. No canoe to be had in evening; so did not go out at all. Not so well, with no appetite and some fever (? in consequence). Took a strong dose of quinine, and slept better. Comet still visible in east by a little south, higher than it was at Rabba. Canoe arrived at last from Egga, with stores and gin.

Nov. 9th. All right again. Packed up and soldered spirit-specimens. Did not go out in canoe in evening, as all the people are engaged getting sticks &c. for wall of new factory. Took a walk along hills and back along top, but saw nothing. Slept very badly. Ibis, 1883, p. 523.

Nov. 10th. Packed away bird-skins. Greenshields shot a Crow, which I pickled. In evening went down creek again in canoe. Lots of the two Bee-eaters close to "beach," over grass-fields. Saw very few birds in creek, but shot a Flycatcher (*Tchitrea* sp.?), one out of several flying about top of high trees in some bush where we landed, and a very fine Owl, apparently a new *Scotopelia*, in creek; also a Bat (*Epomophorus*) fluttering in water, apparently bathing.

Nov. 11th. Got a Siluroid from natives, about 2 feet long, and a small *Protopterus* ("Addo"). Skinned the Owl, which took best part of the day. In afternoon went up left arm of creek in canoe. Got a large *Epomophorus* (? *monstrosus*), of which there were considerable flocks, disturbed out of bordering trees, mixed with the orange-winged species. Of birds, got a *Laniarius barbarus*, *Ceryle rudis*, and a small masked *Ploceus*. This species swarms all round the creeks in reeds and long grass; but all the flocks consist of females or males in olive plumage, with a few males not quite in full colour (are these moulting from, or changing to, full dress?), *vide* a skin procured. Saw an *Ardetta* (*minuta*?) in full dress.

Nov. 12th. Three Ibises passed in morning. They fly like Cranes, with *outstretched* necks, and are very noisy on wing. Note, two long followed by three short, uttered in a bleating sort of way. *Balearica* says "*quack*, *quack*," in a very resonant trumpeting way. In evening went up left arm of creek again. Shot a young *Saxicola* (? *rubetra*) at landing-place, and in creek a *Merops nubicus*, *Halcyon senegalensis*, a *Plotus*, and a *Phalacrocorax africanus*, of which I saw four or five in the trees. Swarms of *Merops* again; besides, saw a very fine red-white-and-blue *Halcyon*, and a large white bird (I think a Pelican), *Haliaetus vocifer*, *Gypohierax*, *Ibis hagedash*, &c.

Nov. 13th. Dissected the stomach of the *Plotus*. Just as in the first,
Ibis, 1883, p. 524. no V-shaped "ridge," except that the proventricular patches, particularly one, are rather elevated marginally. Fish (all small and transfixed) in stomach, with nematodes, and many tæniæ. Remade all cartridges. Greenshields shot a *Halcyon senegalensis* close to new factory. Saw an adult *Ardea atricollis* in rice-fields opposite. Did not go out in evening.

Nov. 14th. Went out about 6.30 on hills behind factory towards town, but only got another Whinchat and two *Merops nubicus*, which was in numbers on two or three trees. Saw a fine pair of a red-headed grey-backed *Falco* (? *ruficollis*) and a flock of apparently *Foudia erythrops*, but only one was in colour, and that flew. Got two fine *Malapterurus* and a Percine form from natives. In evening went down creek, but only got a *Halcyon* (*dryas*?) and a *Lacerta*; the latter caught in canoe. "Flogging palaver" in evening. Saw a single *Palæornis* in creek.

Nov. 15th. Started about 6.30 A.M. in canoe, and went up left arm of creek. Unlucky; only got a Jaçanà and a small Warbler, apparently *Acrocephalus arundinaceus*. Saw a *Plectropterus*, *Emblema rufopicta*, *Limnocorax*, several *Ardea purpurea*, *Laniarius*, an Oriole, *Ceryle gigantea*, seven young *Nycticorax* (? *europæus*), and four *Irrisor* (apparently *Irrisor pusillus*), &c., &c., three together, but all unfortunately out of shot. They fly with tail stretched out straight behind. Saw two *Balearica*, each *perched* on *top* of a tree answering each other. Greenshields got my gun "fixed" again safely. Got six half-grown examples of the

Percine form. In afternoon caught a few butterflies &c. and a very fine bug—in life straw-colour, with Veronese-green spots and red sinuous line on prothorax.

Nov. 16th. Went out in morning along footpath at base of hills to near bush on creek. Got four or five new birds, including a Parrot, apparently *Pœocephalus rufiventris*, and saw more; also one or two *Acrocephalus turdoides* (in bushy part), a *Drymœca* (? new), and *Estrelda cinerea*. Also saw *Euplectes oryx* in flocks with last, *Euplectes franciscanus*, *Urobrachya macroura*, *Hyphantornis personatus*, *Spermestes cucullata*, &c.; all *Euplectes oryx* out of full colour, apparently moulting, whereas many *E. franciscanus* in full plumage. Shot a ragged female, same as male, some still in yellow-and-black dress. Also got a *Crithagra chrysopyga*. Got a good-sized *Clarias* and another Siluroid, also a large-scaled barbel-like fish, from natives. Ibis, 1883, p. 525.

Nov. 17th. Finished-off Parrot in morning; put fresh spirit in tins &c. In evening went down to bush and palm-groves, where I saw many birds—*Colius*, Hornbills, Kingfishers, Ibis, &c.; but all out of shot, and only got a ragged (moulting) Weaver-bird of a species new and unknown to me, with black crown and broad rufous eyebrows (ptil. hyem.). The note of the *Ixos* usually is a mellow whistle of two notes, the second stronger and more pronounced. Tree on beach with Palm-birds' nests now quite deserted, and Greenshields says young flown. This, taken with other facts (*Hyphantornis personatus*), looks as if Weaver-birds bred during *wet* season (*cf.* Abutschi), moult into non-breeding dress, and take to fields in flocks. Greenshields got me a nice living *Cyclanosteus* from the natives.

Nov. 18th. Down to palm-groves early. Got some good birds, three new, *Cossypha albicapilla*, *Andropadus* sp.?, and *Anthus pratensis*, another species, the doubtful Weaver, the fine *Nectarinia*, and *Criniger gularis*, and saw many others—*Pœocephalus*, *Palæornis* and *Agapornis* (both in some numbers), *Colius*, *Irrisor*, a pair of a *Musophaga*, the striolated *Halcyon* (? one at Abutschi), the rufous-fronted *Timelia*, &c. &c. The *Ibis* is, I believe, *falcinellus* after all. I saw a Coly clinging to tree-trunk (a vertical palm-stem) just like a Woodpecker, one of which, also of a species not seen before, was just above it. Both *Irrisor* and *Colius* are very wary, keeping just in front of you out of shot, and flying from one palm-crown to another. I rather thought I recognized a fourth Parrot, a *Pœocephalus* of the *meyeri* lot, but too far away to be certain of. Greenshields got me a nice Murænoid fish (about 30 inches), with very small eyes. Skinned birds all day. Greenshields went down to palms in evening, but only got an *Ixos*.

Nov. 19th. Down to palm-groves in morning. Got two new birds (*Pyrenestes ostrinus* ♂ and two *Æjialitis tricollaris*) in rice-fields, where there was also another Wader with white tail; also shot a *Drymœca* and Ibis, 1883, p. 526.

Agapornis, of which there were a good many. Saw a small orange-fronted black-faced Weaver (? *Hyphantornis brachypterus*) of an unobtained species, *Pœocephalus*, a large black Hawk (*Spizaetus*), *Hypergerus*, *Cossypha*, &c. &c.; no *Colius* nor *Irrisor*, and only one *Toccus*. Greenshields got another scorpion. In evening down to palm-groves again; got two new species—*Toccus pœcilorhynchus* and *Hyphantornis brachypterus*.

Nov. 20th. Down to palm-groves early. Did well, shooting two *Irrisor senegalensis*, a large Bulbul of a new species, another *Pœocephalus*, and a *Halcyon senegalensis*. The black-and-white Hornbill is apparently *Toccus semifasciatus*. Greenshields went out and got two or three small birds and a Wader of a new species, apparently a young Redshank. Later on he got a *Halcyon rufiventris* on beach and a small snake. Got four fish from natives, two specimens of a large marbled grey-and-black siluroid, and two of a Percine form with dark-banded tail. Felt rather seedy all day, having had a bad night.

Nov. 21st. Much better. Got a small grass-snake from native, of a bright dark green above, paler below, a few of the scales entirely light blue, many with a small spot towards base of same colour. Also got a large-scaled abdominal carp-like fish, with yellow eyes. Comet still visible and much higher, apparently as long as height of Orion when vertical; bearing E.S.E. Took things easily rest of day, skinning Parrot and reloading cartridges.

Nov. 22nd. A regular "thoke." Got no specimens of any kind, except two of the Murænoid fish. Went down creek in afternoon, but got nothing. Had a shot at a snake swimming across creek, and another at a Falcon in tree close to Katambos (the outside houses with two entrances are called "kattas").

Nov. 23rd. Down to palm-groves again. Got a Hornbill of a new species (apparently a *Toccus*, sp. nov.), two *Andropadus*, the *Passer*, and
Ibis, 1883, p. 527. the same green *Nectarinia* as occurred at Lukoja. Saw *Cossypha*, the grey-and-red *Tchitrea*, &c., but no *Colius* or *Irrisor*. The Ibis has red feet and reddish beak, and is apparently after all *Ibis hagedash*. Got a calabash full of small fish of five or six species, a *Phoxinus* and perhaps one or two others new. Got two large specimens of the Murænoid fish from the fishermen; it makes a noise when held in hand.

Nov. 24th. Almost a blank day, and did not go out at all. Only got a few beetles &c. from box. Bought a pair of female jujus from Florin and a mat from Bidda. Packed a tin and got it soldered, which took five men about two hours, and then it leaked.

Nov. 25th. Down to palm-groves in morning. Got nothing new, and saw comparatively little except a fine pair of *Spizaetus occipitalis*. Shot a Parrot, *Nectarinia*, *Hyphantornis textor* (? ♂ out of colour), &c. Found four *Polypterus* for me on return, and later on got three smaller ones from same women. Heads all broken, being supposed to be very savage by natives (name *Nupi*). Went out again in evening in canoe, but got no birds. Saw two or three *Ceryle gigantea*, lots of *Merops nubicus*, &c. &c. Got some more fish from boys in evening, all small, and another specimen of Siluroid, very silvery beneath, olivaceous above. A Labyrinthicine (?) form has a series of small metallic bright blue spots along back, 2–5 in vertical series, and a similar (1–2) series on dorsal fin; a blackish spot on operculum and another on sides of body posteriorly; skin at base of scales reddish; general colour olivaceous green, paler and redder below.

Nov. 26th. Again down to palm-groves, but only shot a young *Centropus*. Missed a Hornbill, and only wounded one or two other birds, which escaped. Saw a covey of Guinea-fowls perched in high tree; the one struck got away wounded. Got another *Polypterus*, and a second specimen of one of the Percine forms. In afternoon went out for a ride with Greenshields to Shonga town (the wharf town is called Shonga Patteh) and beyond. Got a nasty tumble, hurting badly left shoulder, hip, and side. Very busy market-place, surrounded by king's house, Ibis, 1883, p. 528.
mosque (destroyed), &c. In garden of former are some fine date-palms (introduced), and in one of the yards I saw a Cactoid (*Euphorbia*), which is rare in this part, so far as I have seen.

Nov. 27th. Did not go out in morning. Got a *Polypterus* (the ninth) and another fish from people, and in evening one of the large Siluroids and a basinful (about 20) of an eight-barbed species of small size. Went down creek in evening, but got nothing. Saw *Ceryle gigantea*, a pair of *Schizorhis*, and a single *Podica*, which got away wounded; it climbed up bank out of water, and rather nimbly up a small tree to ten or twelve feet from ground; very Duck-like altogether in habit.

