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TRANSACTIONS

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CONTENTS.

TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY.

I. *On the Anatomy of the Lemuroidea.*

By JAMES MURIE, *M.D., F.G.S., Prosector to the Zoological Society, and* ST. GEORGE MIVART, *F.L.S., F.Z.S., Lecturer on Comparative Anatomy at St. Mary's Hospital.*

Read March 27th, 1866.

[PLATES I. to VI.]

Introductory Remarks.

THE Lemuroidea[1] present many features of especial interest both to the zoologist and the comparative anatomist, because they may be considered, as it were, the transition between the higher Primates and ordinary Mammals, and because of the great varieties and striking peculiarities of form and structure which so many of them exhibit.

In addition to the notices regarding *Lemur* and *Loris* contained in Meckel's 'Comparative Anatomy[2], several special memoirs have from time to time appeared of various genera of the suborder. Such are J. van der Hoeven's treatise on the Potto[3], and F. A. W. van Campen's admirable paper on the same animal[4]; also J. L. C. Schroeder van der Kolk and W. Vrolik's joint paper on *Stenops*[5] recently supplemented by us[6];

[1] Proc. Zool. Soc. 1864, p. 635.

[2] Traduit par MM. Riester et Alph. Sanson, 1830.

[3] Bijdrage tot de Kennis van den Potto. Van Bosman, Amsterdam, 1851.

[4] Verhandelingen der Koninklijke Akademie van Wetenschappen, Amsterdam, 1859.

[5] Bijdragen tot de Dierkunde, uitgegeven door het Koninklijk Zoologisch Genootshap Natura Artis Magistra. Erste Deel. Amsterdam, 1848–54.

[6] Proc. Zool. Soc. 1865, p. 240.

Burmeister's very complete monograph on *Tarsius*[1]; Kingma's[2] Graduation Thesis on *Otolicnus* (*Galago*) *peli*; Professors Owen[3] and Peters's[4] excellent memoirs on *Cheiromys*, and Professor Huxley's able paper on *Arctocebus*[5].

Notwithstanding, a careful comparison and view of the general internal anatomy of the *whole* of the Lemuroidea is still a desideratum. But this, unfortunately, is as yet impossible, if only for the reason that information regarding the internal organs of the *Indrisinæ*[6], *Hapalemur*, *Lepilemur* and others has been heretofore inaccessible to anatomists.

Besides the rare *Indrisinæ*, even the more common genera *Lemur* and *Galago* have received less attention from comparative anatomists than might have been anticipated, considering the peculiar structure of the latter and the fact that the former is the typical genus of the whole suborder.

Under these circumstances, and because specimens of both these genera have come into our possession, we think it advisable to attempt as general a review as the material at our disposal will permit.

For this purpose we have taken the two last mentioned as our basis, and availed ourselves of the several memoirs above referred to for comparison.

We have recently dissected eight species of those two genera, namely, *Lemur catta*, *L. varius*, *L. niger*, *L. xanthomystax*, *L. nigrifrons*, *Galago crassicaudatus*, *G. garnettii*, and *G. allenii*[7].

From this number we propose to select and describe the Ring-tailed Lemur, *L. catta*, in our text, as a type and standard of comparison for the entire suborder of Lemuroidea.

We choose this genus not only because we have been able to give the details of five specimens of it, but also on account of its being, as before said, the type of the suborder, because specimens of *Lemur* are pretty readily procurable, and, finally, on account of their large size enabling anatomical detail to be worked out with greater ease and more certainty.

When we commenced this paper we intended to take *L. catta* as our type, both for description and figures; but finding that the muscles of that animal have been delineated by Cuvier and Laurillard in their magnificent 'Planches de Myologie,' we have judged

[1] Beiträge zur näheren Kenntniss der Gattung *Tarsius*. Berlin, 1846.

[2] Eenige Vergelijkend-Ontleedkundige Aanteekeningen over den *Otolicnus peli*. Eene Academische Proeve door P. Hoekema Kingma. Leyden, 1855.

[3] Trans. Zool. Soc. vol. v. p. 33.

[4] "Ueber die Säugethiergattung *Chiromys*," Abhandlungen der Königl. Akad. der Wissenschaften zu Berlin, 1865.

[5] Proc. Zool. Soc. 1864, p. 314.

[6] Since this paper was read, M. Alfred Grandidier has brought to Paris from Madagascar a new species of the *Indrisinæ* preserved in spirits of wine. M. Alphonse Milne-Edwards is, we are glad to say, about to describe fully the anatomy of this animal; and thus a most important gap in our knowledge of the Lemuroidea will be filled up.