Nov. 28th. Went down creek again in morning to look after *Podica*, but in vain. Only shot a *Platystira* with scarlet eye-wattles and a *Totanus* of same species as one skinned at Egga (iris brown; beak greyish; legs pale dead-flesh colour). A small scarlet *Homopteron* is common on reeds in reed-beds, and a brilliant object when flying in the sun. Refilled cartridges, labelled birds, &c. rest of day.

Nov. 29th. Down to palm-groves in morning. Did well, getting three specimens of Woodpeckers (all new to me), *Hirundo senegalensis*, one of the obscure *Ploceus* in good (out of colour) plumage, and an *Ægialitis*, apparently *hiaticula* (eyelids narrowly yellow; iris olive-brown; beak black; legs pale orange), on beach, and a mature moulting specimen of the black-and-white *Toccus*. Saw three or four *Crithagra*, the fine *Nectarinia*, &c. Saw a family of a fine large *Cynocephalus*, apparently *C. anubis*, on border of bush and in banana-clearing—large, with long tail, mane rather deep colour, and large callosities; face blackish. Got a small harmless snake in afternoon from a native; and in afternoon

went down creek, getting five birds—a *Turdus*, *Dicrurus*, *Butorides*, *Œdicnemus*, and a *Caprimulgus*, the first two in bush, the last in reed-marsh. Got two shots at the big Kingfisher, and of course missed; also saw, but did not get, a *Cossypha* in bush. *Dicrurus* was in a swarm of
Ibis, 1883, p. 529.
ten to fifteen, and is awfully active, incessantly in motion. Got my tenth *Polypterus* (undamaged) from fishermen in marshes. About 10 P.M., as Greenshields and I were sitting in piazza, with lamp, a snake's head appeared above low parapet-wall separating piazza from factory, and disappeared again directly. I saw it, and going out killed (in three shots from 16-bore)—a good deal damaging it—a fine puff-adder, 44 inches long. On dissection it turned out a female full of eggs, but with empty stomach. Shonga cannot be considered exhausted as regards birds, as to-day I have got eight new species, six of which I had not even seen before. Have been here eight weeks, and have got or seen about 105 birds.

Nov. 30th. Not out in morning, but put spirit-specimens in order. Got some fish from Suma (=Sheedi), a black *Osteoglossum* (?), a Percine form, and a silvery Clupeoid with ventral and anal fins slightly tinged, with lower lobe of caudal entirely bright red (? same as got at Lukoja). In evening went down creek, but only got a *Melierax* (has not this bird lumbar powder-downs ?), beautifully shot. Had a shot at *Macrodipteryx*; of course saw, but did not get, the big *Ceryle*.

Dec. 1st. Down to palm-groves, but unlucky; only got one new species, *Estrelda subflava*, a *Euplectes franciscanus* in moult, and another of the doubtful *Ploceus*. Saw little else, except a flock of five *Colius* (one of which I might, if not short-sighted, have got), *Crithagra*, *Agapornis*, &c. Got five fishes from natives—two Siluroids (new species: of the silvery form which has lower lobe of tail reddish, and one very heavily armoured), a *Polypterus*, and two banded-tailed Percoids. The natives have an idea that the eggs of the puff-adder (Edou-Tappa-Nupi-Arka-Yagi=Yoruba) produce *Polypterus*. Got a lot of eggs of a very large Teleostean (? Siluroid), full of yolk (size and colour of a large white-heart cherry), with small very vascular area, pellucid above, in which lie well-developed and active 1½-inch embryos, with perfect black conspicuous eyes and limbs, extracted from uterus: natives say eggs grow
Ibis, 1883, p. 530.
to twice the size before hatching: adult has smooth thick skin, of dull silvery colour; across middle of body (in transverse section) 10 inches. In afternoon got a small black snake in stable, coiled up beneath lumber. Took some photographs of beach and natives in afternoon, and afterwards went down creek, shooting a couple of *Elminia longicauda* in bush. Got a few small fish from native boys, including a nice little *Polypterus* and the young (of several sizes) of a curious suctorial-mouthed form. This grows to about 18 inches. Felt feverish in evening, and had a wretched night, not getting any sleep after 12.

Dec. 2nd. Felt seedy, and did not go out in consequence all day. Got a good *Polypterus*, and in evening a large specimen of the silvery Siluroid (with very long upper tentacle) and an adult of the banded-finned Percoid. Shuma brought in for inspection a mutilated and much-contracted skin of a *Viverra*, apparently *V. civetta*, thickly spotted with black, with black head and white patch on each side; fur rather long.

S. Dec. 3rd. Got two more *Polypterus* from natives, still alive when brought; neither very big. Greenshields shot a nice *Laniarius barbarus* in tree behind yard. Went down creek in evening, but did not fire a shot.

Dec. 4th. Got a *Macronyx croceus* (structure of tarsus typically Oscinine and Alaudine) and a *Halcyon rufiventris* (?) in palm-groves; but saw little else particular, except a flock of six or seven *Colius*, which I "chivied" hard, but could not get within range of. A large specimen (28 inches long) of the large-scaled Ceratodoid *Osteoglossum* was brought in, but too big for pickling with the poor spirit at my disposal.

Dec. 5th. Went down to palm-groves in morning, with gun and net. Got a *Pogonias* and *Estrelda cinerea*, and saw a solitary *Colius*, but could not get up to it. Caught a few butterflies &c., and had a little sweeping amongst rushes and ferns &c. in damp parts, producing a very curious *Mantis*, wonderfully plant-like, and two or three species of stalk-eyed flies. Got two new specimens of fish from natives, a very curious horse-headed form, and two large specimens of a large-scaled Cyprinoid. In evening shot a male *Macrodipteryx* in factory-yard, the long feathers apparently broken or shot short. Alarm of a hyæna in night (before). Ibis, 1883, p. 531.

Dec. 6th. Only got an *Estrelda melpoda* in morning's shooting, and saw nothing interesting except a *Hypergerus* and the *Ibis* which has very conspicuous light metallic-green shoulders and white stripe on sides of head. In evening went down other branch of creek. Saw few birds, except *Ceryle gigantea* (as usual) and a lot of *Treron* and *Corythaix* in big tree near fork. Got five Bats (three *Epomophorus* and two of the insectivorous form), and coming back got a female *Macrodipteryx* in reed-beds. Got one big and a lot (about fifteen) of smaller *Polypteri*.

Dec. 7th. Went out for two hours' entomologizing in morning, and got four specimens of *Lycæna*, two *Hesperias*, *Danais*, *Acræa*, &c. &c. in or on road to palm-groves. Got a very blubbery fat *Malapterurus*-like fish (greenish grey spotted with black above, whitish beneath), a Scaroid (silvery dark-striped, like a young mullet, with red fins), a Clupeoid with red fins (? = that got at Lukoja), two specimens of Chætodontoids (silvery, one with entirely red fins and unmarked; the other with eleven long lines, the more dorsal zigzagy, fins edged with red and larger scales), and a large dull grey barbel-like fish. In evening down to palm-groves. Got a *Turdus pelios* and a second larger specimen of *Centropus*, of which I had also got (but not recognized as distinct) a young bird.

Dec. 8th. Got one big and two small *Polypteri*, two of the black *Osteoglossum*, and two of a new fish with no ventrals, small pointed dorsal, and very long anal fins. People brought in with other hides a skin of *Hippotragus equinus* from Potashi, a town about half-a-day's steaming from Bussah. Got a large, small-scaled, carp-like fish, of a new species, in evening from Bishop. Went down creek in afternoon, as far as bush at fork. Got a *Xerus* and three birds—female of *Platystira melanoptera*, *Hypergerus* (several seen; its note a harsh one, repeated several times), and a new *Drymœca*-like form. Saw and wounded a large grey monkey, apparently *Cercocebus albigena* or *C. fuliginosus*, also a *Nycticorax*; but both escaped.

Ibis, 1883, p. 532.

Dec. 9th. Got three *Polypteri* and two other fishes, the silvery Clupeoid and the Scaroid, which superficially exactly resemble one another, differing in teeth, form of head, anal fin, and coloration of ventrals. In evening went down creek, but got little, only an *Epomophorus* and an *Estrelda rubropicta*, both damaged.

Dec. 10th. Down to palm-groves &c. and got five birds, two being new, a small *Barbatula* (iris brown, with bright orange-yellow frontal spot, light yellow-sulphury uropygium, and citron-yellow edgings to lesser wing-coverts; greater coverts and most proximal remiges bordered with white; crown, nape, and neck flammulated with white) and a small *Drymœca*. All flocks of *Euplectes* and of *Ploceus*, sp. inc., are now in full winter plumage. Lots of *Pratincola* about. In evening went down creek; got a female *Ploceus brachypterus* and male *Macrodipteryx*. Saw also the male of the *Tchitrea* I had previously got female of; it is white, with glossy crested head and two long rectrices. Saw also some females of it, *Laniarius*, &c.

Dec. 11th. Down to usual shooting-grounds in morning. Got two females and one male of *Ploceus brachypterus* and a small *Drymœca*. Saw a single *Scopus* (flight light, easy sailing, with no heavy flapping as in Herons), and wounded or killed, but could not find, what was apparently an *Indicator*. In evening, down creek, got the male *Tchitrea*; also a *Scotornis climacurus* on way back. Rather feverish again.

Dec. 12th. Did not go out in morning, but took a "thoke." Filled a tin full of specimens. In evening down creek. Saw a *Scopus*, and shot one of the large species of *Centropus*. Stores from Egga arrived. Got a few fishes, including two specimens of a new barbel-like fish with a red spot on tips of scales.

Dec. 13th. Got about eighteen fishes in morning, of six or seven species, including one new one, a barbel-like form with very large scales. Did not shoot in morning. Got a young *Ibis æthiopicus* in evening in rice-fields opposite factory, one of a number; these birds have appeared quite commonly during the last few days. Saw several *Scopus* in company with these Ibises and Cow-birds; and there were also a fine

Ibis, 1883, p. 533.

pair of *Xenorhynchus* stalking about in same fields, now with water let off and rice about a foot high. Down creek in evening, and got a new *Phylloscopus* in high bush. Saw a pair of *Ciconia episcopus* flying over creek.

Dec. 14th. Down to palms in morning; got a *Campephaga* (♀), one of the small *Centropus*, and three others. Saw a number of what was nearly certainly, from size, colour, and note (which is particularly whirring), *Ploceus textor*, frequenting the small palms there. Greenshields tells me they do not return to beach till about March, *i. e.* beginning of rains. All those I saw to-day were in female plumage, and for a long time I have seen no full-plumaged males. Comet still visible from about 10 till early morning, much more dim than formerly; movement from E. to W. Got a number of small fishes in afternoon, chiefly a perch-like form; amongst them a curious, spotted, small Siluroid, with the two inferior pairs of tentacles *branched*.

Dec. 15th. Went into rice-fields in morning, but was nearly murdered by mosquitoes and had to come back soon. Shot in rice-fields a large *Centropus*, an *Acrocephalus turdoides*, and a *Limnocorax flavirostris*. Greenshields afterwards shot an *Ibis*; and we saw *Scopus* and a *Ciconia episcopus*, each singly, in same flock. In evening down creek and got a *Nycticorax europœus* in adult dress, but with no long crest-feathers. Saw, going down creek, an antelope (apparently a male *Tragelaphus*), a Gull (? *Rissa*), and a white-winged pale rufous Heron (? *Ardea comata*).

Dec. 16th. Rather seedy, with a headache. Went down to palms, and got at last a big *Ceryle*; also a *Macronyx* and a small *Drymœca*. Did not go out in evening.

Dec. 17th. Started about 9 with Greenshields in canoe for an expedition down creek into big river (Edou-Tappa-Quorra-Gambari-Oiya-Yagi), getting back about 7.30. In lower part of creek came across *Merops bullocki* in some numbers, settling in high trees on bank and flying off in regular Bee-eater style; also shot a *Ceryle gigantea* (? female or young, very different from others) and one of the *Lobivanellus* which is Ibis, 1883,
common here and turns out to be *albiceps*. Went up river towards Rabba p. 534.
for some way, and saw plenty of birds on banks—about twenty *Balearica* on one bank, with some Ibises (*I. æthiopica*), a pair of *Chenalopex*, and three Spoonbills, one of which I shot, Greenshields getting one of the Geese. Also saw an Osprey, one or two *Haliaetus*, and plenty of *Gypohierax*. Saw a couple of monkeys (? *Cercopithecus cynosurus* or *C. griseoviridis*) in bush, and might have had a fine shot at them, but rifle not loaded. Also saw and shot at a single Hippopotamus. Feverish all day.

Dec. 18th. Slept till 10, and felt much better. "Gunniga" brought in two bush-fowl, chickens, just hatched. They are apparently a *Turnix* in first plumage. Got a second *Cyclanosteus*; it has yellow iris. The

Platalea (a male) has wind-pipe thoracically dilated, depressed, of peculiar structure, and convoluted subcutaneously, the loop coming halfway up neck nearly. Greenshields shot a *Balearica* opposite factory. In afternoon down creek. Got an immature Squacco Heron and a nice *Scopus*, perched on a low branch of tree overhanging water; it vomited up a number of small fishes when shot. Saw the *Rissa* (?) again in reed-beds. Wretched night.

Dec. 19th. Greenshields shot a second *Scopus* just outside in morning. Filled up a tin with spirit-specimens. Felt seedy all day. Went down creek in afternoon, and shot a *Cossypha verticalis* in bush, and saw others. They hop about ground and low bushes and trees, and are very shy; their note a harsh whistle. A sharp attack of fever came on in canoe; so got home early and lay up. No dinner. Got two more *Cyclanosteus* from a woman; smaller than others.

Dec. 20th. Much better this morning. Got another *Cyclanosteus* and five other fishes—two *Malapterurus* and three specimens of a small-scaled barbel. Went down creek in evening and saw two or three *Rissa* (?) near wharf, and shot a small *Phylloscopus* (greenish, with yellow soles), which got ruined in rain. About 5.30 a strong tornado-breeze, with lightning and heavy rain, came on; and we got a good wetting. It has been very cool and cloudy for last day or two. This is first rain for about two months, except one or two very slight showers. It rained again in night, sleepless for me.

Ibis, 1883, p. 535.

Dec. 21st. Got a large Siluroid, with big rounded adipose fin; I think new to me. Dull and cloudy all day, and in evening it came on to rain about 5, and rained afterwards again all night. Did not go out all day.

Dec. 22nd. Not out in morning. Got a few fishes, but nothing new. Cloudy and dull all day, but no rain; cleared up a little before sunset. Went about 5 down creek, and got a young black Tern (new) and a second *Cossypha verticalis* on a tree the other side of creek. Saw the white male *Tchitrea* again, with female *Laniarius* and *Dicrurus*, &c.

Dec. 23rd. Down to usual shooting-grounds, but saw and shot nothing new. *Ploceus brachypterus* is now abundant; these feeding on corn (and palms ?). Got another of the Drymœcine form, in which sexes differ in colour of soft parts, a *Macronyx* (perched in a biggish tree), one of the *Zosterops*-like form, and a *Hypergerus*. In evening down creek; got two males of the *Tchitrea* (one in perfect, one in immature dress) and a *Scopus*.

Dec. 24th. Down to usual shooting-grounds in morning, and then turned off to right over hills, where grass has been burnt, and so back to Shonga. Saw several (and shot one) *Hoplopterus spinosus*, *Toccus pœcilorhynchus*, a *Dicrurus*, *Macrodipteryx*, and two or three of a *Pterocles* in sandy places on hills, the *Zosterops*, &c. A pair of *Xenorhynchus* again in rice-fields opposite, stalking about in afternoon.

Dec. 25th. CHRISTMAS DAY. Out shooting in morning, but got little, though I saw several nice things—an Oriole, grey *Campephaga* (?), a single *Pterocles*, *Toccus pœcilorhynchus* (several), &c. &c. A small flock of *Schizorhis* in palm-groves; they have a loud call-note, rapidly repeated, "*cow-cow-cow*" &c., and when sitting sometimes raise tail till quite vertical over body. Bag: one *Turdus pelios* (shot hopping on ground amongst burnt bush) and one *Drymœca*. Got a *Diodon* (or *Tetrodon*) from a native woman—ground-colour olive-black; chin and belly nearly whitish, shading off above into yellow; several long stripes pale yellow Ibis, 1883,
dorsally, getting deeper ventrally, and below level of caudal fin getting p. 536.
chrome-yellow of flanks and vent, round latter of which the colour is brightest; dorsal fin yellowish; caudal fin olive-green for basal half, rest bright yellow; pupil yellow, with a red ring round it. This specimen was rather dry when brought; the colours are much brighter where skin has kept moist by being covered by the fins. In its stomach were remains of a small *Anodon* or *Unio*, which also forms food for the *Cyclanosteus*. The fish is well known to natives, and it is said to be common. They do not "chop" it, but make drums of its skins. Greenshields caught, almost uninjured, a small snake in factory-yard, and brought it in alive; apparently allied to *Tropidonotus*. In evening down creek; got a new Flycatcher and a second specimen of Tern with reddish beak, perched on high grass amongst reeds. Saw also a *Musophaga violacea* in big trees, but could not get a shot at it; a second specimen of the big *Scotopelia*, which I missed twice; and a third time got a missfire at several *Platystira*, a couple of female *Tchitrea*, *Scopus*, &c. &c.

Dec. 26th. BOXING DAY. Intended to have gone out photographing in morning; but the fall was out of order, and it took some time to set it right. Got a couple of small fishes in afternoon—one new, one of the red-spotted barbel. Went down creek in evening, but got nothing and saw little—two or three *Laniarius*, a *Malaconotus*, &c. The canoe-men saw and caught for me a chamæleon which was on a small tree overhanging river; it is apparently *Chamæleon senegalensis*. Saw also a snake swimming across creek; but it just escaped: apparently a *Tropidonotus* with a row of dark brown spots down back.

Dec. 27th. Seedy from diarrhœa in morning and did not go out, having slept badly. Went down second branch of creek in evening, but got nothing, not even firing my gun. Got two fishes, one new, a large Gadoid-like Acanthopteron, which Greenshields says is the species that grows to be the biggest fish in this river.

Dec. 28th. Still ill, having had another wretched night. Stayed in Ibis, 1883,
house all day. Greenshields shot a second *Lanius rutilans* for me from p. 537.
bush opposite factory.

Dec. 29th. Not much better, the diarrhœa (or dysentery) continuing. Women brought in a small land-tortoise, with movable carapace (*Cinixys*).

In factory all day. Greenshields shot me a small *Centropus* in field opposite.

Dec. 30th. Still ill. Greenshields got me a *Limnocorax*; and they brought in a pretty lineated Tropidonotine snake, scarcely at all damaged.

Dec. 31st. In factory all day; perhaps a little better. Greenshields in morning shot a young *Anastomus lamelligerus* on top of roof of house. He says they are not uncommon here. (N.B.—Notice the peculiar lamellæ at the apex of maxilla.)

1883.

Jan. 1st. Much the same, with no decided change. Got a new Scaroid fish and a very pretty small Colubrine snake.

Jan. 2nd. Still seedy.

Jan. 3rd. A small snake was caught in factory during the night.

Jan. 4th. Still seedy, getting better only slowly, with want of appetite and weakness. Greenshields shot a couple of Waders from two separate flocks in rice-field; they are both new to me. Canoe-men brought in a small *Monitor* (? *ocellatus*).

Jan. 5th and 6th. Still ill; feverish, with no sleep or appetite. Saturday afternoon got a big packet of letters from home; the last about November 8th. It is about 14 *weeks* since the last lot reached Egga.

Jan. 7th, 8th, 9th, and 10th. Still very ill; in great fever.

[*In another hand.*]

Jan. 11th. In high fever.

Jan. 12th and 13th. In very high fever, and delirious night and day.

S. Jan. 14th. W. A. F. died at 8.40 A.M.

INDEX.

A.

Abdimia, 12.
Abdimia sphenorhyncha, 6.
Abnormales, 148.
Aburria carunculata, 343.
Acanthisitta, 360–363.
Acanthisitta chloris, 360.
Acanthorhynchus, 73.
Accipitres, 6, 284.
Achras sapota, 257.
Acidalia immorata, 31.
—— immutata, 31.
—— ornata, 32.
—— perochraria, 31.
—— strigilaria, 31.
Acræa, 451, 453, 464, 473.
Acrobata, 188.
Acrobata pygmæa, 180.
Acrocephalus arundinaceus, 468.
—— turdoides, 469.
Acromyodi, 148, 208.
Acryllium vulturinum, 343.
Actias luna, 294.
—— yama-mai, 294.
Adamastor, 369, 370, 393, 414, 415, 420, 423, 431, 432.
Adamastor cinereus, 368, 413, 419, 426.
Ægialites hiaticula, 226, 471.
—— inornatus, 35, 42.
—— tricollaris, 469.
Ægotheles, 443.
Aeipetes, 380, 383, 384, 392, 397, 415, 431.
Aeipetes antarcticus, 365, 404, 407, 413, 419, 432.
Æthopyga, 136.
Agapornis, 99, 132, 133, 205, 459, 469, 470, 472.
Agrion, 294.
Agrotis c-nigrum, 31.
Ajaja rosea, 343.
Alca, 417, 418.
Alca alle, 386.
Alca torda, 7, 13.
Alcedinidæ, 207, 212, 346, 347.
Alcedo, 207, 351, 455.
Alcelaphus, 460, 461.
Alcelaphus tora, 458, 461.
Alces, 315.
Alcidæ, 191, 225, 335, 415, 442.
Alcyone, 441, 442.
Alectorides, 7, 164.
Alle nigricans, 368.
Amaurospiza unicolor, 259.
Amblyrhamphus holosericeus, 6.
Amphigyri, 164.
Amphioxus, 28.
Anaitis plagiata, 32.
Anastomus lamelligerus, 477.
Anatidæ, 341, 372.
Andrias scheuchzeri, 105.
Andropadus, 469, 470.
Angulirostres, 352.
Anodon, 477.
Anomalogonatæ, 202, 209, 346, 351, 352.
Anophthalmus, 451, 452.
Anous sp., 243.
Anser cinereus, 5.
Anseranas melanoleuca, 341.
Anseres, 6, 164, 354, 371.
Anseriformes, 212, 372.
Anthocharis belia, 167.
—— euphenoides, 166, 167.
Anthropoides virgo, 344.
Anthus, 460.
Anthus campestris, 464.
—— pratensis, 469.
Antilocapra americana, 127, 295.
Apatura ilia, 30, 168, 294.
—— iris, 294.
Aphantochroa cirrochloris, 269.
Aphides, 295.
Aphobus chopi, 263.
Aplonius tavuensis, 44.
—— vitiensis, 44.