[7] For the opportunity of examining this specimen we are indebted to the kindness of Mr. W. H. Flower, F.R.S.

it better to figure *Galago crassicaudatus*. We have not, however, thought it necessary to rewrite the whole of the descriptions, and have therefore retained *L. catta* as our type in the text.

The skeleton, dentition, and brain of the animals composing this group having already been extensively investigated and compared the one with the other, we think it superfluous to retread the same ground. In the present memoir, therefore, omitting the consideration of those structures, we rather confine ourselves to a comparison of some external points, the muscles, the viscera, the generative organs, the blood-vessels, and the nerves of the several genera of the suborder. The present communication treats only of the external points and the myology.

Except where distinctly stated, it is to be understood that we have not been able to ascertain any divergence from the structure of *L. catta* in the other species or genera of Lemuroidea here referred to.

As regards the genera *Perodicticus* and *Tarsius*, however, we are unable to say as to some points whether there is an agreement or not, owing to the silence of the authors already mentioned respecting certain myological details.

The loss the Society sustained in the death of their fine specimen of Aye-Aye (*Cheiromys madagascariensis*) has been to us a gain, inasmuch as it has supplied us with the means of comparing Professor Owen's myological description with nature, and of adding details which he did not deem it necessary to state, but which are useful for our comparisons.

I. On some External Characters.

The object of the present memoir, as has been stated, is chiefly a comparison of the internal anatomy of the group; but, considering the correlation between external form and internal structure, we cannot altogether pass over the former in silence. This appears to us necessary, as the whole of the Lemuroidea, in spite of their seemingly great diversity of type, have strong external family resemblances accompanying those common characteristics of internal anatomy which separate them so sharply from the higher Primates.

The external characters differentiating the various groups of the suborder have already been sufficiently described by previous writers. We propose, then, simply by a few remarks to direct attention to:—1st, the general form of the body; 2nd, the head and ears; 3rd, the conditions presented by the extremities.

1. *General form of the Body and Limbs.*

Great as is the difference which seems at first sight to exist between such an animal as the Ring-tailed Lemur (*Lemur catta*), our type, on the one hand, and the Slow Loris (*Nycticebus tardigradus*) on the other, yet the whole of the Lemuroidea, from *Indris* to *Cheiromys*, agree together in the following points.

The trunk is relatively long, laterally compressed, and the abdomen slender[1]; and no deviation is presented in this respect even by that abnormal form *Cheiromys*[2]. That resemblance to the Rodentia which many have thought could be traced in the Aye-Aye is entirely fallacious, as has been recently demonstrated by Professors Owen[3] and Peters[4].

In the very great majority of cases this elongated body is terminated by an elongated tail, as in *Lemur catta* and its congeners; but, as is well known, this appendage is obsolete in *Loris* and *Nycticebus*, and is very short in *Arctocebus* and also short in *Perodicticus* and *Lepilemur*. In some Lemurs (e. g. *L. niger* and *L. varius*) the tail assumes more of a bushy character; this is carried to an extreme in *Cheiromys* and some Galagos (e. g. *G. crassicaudatus*; see the representation of this animal from a photograph, Pl. I. fig. 1).

In all cases the pelvic limb is longer than the pectoral one, and this whether their respective extremities (pes and manus) are or are not included[5].

As is well known, certain genera (e. g. *Galago* and *Tarsius*) present an elongation of the tarsal part of the leg which is altogether peculiar, and no approximation to which is possessed by any other order of the vertebrate subkingdom save the sufficiently remote Batrachia[6].

[1] In Dr. Peters's figure of *Galago crassicaudatus* (Reise nach Mossambique, Säugethiere, i. tab. ii.) the abdomen is represented so distended, and the apparent line of demarcation between it and the hind limb is so imperfect, that we suspect it must have been taken from a badly stuffed specimen.

[2] This slenderness of the abdomen is well shown in Owen's memoir referred to, Zool. Trans. vol. v. pls. 16 & 17.

[3] *Op. cit.*

[4] *Chiromys*. Berlin, 1866.

[5] See St. G. Mivart, Phil. Trans. 1867, p. 382.