Apteryx, 15, 18, 202, 232, 234, 237, 241.
Apteryx australis, 235.
—— haasti, 235.
—— mantelli, 6, 234, 235.
—— oweni, 6, 235.
Ara spixi, 245.
Aramides, 227.
Aramides cayennensis, 277.
Aramus, 191, 206.
Aramus scolopaceus, 206, 226, 344.
Arboricola torqueola, 6.
Archæopteryx, 440.
Archibuteo lagopus, 6.
Arctica alle, 222.
Ardea, 456, 463.
Ardea atricollis, 463, 466, 468.
—— candidissima, 246, 274.
—— cinerea, 463, 467.
—— cocoi, 6.
—— comata, 475.
—— flavirostris, 453, 462.
—— goliath, 453, 462, 467.
—— purpurea, 467.
Ardeidæ, 282, 387, 388, 434.
Ardetta, 463.
Ardetta minuta, 468.
Argus giganteus, 6.
Argynnis adippe, 30.
—— aglaia, 102.
—— amathusia, 102, 169.
—— dia, 30, 102.
—— eris, 169.
—— ino, 102.
—— lathonia, 30, 102, 169.
—— niobe, 30, 102, 169.
—— pales, 102.
—— paphia, 30.
—— thore, 169.
Artamus, 282.
Artamus leucopygialis, 36.
Arundinicola leucocephala, 218, 264.
Astacus, 465.
Astur, 164.
Ateles, 117, 119, 123.
Atelornis, 150, 159.
Atelornis crossleyi, 152.
Atrichia, 208, 209, 214, 282.
Atrichiidæ, 148.
Attacus atlas, 294.
Attagis, 13, 207, 224, 225, 443.
Attagis gayi, 226.
—— sp., 6.
Atticora cyanoleuca, 254.
—— fasciata, 453.
Atticora melbina, 461.
Aulacorhamphus prasinus, 323.

B.

Balæniceps, 333.
Balænoptera, 318.
Balearica, 344, 456, 458, 461, 462, 468, 476.
Barbatula, 474.
Baryphthengus, 349, 350.
Basileuterus auricapillus, 254.
Belideus, 181, 188.
Belideus breviceps, 180.
—— sciureus, 180, 183.
Berenicornis, 456.
Biziura lobata, 354–357.
Bombyx rubi, 31.
—— trifolii, 31.
Bos brachyceros, 460.
Botaurus stellaris, 193.
Botys cespitalis, 32.
—— lutealis, 32.
—— nubilalis, 32.
—— purpuralis, 32.
Brachypteracias, 150, 154, 159.
Brachyurus calvus, 117, 124, 126.
—— israelita, 123.
—— melanocephalus, 117, 124.
—— ouakary, 123.
—— rubicundus, 105–126.
Bradypus didactylus, 308.
Bucconidæ, 156, 200, 212, 284.
Buceros, 453, 454, 455.
Buceros atratus, 462.
—— buccinator, 457.
—— cylindricus, 455.
—— elatus, 456.
—— fistulator, 453.
Bucerotidæ, 199, 207, 212.
Bucorvus, 157.
Bucorvus abyssinicus, 193.
Budytes flava, 464.
—— raii, 464, 465.
Bulweria, 369, 372, 373, 375, 380, 384, 391, 392, 393, 395, 404, 415, 420, 430, 431, 448.
Bulweria columbina, 365, 387, 413, 426.
—— macgillivrayi, 365, 406, 408.
Buteo jackal, 6.
Butorides, 455, 462, 472.
Butorides cyanurus, 275.

C.

Cacatua, 205.
Cacatua sulphurea, 193.
Cacatuinæ, 131, 205.
Caccabis chukar, 6.
—— melanocephala, 6.
—— saxatilis, 6.
Cacomantis, 6, 155.
Cacomantis flabelliformis, 40.
Calathus nubigena, 34.
Calidris, 442.
Callianassa, 452.
Callimorpha hera, 31.
Callipepla gambeli, 6.
Calliste, 136.
Calliste cyaneiventris, 137.
—— fastuosa, 256.
—— festiva, 137, 256.
—— flava, 256.
—— melanonota, 137.
—— nigriviridis, 137.
—— thoracica, 137.
—— tricolor, 137.
Callithrix, 119, 123.
Callithrix amicta, 113, 115.
Calodromas, 442.
Calotes, 459.
Calyptomena, 214, 218.
Calyptomena aura, 274.
—— viridis, 138, 139.
Camelopardalis, 315.
Campephaga, 455, 461, 475, 477.
Cancroma, 210.
Cancroma cochlearia, 6.
Capitonidæ, 200, 201, 207, 212, 323–326.
Capitoninæ, 207, 208, 323.
Capreolus, 313, 315.
Caprimulgidæ, 204, 212, 353, 443.
Carabus catenulatus, 34.
Cariama, 325, 415.
Cariama cristata, 278.
Carica papaya, 257.
Carpophaga, 325.
Carpophaga assimilis, 41.
—— latrans, 204, 386.
Carterocephalus palæmon, 169.
Cassicus persicus, 262.
Casuaridæ, 241, 442.
Casuarius, 16, 443.
Casuarius beccarii, 6, 15, 238.
—— bennetti, 238.
—— galeatus, 236–238.
Casuarius picticollis, 6, 15.
—— uniappendiculatus, 6, 15, 238.
—— westermani, 238.
Cathartes atratus, 244, 274.
—— aura, 206.
Cathartidæ, 199, 211, 242, 388, 434, 435.
Catocala fraxini, 294.
—— paranympha, 31.
Cebus, 119, 123.
Cebus apella, 120, 121, 123.
—— capucinus, 113, 119, 120, 121.
Cecomorphæ, 371.
Centropus, 453, 454, 455, 462, 463, 464, 473, 474, 475, 477.
Centropus phasianus, 40, 194.
—— rufipennis, 153, 194.
Cephalopterus, 138, 149.
Ceratorhinus sumatrensis, 170–172.
Cercocebus albigena, 474.
—— fuliginosus, 474.
Cercopithecus cynosurus 475.
—— griseo-viridis, 475.
—— mona, 454, 462.
—— sabæus, 457.
Cereopsis, 354.
Certhia sanguinolenta, 71.
Certhiidæ, 361.
Certhiola chloropyga, 255.
Certhiparus, 359, 363.
Cervicapra bohor, 458.
Cervulus, 313.
Cervus, 315.
Ceryle, 463, 472.
Ceryle americana, 270.
—— gigantea, 467, 468, 471, 473.
—— maxima, 467.
—— rudis, 455, 466, 468.
Cetonia, 464.
Cetonia aurata, 1.
Ceyx, 441, 442.
Chætura, 133.
Chalcopsitta, 70.
Chalcopsitta rubiginosa, 22.
Chalcosia, 452.
Chamæa, 359.
Chamæidæ, 3.
Chamæleon senegalensis, 477.
Chamæpelia griseola, 276.
—— talpacoti, 276.
Charadriidæ, 221, 223, 226, 229, 442.
Charadriiformes, 212, 224.
Charadriomorphæ, 221.
Charadrius, 442.
Chauna, 12, 164, 197, 201, 205.

Chauna derbiana, 6, 8, 197, 205.
Chenalopex, 456, 461, 475.
Chionididæ, 221.
Chionis alba, 226.
Chionobas, 104.
Chionobas aëllo, 103.
Chiropotes, 123.
Chiroxiphia pareola, 266.
Chloronerpes affinis, 270.
Chlorophonia, 136.
Chlorophonia viridis, 136.
Cholœpus, 308.
Cholornis, 441, 442.
Cholornis paradoxa, 442.
Chordata, 281.
Chrysobronchus virescens, 270.
Chrysococcyx, 6, 155, 457, 461, 463.
Chrysolampis moschitus, 270.
Chrysomela alpina, 34.
—— cerealis, 2.
—— marginata, 2.
—— menthrasti, 2.
Chrysomitris yarrelli, 261.
Chrysothrix, 123.
Chrysotis, 98.
Chrysotis æstiva, 247, 278.
Chunga, 415.
Ciconia alba, 6.
—— boysiana, 6.
—— episcopus, 458, 475.
—— nigra, 412.
Ciconiidæ, 343, 434, 435.
Ciconiiformes, 212, 373, 435.
Cidaria bilineata, 32.
—— cæsiata, 32.
—— ferrugata, 32.
—— flavicinctata, 32.
—— variata, 32.
—— verberata, 32.
Cidaris, 204.
Cidaris goliath, 204.
Cinixys, 452, 477.
Cinnyris eques, 71.
—— rubrater, 71.
Cissomela, 72.
Cissopis leveriana, 6, 137.
Citta thalassina, 6.
Cittura, 346.
Clarias, 469.
Climacteris, 359.
Clitonyx, 358, 363.
Coccygomorphæ, 6, 164, 283, 284.
Cœnonympha arcania, 169.
—— pamphilus, 31.
Cœnonympha satyrion, 103, 169.
Cœreba, 136.
Çœreba cyanea, 255.
Colias edusa, 29, 167.
—— hyale, 29.
Coliidæ, 207, 212, 353.
Coliopasser, 463.
Colius, 469, 470, 472.
Colius castanonotus, 6.
Colluricincla rufigaster, 37.
Columba livia, 5, 12.
—— picazuro, 276.
—— rufina, 246, 276.
—— speciosa, 246.
Columbæ, 6, 164, 204, 221.
Columbidæ, 191, 211, 221.
Colymbidæ, 335, 372, 396.
Colymbus torquatus, 442.
Conopophaga, 217, 218, 219, 241.
Conopophaga aurita, 217, 267.
—— lineata, 217, 219, 267.
—— melanops, 217.
Conopophagidæ, 217, 219.
Conopophaginæ, 217.
Conurus cactorum, 272.
—— jendaya, 272.
Cookilaria, 369.
Coracias garrula, 151, 153.
—— indica, 151.
Coraciidæ, 154, 157, 159, 202, 204, 212, 284.
Coracopsis, 96, 97, 99.
Coracopsis mascarina, 98.
—— nigra, 98.
Corvus curvirostris, 454, 461.
—— monedula, 5.
Corydon, 214.
Corydon sumatranus, 138, 143.
Corythaix, 473.
Corythaix erythrolopha, 194, 195.
—— persa, 194.
—— porphyreolopha, 194.
Corythopsis, 217.
Corythornis, 458, 466.
Corythornis cæruleocephala, 467.
Cosmeteira, 71, 73.
Cossus ligniperda, 31.
Cossypha, 465, 470, 472.
Cossypha albicapilla, 469.
—— verticalis, 476.
Cotingidæ, 144, 147, 148, 208, 209, 362.
Coturniculus manimbe, 261.
Coturnix communis, 5.

Cracidæ, 342.
Cracticus, 359.
Crambus culmellus, 32.
—— geniculeus, 32.
—— perlellus, 32.
—— tristellus, 32.
Craspedophora magnifica, 38.
Crax alberti, 342.
—— alector, 342.
—— carunculata, 342.
—— daubentoni, 342.
—— globicera, 342.
—— incommoda, 342.
—— sclateri, 6, 342.
Creadion, 359.
Crex, 221.
Criniger gularis, 468, 469.
Crithagra, 471, 472.
Crithagra chrysopyga, 455, 469.
Crocodilus acutus, 455.
Crotalus horridus, 276.
Crotophaga ani, 271.
—— sulcirostris, 200.
Crypturi, 202.
Crypturus, 333.
Crypturus noctivagus, 279.
—— talampa, 6, 278.
Cuculidæ, 11, 154, 156, 157, 159, 208, 211, 212, 415.
Cuculinæ, 207.
Cuculus canorus, 6, 153, 154.
—— cineraceus, 40.
Cursorius, 207, 221, 442.
Cursorius gallicus, 226.
Cuscus, 181, 188.
Cuscus maculatus, 180.
Cyanalcyon macleayi, 36.
Cyanopica cooki, 243.
Cyanorhamphus, 63, 66.
Cyanorhamphus auriceps, 66.
—— novæ-zealandiæ, 66.
Cyclanosteus, 438, 475, 476, 477.
Cyclocœla, 164.
Cyclopsitta, 132, 133.
Cyclorhis albiventris, 254.
Cycloturus, 301, 309.
Cygnidæ, 343.
Cygnus americanus, 344.
—— atratus, 344.
—— bewicki, 344.
—— buccinator, 344.
—— coscoroba, 344.
—— ferus, 343, 344.
—— immutabilis, 344.
Cygnus nigricollis, 344.
—— olor, 6, 12, 16, 344.
Cymbirhynchus, 139, 140, 141, 218, 362.
Cymbirhynchus macrorhynchus, 138–142.
Cymochorea, 366, 369, 374, 378–381, 390, 393, 399, 405, 415, 416, 423, 424, 428, 430, 431.
Cymochorea leucorrhoa, 230, 365, 387, 401, 413, 419, 426.
—— monorhis, 387.
Cynocephalus, 119.
Cynocephalus anubis, 471.
—— sphinx, 457.
Cypseliformes, 211, 212, 353.
Cypseloides, 194.
Cypselomorphæ, 164.
Cypselus, 194.
Cypselus abyssinicus, 463.
—— apus, 448.

D.

Dacelo, 199.
Dacelo cervina, 194.
—— gigantea, 6, 11, 194.
Dacnis cayana, 255.
—— plumbea, 255.
Danais, 473.
Daplidice, 29.
Daption, 368, 369, 371, 378, 382, 383, 384, 392, 401, 415, 431.
Daption capensis, 379, 387, 413, 419, 426.
Darter, 216.
Dasypodidæ, 305.
Dasyptilus, 205.
Dasypus, 303.
Dasyuridæ, 186.
Dendrocolaptes, 219.
Dendrocolaptidæ, 146, 335.
Dendrocygna, 461.
Depressaria heydeni, 32.
Desmodactyli, 148.
Desmognathæ, 350, 371.
Diasemia litterata, 32.
Dicæum hirundinaceum, 39.
Dicrurus, 472, 476.
Didunculus, 335.
Dilophus, 144.
Diodon, 477.
Diomedea, 231, 367, 368, 370.
Diomedea brachyura, 360, 365, 376, 377, 378, 380, 387, 389, 410, 412, 413, 415, 419, 426.

Diomedea chlororhynchus, 371, 379.
—— derogata, 412.
—— exulans, 360, 365, 370, 372, 375–378, 380, 383, 387, 410, 411, 413, 414, 419, 420, 426.
—— fuliginosa, 369.
—— nigripes, 412.
Diomedeinæ, 284, 392, 393, 395, 423, 424, 429, 442.
Diplopterus nævius, 272.
Donacobius atricapillus, 253.
Drepanis, 73.
Dromæus, 236.
Dromæus novæ-hollandiæ, 6, 14, 238.
Dromas, 221.
Dromas ardeola, 226.
Dromicia, 188.
Dromicia nana (?), 180.
Drymœca, 451, 458, 459, 460, 461, 463, 464, 469, 474, 475, 477.
Dryocopus major, 324.
—— medius, 324.
—— minor, 324.
Dulus, 359.
Dysporomorphæ, 434.

E.

Eclectus, 19–25.
Eclectus cardinalis, 19, 25.
—— corneliæ, 19, 25.
—— grandis, 19, 25.
—— intermedius, 19.
—— linnæi, 19.
—— polychlorus, 19, 25.
—— westermanni, 19, 25.
Edentata, 304.
Elainea pagana, 264.
Elaphodus, 313.
Elephas, 308.
Elephas africanus, 46–62.
—— indicus, 55, 62.
Eleutherodactyli, 148.
Eleutherodactylous Passeres, 282.
Elminia, 458, 460.
Elminia longicauda, 472.
Emberiza, 465.
Emberiza forbesi, 458.
Emblema rufopicta, 468.
Entomyza, 359.
Eos, 70.
Eos rubra, 69.
Ephemera, 294.
Epomophorus, 467, 468, 473, 474.
Erebia, 104.
Erebia æthiops, 31.
—— ceto, 102.
—— epiphron, 102, 169.
—— euryale, 103, 169.
—— evias, 169.
—— glacialis, 103.
—— lappona, 103.
—— ligea, 31, 103.
—— medusa, 169.
—— melampus, 169.
—— nerine, 30.
—— pronoë, 30.
—— stygne, 30.
—— tyndarus, 104.
Erebiæ, 33.
Erismatura rubida, 355.
Erismaturinæ, 355.
Erodii, 164, 373.
Erythrauchæna humeralis, 41.
Estrelda, 453, 454.
Estrelda cinerea, 469, 473.
—— melpoda, 457, 458, 463, 473.
—— minima, 457, 460.
—— nigricollis, 457.
—— phœnicotis, 458.
—— rubropicta, 474.
—— rufopicta, 460, 463.
—— senegala, 457.
—— subflava, 472.
Eucephala cærulea, 270.
Euchloë belia, 101.
Eudromias morinellus, 226.
Euelephas, 62.
Eumomota, 350.
Eupetes, 281.
Eupetes macrocercus, 331.
Euphema, 63.
Euphema pulchella, 62, 63.
Euphonia, 134–137.
Euphonia violacea, 135, 256.
Eupithecia euphrasiata, 32.
Euplectes, 474.
Euplectes abyssinicus, 461.
—— flammiceps, 454, 457.
—— franciscanus, 455, 456, 457, 458, 462, 469, 472.
—— ignicolor, 467.
—— macrocercus, 281.
—— melanogaster, 462, 464.
—— nigriventris, 161.
—— oryx, 454, 469.

Euplocamus cristatus, 6.
Eupodotis, 193.
Eupodotis australis, 205.
—— denhami, 162.
Eurycreon verticalis, 32.
Eurylæmidæ, 3, 136–144, 148, 208, 209, 214, 220.
Eurylæmus, 282, 362.
Eurylæmus javanicus, 138.
—— ochromelas, 138–142.
Eurypyga, 191, 223, 281, 331–335.
Eurypyga helias, 226.
Eurypygidæ, 191.
Eurystomus gularis, 152.
Euscarthmus gularis, 264.

F.

Falco ruficollis, 468.
Falconidæ, 212, 388, 434.
Falcunculus, 359.
Felis pardus, 127.
Fluvicola climacura, 244, 263.
Formicariidæ, 217.
Formicarius, 219.
Formicivora grisea, 269.
—— rufatra, 269.
Foudia erythrops, 468.
Francolinus, 464.
Francolinus bicalcaratus, 6.
—— vulgaris, 6.
Fratercula arctica, 393.
Fregetta, 230, 231, 369, 373, 376, 377, 388, 389, 393, 395, 415, 418, 420, 428.
Fregetta aquila, 243, 367.
—— grallaria, 243, 365, 387, 413, 428.
—— melanogaster, 365, 385, 389, 413, 419, 426, 428.
—— mœstissima, 428.
Fregilus graculus, 6.
Fringilla nitens, 160.
Fulica, 227.
Fulica atra, 5.
—— rufigula, 6.
Fulicariæ, 221.
Fuligula rufina, 12.
Fulmareæ, 369, 371.
Fulmaridæ, 230, 272, 373.
Fulmarus, 367–369, 371, 372, 378, 383, 384, 392, 397, 403, 404, 415, 416, 431.
Fulmarus glacialis, 365, 379, 386, 387, 402, 413, 419, 426, 428.
Furnariidæ, 148.
Furnarius, 191, 219.
Furnarius figulus, 267.
—— rufus, 191, 192.

G.

Galbula rufo-viridis, 271.
Galbulidæ, 156, 200, 212, 284, 346, 347.
Galliformes, 212.
Gallinæ, 6, 156, 190, 202, 208, 232, 335, 397.
Gallinago frenata (?), 278.
Gallus bankiva, 196, 199.
—— domesticus, 5, 190.
Gambetta pulverulentus, 42.
Gampsonyx swainsoni, 274.
Garrodia, 231, 373, 376, 389, 395, 399, 418, 428.
Garrodia nereis, 365, 387, 413, 419, 426.
Garrulax chinensis, 6.
Garrulus brandti, 45.
—— japonicus, 45.
—— lidthi, 45.
Gaviæ, 6.
Gecinus canus, 324.
—— viridis, 324.
Gecko, 458, 462.
Geobiastes, 154, 159.
Geobiastes squamigera, 154.
Geococcyx affinis, 6.
Geometer, 451.
Geopelia humeralis, 41.
—— tranquilla, 41.
Geopsittacus, 132.
Geranoaëtus aquila, 6.
Glareola, 207, 453.
Glareola cinerea, 454, 456, 461.
—— pratincola, 226.
Gnophos dilucidaria, 32.
—— glaucinaria, 32.
—— obscuraria, 33.
Goura, 12.
Goura coronata, 6.
Grallæ, 6, 164.
Graucalus hypoleucus, 36.
Gruidæ, 191, 223, 226.
Grus, 12, 206.
Grus americana, 226, 344.
—— antigone, 344.
—— australasiana, 226, 344.
—— canadensis, 344.
—— carunculata, 6, 344.
—— cinerea, 226.

Grus leucogeranos, 344.
Guira piririgua, 6, 271.
Guiraca cyanea, 259.
Guttera cristata, 343.
—— eduardi, 343.
—— pucherani, 343.
Gymnoderus, 149.
Gyparchus papa, 6, 274.
Gypohierax, 453, 462, 468, 475.

H.

Hadrostomus, 218.
Hæmatopus, 442.
Hæmatopus ostralegus, 226.
Halcyon, 164, 463, 465, 469.
Halcyon cinereifrons, 467.
—— dryas, 468.
—— macleayi, 36.
—— rufiventris, 470, 473.
—— senegalensis, 467, 468, 470, 471.
Haliaëtus, 475.
Haliaëtus vocifer, 6, 454, 460, 468.
Halicore, 207.
Halobæna, 369, 372, 379, 383, 481.
Halobæna cærulea, 379.
Halocypteua, 369, 374, 381, 383, 387, 389, 399, 418, 426, 431.
Halocyptena microsoma, 365.
Haploophonæ, 148.
Harpactes, 349.
Harpactes reinwardti, 283.
Helotarsus, 460.
Hemipodius melanonotus, 42.
—— varius, 226.
Herodiones, 6, 387, 434.
Herpetotheres cachinnans, 274, 279.
Herpsilochmus pileatus, 269.
—— sp. inc., 269.
Hesperia, 473.
Hesperia comma, 31.
—— lineola, 169.
—— thaumas, 169.
Heteralocha, 204, 209.
Heteralocha gouldi, 204.
Hiaticula inornata, 42.
Himantopus nigricollis, 224.
Hippotragus equinus, 460, 473.
Hirundinea bellicosa, 265.
Hirundo, 457.
Hirundo leucorrhoa, 244, 254.
—— melanocrissus, 463, 466.
—— senegalensis, 455, 471.
Hologyri, 164, 165.
Homalogonatæ, 201, 209.
Homœomeri, 148.
Homopteron, 454, 471.
Hoplopterus, 442, 463, 467.
Hoplopterus spinosus, 476.
Hyæna crocuta, 181.
Hydradephaga, 294.
Hydralector cristata, 224.
—— gallinacea, 228.
Hydrophasianus africanus, 222.
—— chirurgus, 6, 221, 222, 224, 228.
Hydropotes inermis, 313–315.
Hydropsalis forcipata, 270.
Hydrornis, 214.
Hydrornis natator, 370.
Hylactes, 218, 219.
Hylomanes gularis, 346, 349.
Hymenoptera, 294.
Hyomoschus, 181.
Hypena obesalis, 32.
—— obsitalis, 32.
Hypergerus, 464, 465, 470, 473, 474, 476.
Hyphantornis, 449, 453, 454, 460, 461, 464.
Hyphantornis aurifrons, 454.
—— brachypterus, 470.
—— castaneo-fuscus, 455.
—— luteus, 454.
—— personatus, 454, 461, 467, 469.
—— textor, 455, 457, 458, 461, 463, 466.
Hypochera, 457, 458, 463, 466.
Hypochera nigerrima, 160.
—— nitens, 159.
Hypsibæmoninæ, 144.
Hypsiprymnus, 181.