[6] What this elongated Lemurine tarsus denotes is one of those questions which might well provoke discussion. The singular fact of such a structural resemblance existing between creatures supposed almost as remote in habit as in zoological position and affinity, seems at first an inexplicable puzzle, whether on teleological or developmental hypotheses. Such, indeed, it did appear to us until, so to speak, our eyes were opened to habits in the Galagos which previously we were perfectly unacquainted with, and are not aware that any one hitherto has published an account of the same. To Mr. Bartlett, Superintendent of the Society's Gardens, is due the honour of this discovery, and we are indebted to him for permission to incorporate in our Memoir the subjoined letter. He also kindly allowed us ample opportunity of studying the movements of the live animal, enabling us to depict (see Pl. I. fig. 2) the peculiar attitudes which he himself so ably describes, and which we can unhesitatingly corroborate. On the 1st September, 1868, he writes:—

"My dear Murie,—You well know that I have long been much interested in the Lemuridæ, and have published several accounts of the habits of some of them in captivity. While you are at work on the group, therefore, I am sure you will be as pleased as I myself was to know what a wonderful and active little fellow Garnett's *Galago* is. The other night I took an opportunity of letting one of these interesting animals have his liberty in my room, and I assure you I was well repaid by his performance. Judge my utter astonishment to see him on the floor jumping about *upright* like a Kangaroo, only with much greater speed and intelligence. The little one sprung from the ground on to the legs of tables, arms of chairs, and, indeed, on to any piece of furniture in the room: in fact, he was more like a sprite than the best pantomimist I ever saw. What surprised me most was his entire want of fear of dogs and cats. These he boldly met and jumped on at once, and

It might be expected that the elongation of the pelvic limb, as compared with the pectoral one, would proceed *pari passu* with this tarsal extension. Such, however, is not the case; for though in *Galago* it is at its maximum, yet in *Indris* the proportion of the pelvic limb to the pectoral one very much exceeds that which exists in *Tarsius*, as well when the terminal segments of the limbs are included in the estimate as when they are not so.

On the other hand, if the pectoral limb with the manus be compared with the trunk, it is found to exceed the latter only in *Loris*, *Tarsius*, and *Cheiromys*; without the manus it does so only in *Tarsius*.

A similar maximum of development of the pelvic limb as compared with the body is presented by the same genus, and this even when the pes is excluded from the estimate.

2. *The Head and Ears.*

With regard to the form of the head the Lemuroidea present great variations; and this is the case even with forms very closely allied. Our type (*L. catta*), like all the species of the genus, has the well-known elongated, almost fox-like, muzzle (woodcut, fig. 1). In *Indris*, on the contrary, while the larger species (*I. diadema* and *I. brevicaudatus*) have a muzzle approaching in elongation that of Lemur, the smaller kinds (*I. laniger* and *I. verreauxii*) have the snout quite short and the head rounded, approximating in this respect to *Galago* (fig. 2) and *Microcebus*, which lead to the more square-visaged or short-snouted *Cheiromys* and *Nycticebus* (see fig. 3).

It might be expected *à priori* that in a group the species of which differ notably in size, a similar difference in the relative proportions of cranium and face would be found to coexist. This at least is the case in the *Cynopithecinæ*[1] amongst the higher Primates, where examples show such concomitant variations.

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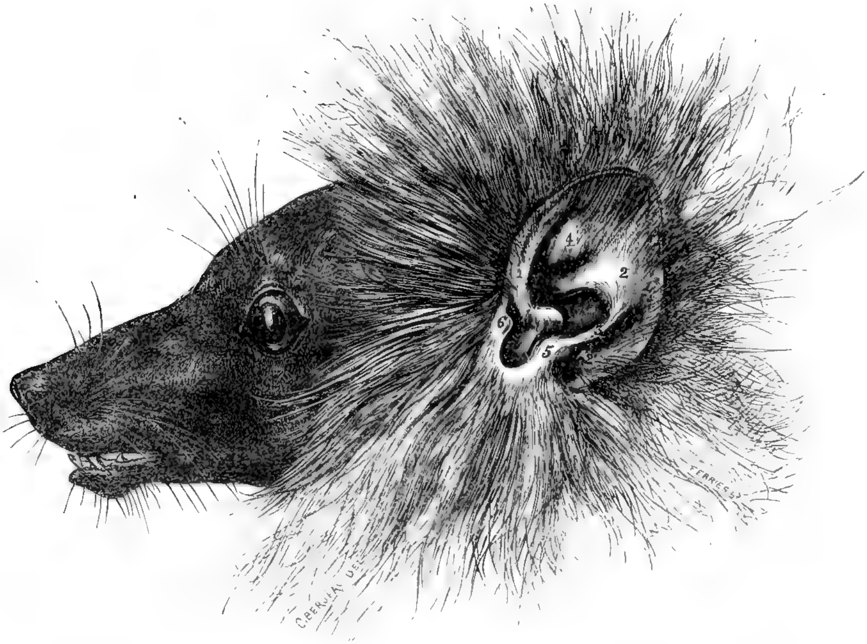
in the most playful manner hugged and tumbled about with them, rolling over and over, hanging on their tails, licking them on the head and face. I must add, however, that now and again he gave them a sharp bite, and then bounded off, full of fun at the noise they made in consequence of the sly nip he had inflicted. This active trickery he never appeared to tire of; and I was myself so pleased on witnessing the droll antics of the creature that the night passed and it was near daybreak before I put a stop to his frolics by catching and consigning him to his cage. In bounding about on the level ground, his jumps, *on the hind legs only*, are very astonishing, at least several feet at a spring, and with a rapidity that requires the utmost attention to follow. From the back of a chair he sprung, with the greatest ease, on to the table, four feet distance. He was delighted with a little wooden ball, which he rolled about and played with for a considerable time, carrying it on one hand while he hopped and skipped about in high glee.