I.

Ianthœnas leucolæma, 204.
Ibididæ, 335.
Ibis, 191, 206, 463, 469, 473, 475.
Ibis æthiopicus, 474.
—— falcinellus, 6.
—— hagedash, 468.
—— rubra, 6, 226.
Icterus chrysocephalus, 247.
—— tibialis, 262.
Indicator, 323, 325, 458.
Indicator major, 207.
Indicatoridæ, 201.
Irrisor, 469, 470.
Irrisor pusillus, 468.

Irrisor senegalensis, 470.
Ispidina cyanotis, 467.
Ixos, 456, 458, 463, 466, 469.

J.

Jacamaralcyon, 441, 442.

L.

Lacerta, 468.
Lacertilia, 440.
Lagonosticta, 458, 461, 463.
Lagopus scoticus, 6.
Lagostomus, 308.
Lagothrix, 119, 122, 123, 247.
Lagothrix humboldti, 113.
Lagria hirta, 1, 2.
Lamprocolius, 460.
Lamprotreron superbus, 41.
Laniarius, 460, 468, 474, 476, 477.
Laniarius barbarus, 464, 465, 468, 473.
Lanius rutilans, 477.
Laridæ, 164, 191, 225, 284, 335, 371, 372, 373, 380, 415, 433.
Larus, 13, 222.
Larus affinis, 448.
—— argentatus, 190, 393.
—— glaucus, 393.
—— ridibundus, 6.
Lathamus, 62–71.
Lathamus discolor, 65.
Leistes superciliaris, 262.
Lepidoptera, 32, 166, 294.
Leptasthenura, 191.
Leptoptila ochroptera, 277.
Leptosoma, 333, 346.
Leptosoma discolor, 149–159.
Lestris, 367, 378.
Leucophasia duponcheli, 167.
—— sinapis, 29, 101.
Libellula, 294.
Libythea, 167.
Libythea celtis, 168.
Licmetis tenuirostris, 205.
Limenitis camilla, 30, 168.
—— populi, 102, 168, 294.
—— sibylla, 294.
Limicolæ, 191, 206, 221, 222.
Limnocorax, 468, 477.
Limnocorax flavirostris, 475.
—— niger, 459.
Limosa melanura, 226.
Lipaugus, 218.
Lobivanellus senegalensis, 457.
Lophopsittacus, 98, 99.
Lorius, 63, 70.
Lorius tibialis, 22.
—— tricolor, 70.
Loxia tridactyla, 441.
Loxodon, 62.
Lucanus cervus, 1.
Lycæna, 473.
Lycæna alcon, 102, 168.
—— argiades, 30.
—— argus, 168.
—— argyrotaxus, 30.
—— arion, 102, 168.
—— belargus, 30.
—— corydon, 102.
—— cyllarus, 168.
—— damon, 102.
—— eros, 168.
—— escheri, 102, 168.
—— eumedon, 168.
—— hylas, 102, 168.
—— icarus, 30, 168.
—— minima, 102.
—— orion, 168.
—— sebrus, 168.
—— semiargus, 102, 168.
Lygris populata, 32.

M.

Macacus, 119.
Machetes pugnax, 224, 226.
Machetornis rixosa, 264.
Macrocercus, 281.
Macrochires, 212.
Macrodipteryx, 472, 473, 474, 476.
Macroglossa stellatarum, 31.
Macronyx, 476.
Macronyx croceus, 473.
Majaqueus, 369, 371, 375, 376, 379, 380, 381, 384, 388, 391, 392, 393, 395, 412, 414, 415, 420, 423, 431, 432.
Majaqueus æquinoctialis, 365, 387, 413, 419, 426.
Malaconotus, 477.
Manatus, 207.
Manis tridentata, 309.
Mantis, 473.
Manucodia atra, 337, 338–344.
—— chalybeata, 338, 341.
—— gouldi, 37.

Manucodia jobiensis, 338, 341.
—— keraudreni, 37.
Mascarinus duboisi, 96, 99.
—— madagascariensis, 98.
Megacephalon, 207.
Megalæma, 6.
Megalæma asiatica, 200.
—— franklini, 323.
—— virens, 323.
Megaloprepia assimilis, 41.
Megapodidæ, 207, 211.
Megapodius, 35, 36.
Megapodius tumulus, 41.
Melampitta, 149, 214.
Melanargia galathea, 30.
Melapterurus, 468, 476.
Meleagris mexicana, 5, 6, 7.
Melierax, 164, 472.
Melitæa athalia, 30, 102, 168.
—— aurinia, 102.
—— cinxia, 294.
—— cynthia, 102.
—— dejone, 166, 168.
—— dictynna, 102, 168.
—— didyma, 30, 102, 168.
—— maturna, 294.
—— parthenie, 30, 102, 168.
—— phœbe, 168.
Melopsittacus undulatus, 62.
Menopomas, 105.
Menura, 144, 208, 209, 282, 358.
Menura superba, 332.
Menuridæ, 148.
Mergus albellus, 387.
Meropidæ, 212, 335, 346.
Merops, 6, 11, 199, 351, 393, 461, 464, 466, 468.
Merops bullocki, 475.
—— castus, 467.
—— erythropterus, 467.
—— nubicus, 464, 466, 468, 471.
—— ornatus, 35.
Mesites, 149, 191, 281, 331, 335.
Mesites unicolor, 226.
—— variegatus, 331.
Mesitidæ, 226.
Mesogyri, 164.
Mesomyodi, 148, 209.
Mesomyodian Passeres, 360.
Metopiana peposaca, 203.
Metopidius, 227, 228, 463.
Metopidius africanus, 220, 224, 227.
—— albinucha, 224, 225, 226, 227, 228.
—— indicus, 224, 226, 228.
Microglossum aterrimum, 40.
Milium effusum, 31.
Milvus, 464.
Milvus parasiticus, 466.
Mimeta flavocinctus, 38.
—— viridis, 38.
Minoa murinata, 32.
Miro, 359, 363.
Mitua, 342.
Mitua tomentosa, 342.
—— tuberosa, 342.
Mohoua, 358.
Molothrus bonariensis, 262.
Momotidæ, 207, 212, 345, 348, 350, 351.
Momotinæ, 345.
Momotus, 199, 207, 211.
Momotus lessoni, 6, 346, 347.
Monitor, 467.
Monitor ocellatus, 477.
Morpho, 295.
Moschus, 315.
Motacilla, 453, 457, 458.
Motacilla longipes, 361.
—— sulphurea, 448.
Mus, 460.
Musophaga, 469.
Musophaga violacea, 477.
Musophagidæ, 207, 208, 211, 212, 415.
Mycetes, 117, 119, 122.
Myelois rosella, 32.
Myiadestes, 359.
Myiarchus tyrannulus, 266.
Myiobius nævius, 266.
Myiochanes cinereus, 266.
Myiozetetes, 264.
Myiozetetes affinis, 266.
—— similis, 265.
Myrmecophaga jubata, 296–311.
Myrmornithinæ, 144.
Myzomela, 70–95.
Myzomela adolphinæ, 74, 77, 94.
—— boiæi, 74, 77, 93, 94.
—— caledonica, 74, 76, 94.
—— cardinalis, 45, 74, 88, 94.
—— chermesina, 44, 74, 90, 94.
—— chloroptera, 74, 76, 93, 94.
—— cruentata, 74, 86, 93, 94.
—— eques, 73, 74, 83, 93, 94.
—— erythrocephala, 74, 78, 93, 94.
—— infuscata, 79.
—— jugularis, 74, 80, 94.
—— lafargii, 73, 74, 81, 94.
—— lifuensis, 74, 89, 94.

Myzomela nigra, 74, 91, 94.
—— nigrita, 74, 82, 93, 94.
—— nigriventris, 74, 87, 94.
—— obscura, 39, 74, 84, 93, 94.
—— pammelæna, 74, 83, 93, 94.
—— pectoralis, 74, 92, 94.
—— pusilla, 92.
—— rosenbergi, 74, 90, 94.
—— rubratra, 74, 87, 94.
—— rubro-brunnea, 74, 85, 94.
—— rubrotincta, 73, 74, 85, 94.
—— sanguinolenta, 71, 72, 74, 94.
—— sclateri, 74, 81, 94.
—— simplex, 74, 94.
—— vulnerata, 74, 79, 93, 94.

N.

Nanodes, 62.
Nasiterna, 131–133.
Nasiterna pusio, 131.
—— pygmæa, 132.
Nasutæ, 230, 372.
Necropsittacus, 99.
Nectarinia, 451, 455, 463, 466, 469, 470, 471.
Nectarinia australis, 40.
—— frenata, 40.
—— pulchella, 458, 463.
Nectariniidæ, 145, 335.
Nectris, 369.
Nemeobius lucina, 168, 294.
Nemosia fulvescens, 258.
—— pileata, 258.
Neodrepanis, 145.
Neophron, 457, 458, 463.
Neophron percnopterus, 243.
—— pileatus, 455, 466.
Neotropical Mesomyodi, 362.
Nepa, 294.
Neptis, 167.
Neptis lucilla, 168.
Nesocichla, 359.
Nesospiza, 359.
Nestor, 164, 205.
Ninox boobook, 35.
Nisoniades tages, 103.
Noctua, 455.
Noctuæ, 464.
Normales, 148.
Nothocrax urumutum, 343.
Notonecta, 294.
Numenius arquatus, 224, 226.
Numenius phæopus, 226.
Numeria capreolaria, 32.
Numida meleagris, 343.
—— mitrata, 343.
—— ptilorhyncha, 343.
—— rendalli, 459.
Numididæ, 343.
Nyctibius, 443.
Nycticorax, 468, 474.
Nycticorax europæus, 475.
Nyctipithecus, 122.
Nyctipithecus rufipes, 113.
—— vociferans, 113.

O.

Oceanites, 230, 231, 369, 372, 373, 376, 395, 417, 420, 428, 448, 449.
Oceanites oceanicus, 230, 231, 365, 367, 381, 387, 413, 419, 426.
Oceanitidæ, 231, 264, 373, 374, 376, 377, 380, 381, 383, 386, 394, 395, 396, 414, 417, 420, 422, 424, 426, 428, 435.
Oceanodroma, 369.
Ochthodromus inornatus, 42.
Ocydromus, 12, 227.
Ocydromus australis, 6.
Odontophorus guianensis, 6.
Œdicnemidæ, 221.
Œdicnemididæ, 442.
Œdicnemus, 13, 191, 195, 466, 467, 472.
Œdicnemus crepitans, 6.
Œneis aello, 169.
Œstrelata, 369, 370, 371, 381, 383, 384, 391, 415, 420.
Œstrelata brevirostris, 365, 391, 408.
—— bulweri, 371.
—— fuliginosa, 371.
—— grisea, 413, 426.
—— lessoni, 365, 380, 387, 391, 393, 408, 410, 413.
—— mollis, 365.
—— sp. inc., 365.
Œstrelateæ, 369, 392.
Œstrelatinæ, 373.
Opisthocomus, 157, 208.
Orchesticus ater, 259.
—— capistratus, 258.
Oriolus, 466.
Oriolus flavocinctus, 38.
—— galbula, 6.
—— viridis, 38.

Ortalis, 342.
Ortalis albiventris, 277, 342.
—— garrula, 342.
—— motmot, 342.
Orthocœla, 164, 165.
Ortholitta bipunctaria, 32.
—— limitata, 32.
Orthonyx, 149, 214, 357, 359.
Orthonyx ochrocephala, 357, 358.
—— spinicauda, 357, 358.
Ortygospiza, 458.
Ortyx virginianus, 6.
Orycteropus, 302.
Oryzoborus maximiliani, 259.
—— torridus, 259.
Oscines, 341.
Ossifraga, 368, 369, 371, 377, 380, 383, 392, 397, 402, 414, 415, 417, 423, 431.
Ossifraga gigantea, 365, 369, 379, 385, 387, 404, 413, 419, 426.
Osteoglossum, 472, 473, 474.
Otaria gillespii, 316–322.
—— jubata, 316, 317–322.
—— stelleri, 316.
Otididæ, 205, 209, 442.
Otis, 12, 190.
Otis tarda, 6, 205, 356.
Ouakaria, 123.
Ouakaria calva, 125.
—— calvus, 124.
—— melanocephala, 124.
—— rubicunda, 125.
—— spixii, 117, 124.
Oxylophus, 465.
Oxylophus ater, 464.
Oxyrhamphus, 149.
Oxyrhynchus, 219.

P.

Pachycephala flavifrons, 43.
—— icteroides, 43.
—— sp., 35, 36.
Pachyrhamphus atricapillus, 267.
Pagodroma, 369, 372, 377, 384, 392, 400, 401, 415, 431.
Pagodroma nivea, 365, 402.
Paictidæ, 3.
Paixis galatea, 342.
Palæno, 29.
Palæornis, 97, 99, 205, 469.
Palamedeæ, 6, 206.
Palamedeidæ, 197, 205.
Paludina, 461.
Papilio, 451, 452.
Papilio machaon, 29, 101, 294.
—— merope, 455.
—— podalirius, 29, 167.
Paradisea papuana, 337.
—— rubra, 337.
Pararge achine, 169.
—— ægeria, 31.
—— hiera, 31, 103.
—— janira, 31.
—— mæra, 103, 169.
—— tithonus, 31.
Parnassius, 104, 167.
Parnassius apollo, 29, 101, 167.
—— delius, 101.
—— mnemosyne, 101.
Paroaria, 260.
Paroaria larvata, 261.
Parra, 227, 466.
Parra ænea, 221.
—— africana, 221.
—— gymnostoma, 224, 228.
—— jacana, 220–229, 278.
—— sinensis, 221.
Parridæ, 191, 220, 221, 224, 226, 229.
Passer, 463, 465, 470.
Passer simplex, 457, 458.
Passeres, 3, 6, 11, 13, 148, 164, 198, 208, 212, 213, 218, 345, 358, 362.
Passeriformes, 211, 212, 353.
Passerinæ, 217.
Pauxis, 342.
Pedionomus torquatus, 446.
Pelagodroma, 230, 231, 369, 373, 376, 379, 380, 389, 395, 402, 428.
Pelagodroma marina, 365, 387, 413, 426.
Pelargi, 164, 373.
Pelargomorphæ, 434.
Pelecanidæ, 434.
Pelecanoides, 194, 212, 360, 364, 368, 375, 378–380, 383, 385, 389, 393, 395, 396, 399, 414, 415, 417, 418, 420, 421, 423, 429, 430, 442.
Pelecanoides urinatrix, 365, 366, 373, 387, 413, 419, 426.
Pelecanoidinæ, 284.
Pelecanus, 206, 328, 388.
Pempelia semirubella, 32.
Penelope cristata, 342.
—— jacucaca, 342.
—— pileata, 342.

Penelope purpurascens, 342.
—— superciliaris, 277.
Peristera afra, 467.
Petaurus, 183.
Petrœca, 359.
Petrogale, 181.
Pezoporus, 63, 132.
Phænorhina goliath, 386.
Phæornis, 359.
Phaëthon, 388, 421.
Phainopepla, 359.
Phalacrocorax, 11, 193, 327, 356, 421, 434.
Phalacrocorax africanus, 468.
—— brasiliensis, 6.
—— carbo, 6
Phalangista, 177, 181, 186, 188.
Phalangista vulpina, 180.
Phalangistidæ, 184, 188.
Phalangistinæ, 188.
Phaps, 12.
Phaps chalcoptera, 6.
Pharomacrus mocinus, 283.
Phascolarctinæ, 188.
Phascolarctos cinereus, 173–186.
Phascolomyinæ, 188.
Phascolomys, 177, 181, 183, 187, 188.
Phascolomys wombat, 180, 183.
Phasianidæ, 343.
Phasianus parraka, 342.
Philedon, 144.
Philemon buceroides, 39.
Philepitta, 144–149, 214, 362.
Philepitta castanea, 145.
—— paictes, 144.
Philepittidæ, 362.
Philhydrida, 294.
Phlœocryptes, 191.
Phœbetria, 360, 377, 379, 384, 411.
Phœbetria fuliginosa, 360, 365, 366, 371, 377, 395, 413, 416, 429.
Phœnicocercus, 149.
Phœnicopterus, 164, 193, 383.
Phonygama gouldi, 337, 338–344.
—— keraudreni, 338, 339, 341.
Phryganidæ, 294.
Phylidonyris, 71.
Phyllomyias semifusca, 264.
Phylloscopus, 465, 466, 476.
Physaliæ, 243.
Phytotoma, 149.
Phytotoma tridactyla, 441.
Piaya cayana, 272.
Pici, 164, 325.
Picidæ, 156, 201, 207, 212, 324.
Piciformes, 211, 212, 353.
Picoides, 360, 441, 442.
Picus, 457.
Picus martius, 324.
Pieris, 455.
Pieris brassicæ, 29.
—— callidice, 101.
—— napi, 29, 33, 101, 167.
—— rapæ, 29.
Pinarolestes megarhynchus, 37.
—— rufigaster, 37.
Pionea forficalis, 32.
Pionus corallinus, 99.
—— violaceus, 6.
Pipile cujubi, 343.
—— cumanensis, 342.
—— jacutinga, 342.
Pipra rubricapilla, 266.
Pipridæ, 144, 147, 148, 208, 209, 219, 345, 362.
Pipridea melanonota, 137.
Pipro-Cotingidæ, 218.
Pitangus sulphuratus, 265, 266.
Pithecia, 119, 123.
Pithecia alba, 125.
—— calva, 125.
—— chiropotes, 123.
—— melanocephala, 124.
—— monachus, 113, 115, 119, 121.
—— rubicunda, 125.
—— satanas, 107, 111, 116, 121, 122, 312.
Pitta, 146, 209, 362.
Pitta cyanura, 146.
—— melanocephala, 146.
Pittidæ, 3, 148, 209, 362.
Pitylus fuliginosus, 137.
Plagiocœla, 164, 165.
Platalea, 191, 206, 476.
Platalea ajaja, 203, 226.
—— leucorodia, 26, 226, 343.
Plataleæ, 335.
Plataleidæ, 191, 221, 225, 226.
Platycercidæ, 205.
Platycercus, 63, 66, 68, 70.
Platycercus eximius, 66.
—— icterotis, 6, 10, 11.
—— pennantii, 66.
—— venustus, 62.
Platycerium, 455.
Platystira, 456, 458, 471, 477.
Platystira melanoptera, 474.
Plectropterus, 456, 458, 461, 468.
Ploceus, 468, 471, 472, 474.
Ploceus brachypterus, 474, 476.

Ploceus textor, 475.
Plotus, 13, 164, 193, 206, 388, 421, 454, 456, 461, 462, 468.
Plotus anhinga, 3, 12, 206, 326, 327, 387.
—— levaillanti, 206, 326, 327.
—— melanogaster, 326, 330, 454.
—— novæ-hollandiæ, 328.
Plusia gamma, 31.
—— triplasia, 31.
Pluviales, 222, 224, 225, 281.
Pluvianus, 457, 461, 465, 466.
Pluvianus ægyptiacus, 454.
Podargus, 284, 333.
Podargus cuvieri, 6.
—— papuensis, 35.
Podica, 471.
Podiceps, 417.
Podicipitidæ, 372.
Pœocephalus, 99, 459, 464, 469, 470.
Pœocephalus rufiventris, 469.
Pœoptera, 458.
Pogonias, 454, 458, 473.
Pogonorhynchus abyssinicus, 441.
Polioptila leucogastra, 253.
Polyborus tharus, 274.
Polychlorus, 19.
Polygyri, 164.
Polyodon, 105.
Polyodon folium, 105.
—— gladius, 105.
Polyommatus alciphron, 168.
—— argus, 102.
—— dorilis, 29, 101, 168.
—— eumedon, 102.
—— hippothoë, 101, 168.
—— phlœas, 29.
—— virgaureæ, 29, 33, 101, 168.
Polypterus, 470, 471, 472, 473.
Pomarea, 359.
Porphyrio, 12, 221, 227, 461.
Porphyrio alleni, 6.
—— martinicus, 6.
—— poliocephalus, 6.
Porzana notata, 222.
Pratincola, 453, 474.
Priocella garnoti, 368.
Priodontes, 245.
Priofinus æquinoctialis, 368.
—— arcticus, 368.
—— cinereus, 368.
Prion, 368, 369, 372, 375, 379, 384, 389, 404, 415, 417.
Prion banksi, 365, 382, 387, 389, 393.
—— desolatus, 365, 382, 387, 413, 419.
Prion vittatus, 365, 370, 373, 400, 402, 413.
Prioneæ, 369.
Prionops, 465.
Procellaria, 335, 366, 367, 369, 372, 374, 378, 379, 381, 389, 390, 394, 404, 405, 415, 416, 418, 420, 423, 424, 428, 430.
Procellaria albogularis, 428.
—— antarctica, 368.
—— brevirostris, 368.
—— desolata, 368.
—— fregata, 230, 373.
—— gigas, 370.
—— hæsitata, 368.
—— lessoni, 368.
—— nereis, 373.
—— nivea, 368.
—— pelagica, 229, 231, 243, 365, 367, 377, 379, 387, 413, 426.
Procellarieæ, 369, 372.
Procellariidæ, 203, 229, 231, 236, 284, 370, 371, 373, 395, 396, 414, 422, 425, 426, 435.
Procellariinæ, 284, 425, 430.
Procnias, 137.
Progne, 455.
Progyri, 164.
Protopterus, 468.
Psarisomus, 139.
Psarisomus dalhousiæ, 139.
Psephotus, 63, 70.
Psephotus hæmatonotus, 66, 69.
Pseudoprion, 369, 382.
Psittacaræ, 63.
Psittacella, 133.
Psittaci, 6, 65, 164, 204.
Psittacidæ, 156, 211.
Psittacula, 133.
Psittacula passerina, 261, 273.
Psittacus, 96, 97, 99, 456.
Psittacus discolor, 62.
—— erithacus, 6, 454.
—— mascarinus, 98.
—— obscurus, 98.
Psittinus, 132.
Psodos, 33.
Ptenœdus, 359.
Pterocles, 12, 476, 477.
Pterocles arenarius, 6.
Pteroclidæ, 148, 191, 204, 221, 335.
Pterodroma, 369.
Pteroglossus wiedi, 6, 323.
Pteroptochidæ, 220.
Pteroptochus, 219.

Pteroptochus albicollis, 218.
Ptilochloris, 149.
Ptilogonys, 359.
Ptilopus, 204, 325.
Ptilopus superbus, 35, 41.
Ptilorhis alberti, 38, 337, 340.
—— magnificus, 38.
—— paradisea, 337.
Ptilorhynchus smithi, 337.
—— violaceus, 337.
Ptilotis chrysotis, 39.
—— filigera, 39.
—— lewinii, 39.
Pudua, 315.
Puffineæ, 369, 392.
Puffinuria, 231.
Puffinus, 335, 367, 368, 369, 370, 371, 372, 375, 381, 391, 393, 395, 406, 414, 415, 420, 423, 424, 431, 432, 448.
Puffinus anglorum, 368, 387, 413, 418, 419, 426.
—— brevicauda, 365, 384, 387, 391, 406, 408, 413.
—— chlororhynchus, 373.
—— cinereus, 370.
—— fuliginosus, 368.
—— major, 369.
—— obscurus, 368, 375, 379, 384, 387, 391, 408, 413, 419.
Pygopodes, 6, 163.
Pyralides, 33.
Pyranga erythromelæna, 137.
Pyrenestes ostrinus, 469.
Pyrrhulopsis personata, 66.
—— splendens, 6, 66.
Pytelia, 458.
Pytelia cinereigula, 161.
—— citerior, 161.
—— melba, 161.
—— wieneri, 161.
Python bivittatus, 285, 292.
—— molurus, 285–289, 292.
—— sebæ, 285, 292.

Q.

Quedius dilatatus, 46.
Querula, 149.

R.

Rallidæ, 164, 206, 220, 222, 224, 225.
Rallus, 221.
Rallus aquaticus, 221, 225.
—— longirostris, 277.
—— nigricans, 277.
—— pectoralis, 35, 43.
Raptatores, 373.
Raptores, 164.
Rasores, 164.
Ratitæ, 163, 236, 241.
Recurvirostra avocetta, 226.
Rhamphastidæ, 11, 201.
Rhamphastinæ, 208.
Rhamphastos, 208, 323.
Rhamphastos ariel, 6.
—— carinatus, 323.
—— cuvieri, 323.
—— dicolorus, 323, 324.
—— vitellinus, 323.
Rhamphocœlus brasilius, 137, 245, 257.
—— jacapa, 137.
Rhea, 10, 15, 16, 232, 338, 341, 360.
Rhea americana, 5, 6, 14, 238, 239, 241, 280.
—— macrorhyncha, 238, 241, 245, 251, 279.
Rheidæ, 442.
Rhinoceros indicus, 171, 172.
Rhinochetidæ, 191, 221, 226.
Rhinochetus, 281, 331–335.
Rhinochetus jubatus, 226.
Rhodocera rhamni, 29.
Rhodonessa caryophyllacea, 203.
Rhodopyga rhodopsis, 457.
Rhopalocera, 167.
Rhynchæa australis, 342.
—— capensis, 342.
Rhynchops, 454, 461.
Rhynchotus rufescens, 6, 279.
Rimator, 359.
Rissa, 442, 476.
Rivula sericealis, 32.
Rupicola, 144, 147, 148.
Rupicola crocea, 194.
Ruticilla, 460.

S.

Saltator magnus, 137, 255.
Samia cecropia, 294.
—— gloveri, 294.
Sarcidiornis carunculata, 275.
—— melanonota, 203, 275.

Sasia, 442.
Satyrus actæa, 31, 103, 169.
—— alcyone, 169.
—— circe, 31.
—— dryas, 31.
—— hermione, 31, 103.
—— semele, 31, 169.
Saxicola, 458.
Scaphirhynchus, 105.
Scardafella squamosa, 276.
Schizognathæ, 284.
Schizorhis, 466, 467, 471.
Schizorhis africana, 194.
—— concolor, 462.
Sclerurus, 191.
Scolopacidæ, 221, 342.
Scolopacinæ, 221.
Scopus, 388, 434, 435, 452, 474, 475, 476, 477.
Scotopelia, 467, 477.
Scotornis climacurus, 474.
Scytalopodinæ, 144.
Scytalopus indigoticus, 218.
Selenidera maculirostris, 323.
Seleucides nigra, 335–337.
Sericoris conchana, 32.
Serilophus rubropygius, 139.
Serpentarius, 12–16.
Serpentarius reptilivorus, 6.
Serpophaga subcristata, 264.
Sieboldia, 105.
Simia melanocephala, 124.
Siphonorhis, 433.
Sitta, 361.
Sitta chloris, 361.
Sittella, 359, 361.
Spermestes cucullatus, 454, 456, 457, 458, 460.
—— semitorquatus, 463.
—— senegalensis, 463.
Spermophila gutturalis, 260.
—— hypoleuca, 260.
—— nigro-aurantia, 259.
—— plumbea, 260.
Spermophilæ, 260.
Sphecotheres flaviventris, 38.
Spheniscidæ, 372.
Sphenostoma, 359.
Sphenura, 359.
Sphinx convolvuli, 31, 448.
Spiloglaux marmoratus, 35.
Spilothyrus alceæ, 31.
—— althææ, 169.
—— lavateræ, 169.
Spizaëtus coronatus, 6.
—— occipitalis, 467, 470.
Staphylinus fulvipes, 46.
Steatornis, 204, 212, 346, 349, 443.
Steganopodes, 6, 11, 164, 194, 202, 284, 373, 434.
Stelgidopteryx ruficollis, 255.
Sterna, 222, 461.
Sterna caspia, 451.
—— melanotis, 451, 452.
Strepsilas interpres, 35, 42.
Strigidæ, 212.
Stringops, 11, 132, 195.
Stringops habroptilus, 6.
Strix flammea, 6, 274.
Struthidea, 3.
Struthio, 199, 203, 230, 234, 237, 241, 386, 443.
Struthio camelus, 6, 14, 232, 233.
Struthiones, 6, 15, 209.
Sula, 388, 421.
Sula bassana, 6, 11, 328, 449.
—— leucogastra, 328.
—— piscator, 328.
Sycalis, 260.
Sycalis flaveola, 261, 273.
Sycobius, 455.
Syma, 346.
Synallaxis, 191.
Synallaxis albescens, 268.
—— cinnamomea, 268.
—— frontalis, 268.
Synœcus cervinus, 35, 42.
Syricthus alveus, 31, 103, 169.
—— cacaliæ, 103.
—— carthami, 103, 169.
—— proto, 36.
—— sao, 103, 169.
Syrrhaptes, 442, 443.

T.

Tachyphonus coronatus, 137, 258.
—— cristatus, 137.
—— melaleucus, 134, 136, 137.
Tadorna rutila, 6, 12.
Talegalla lathami, 42.
Tamandua, 181, 298, 299, 301, 302, 309, 311.
Tamandua tetradactyla, 304, 312.
Tanagra, 136.
Tanagra abbas, 137.
—— cana, 256.

Tanagra episcopus, 137.
—— olivina, 259.
—— ornata, 137.
—— palmarum, 137, 257.
—— sayaca, 137, 256.
—— vittata, 137.
Tantalus, 335.
Tantalus ibis, 203, 343.
—— leucocephalus, 343.
—— loculator, 203, 343.
Tanygnathus, 96, 99.
Tanygnathus muelleri, 6.
Tanysiptera, 346.
Tapirus, 181.
Taxaspideæ, 144.
Tchitrea, 460, 467, 474, 476, 477.
Telephonus, 454.
Telogyri, 164.
Terias, 455.
Tetrao urogallus, 6, 7, 343.
Tetrapteryx paradisea, 344.
Tetrax, 360.
Thalassiarche, 378, 380, 384, 429.
Thalassiarche chlororhyncha, 415.
—— culminata, 360, 365, 376, 377, 379, 410, 413, 415.
—— melanophrys, 413, 419, 420, 426.
Thalassidroma, 368, 369.
Thalassidroma fregetta, 368.
—— leachii, 368.
—— lineata, 428.
—— marina, 368.
—— nereis, 229.
—— oceanica, 368, 369, 373.
—— pelagica, 368.
—— segethi, 428.
Thalassidrominæ, 211, 373.
Thalassœca, 369, 383, 392, 397, 402, 403, 404, 415, 421, 431.
Thalassœca glacialoides, 365, 366, 368, 384, 387, 388, 413, 419, 426, 432.
Thamnobia frontalis, 460.
Thamnophilinæ, 144.
Thamnophilus, 218.
Thamnophilus palliatus, 268, 269.
—— torquatus, 269.
Thecla ilicis, 168.
—— rubi, 101, 168.
Thiellus, 369.
Thinocoridæ, 207.
Thinocorus, 207, 221, 224, 225, 443.
Thinocorus dorbignyanus, 226.
—— rumicivorus, 226.
Tiga, 360.
Timandra ornata, 32.
Timarcha coriaria, 1.
Timelia, 460, 464, 469.
Timeliidæ, 282.
Tinami, 6, 13.
Tinamidæ, 442.
Tityra, 218.
Toccus, 456, 462, 471.
Toccus pœcilorhynchus, 470, 476, 477.
—— semifasciatus, 470.
—— sp. nov., 470.
Todidæ, 207, 345–353.
Todirhamphus sanctus, 35, 36.
Todirostrum cinereum, 264.
Todus dominicensis, 345, 347, 349.
—— viridis, 345, 347, 349.
Totanus calidris, 224.
—— griseopygius, 42.
—— hypoleucus, 451.
—— incanus, 35, 42.
Tracheophonæ, 148, 149, 219.
Tragelaphus, 460, 475.
Tragelaphus scriptus, 459, 460.
Treron, 204, 453, 463, 465.
Trichoglossinæ, 67.
Trichoglossus, 63, 70.
Trichoglossus concinnus, 67.
—— mitchelli, 22.
—— multicolor, 41.
—— swainsonii, 41.
Trichophorus, 465, 466.
Trichothraupis quadricolor, 137.
Trigonocephalus brasiliensis, 249.
Tringa canutus, 226.
—— cinclus, 226.
Troglodytes furvus, 254.
Trogon atricollis, 283.
—— caligatus, 283.
—— mexicanus, 283.
—— puella, 254, 283.
—— reinwardti, 283.
Trogonidæ, 199, 212, 282.
Tropidonotus, 477.
Tropidorhynchus buceroides, 39.
Tubinares, 164, 212, 231, 234, 363–440.
Turdus, 472.
Turdus fumigatus, 252.
—— merula, 5.
—— musicus, 253.
—— pelios, 473, 477.
—— rufiventris, 253.
Turnicidæ, 191, 221, 226, 442.
Turnix, 444–446, 475.
Turnix castanonota, 446.

Turnix dussumieri, 446.
—— lathami, 42.
—— lepurana, 226.
—— melanogaster, 445.
—— melanonota, 42, 445.
—— pyrrhothorax, 446.
—— rufescens, 445.
—— rufilatus, 446.
—— saturata, 445.
—— scintillans, 445.
—— tanki, 446.
—— varia, 445.
—— velox, 446.
Turtur, 457, 460, 465.
Turtur auritus, 5.
—— semitorquatus, 461.
—— senegalensis, 457, 461, 464.
—— vinacea, 463.
Tyrannidæ, 147, 148, 209, 217, 219, 345, 362.
Tyrannus melancholicus, 266.

U.

Upupa, 282.
Upupidæ, 204, 212.
Urania, 295.
Uria, 417, 418.
Uria troile, 7, 9, 13.
Uriidæ, 371.
Urobrachya macroura, 457, 458, 460.

V.

Vanellus cayennensis, 203.
Vanellus cristatus (?), 226.
Vanessa antiopa, 30.
—— atalanta, 30.
—— c-album, 30.
—— cardui, 30.
—— io, 30.
Vidua hypocherina, 160.
—— macrocerca, 454.
—— nigerrima, 160.
—— principalis, 159, 160, 451, 453, 458, 461.
—— splendens, 159, 160.
—— superciliosa, 160.
Viverra, 473.
Viverra civetta, 473.
Volatinia jacarina, 260.

X.

Xantholæma rosea, 323.
Xenicidæ, 360–363.
Xenicus, 360–363.
Xenicus longipes, 360, 361.
Xenorhynchus, 386, 462, 475.
Xenorhynchus australis, 6.
Xerus, 474.

Z.

Zalophus californianus, 316.
Zonotrichia pileata, 250, 261.
Zosterops, 476.
Zosterops luteus, 35, 40.
Zygæna filipendulæ, 31.

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