"One more word, and that about food. It eats fruits, sweetmeats, bread, and any kind of animal substance, killing everything it can pounce upon and overpower. This strong and active little brute thus eats its prey at once, as I had proof in an unfortunate sparrow which it unmercifully devoured head first."

[1] This subfamily including the genera *Cercopithecus*, *Macacus*, *Inuus*, and *Cynocephalus* (Proc. Zool. Soc. 1865, p. 547).

Fig. 1.



Lemur niger, ♀, nat. size.

Fig. 4.

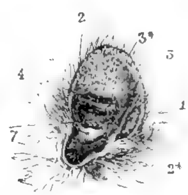


Fig. 2.

Galago crassicaudatus, nat. size.

Fig. 3.

Nycticebus tardigradus, nat. size.

The ears are always fairly, often considerably, developed, and their relative size is a more constant character in certain groups than is the prolongation or shortness of the muzzle.

Their occasionally great mobility during life and flexibility after death, however, renders this character of little value as regards stuffed specimens; for, as Dr. Gray has remarked[1], they are apt to become so much distorted artificially in the drying.

The ears are smallest in the *Nycticebinæ* (woodcuts, figs. 3 & 4) and in *Lemur* (woodcut, fig. 1), where they are less than half the external length of the head.

On the other hand they attain their maximum of relative, and indeed of absolute, size in *Galago*, *Tarsius*, and *Cheiromys*. In the first-named genus of these three they exceed three quarters of the extreme length of the head (woodcut, fig. 2).

In *Galago*, also, their mobility during life is extreme. Attention was first called to this fact by Mr. A. D. Bartlett[2], who has figured his *G. monteiri* with one of its ears elevated, and the other depressed. We ourselves have repeatedly noticed and experimented on the ears of *G. maholi*. In this tiny animal the rapidity and great power of contraction of the pinna when the creature is alarmed or irritated, is something remarkable. This puckering of the ear is shown in *Galago garnettii*, Pl. II. fig. 4.

The hair about the ears or on them sometimes attains a noteworthy length[3]. Thus the ears are tufted in *L. varius*, while in *L. niger* (woodcut, fig. 1) the ear is surrounded by a circlet of very long hairs, which radiate round it in all directions, giving the animal quite a remarkable appearance.

The ears of the Lemuroidea are sensibly different in shape from those of Man and Monkeys.

As to the folds and prominences which compose the pinna of the external organ of hearing in the several genera of the Lemuroids, they are as follows:—

In *Lemur* (see woodcut, fig. 1, of *L. niger*) there is no distinct lobule. The helix is flattened out posteriorly, so that it forms the actual postero-external margin of the pinna (woodcut, fig. 1, no. 1*); but at the anterior margin of the pinna (no. 1) it forms a deep fold overhanging the fossæ of the antihelix and concha (nos. 4 and 7). The antihelix (no. 3) is a prominent though short fold; and there is a deepish pit existing (at no. 2*) between it and the adjacent part of the helix. This latter almost disappears towards the middle of the pinna, then suddenly reappears as a short but very prominent horizontal ridge, which dips beneath the recurved anterior bend of the helix before mentioned. This short horizontal fold appears to answer to the lower of the two prominences forming the anterior bifurcation of the human antihelix. Of the

[1] Proc. Zool. Soc. 1863, p. 144.

[2] P. Z. S. 1863, p. 231, and pl. xxviii.

[3] Dr. Gray, *loc. cit.*, has made use of the presence or absence of a tuft on the ears and a ruff round the head as marks to distinguish his subdivisions of the genus *Lemur*,—subdivisions which we are unable to adopt, being convinced that all the species form but one natural genus.

upper part of that bifurcation there appears to be no trace. Both the tragus (woodcut, fig. 1, no. 6) and antitragus (no. 5) are fairly developed; of the two the antitragus is rather more developed. The fossæ of the helix and antihelix (woodcut, fig. 1, nos. 2 and 4) are broad and flat; the fossa of the concha (no. 7) is broad and deep.

The appearance of the ear in *Microcebus* as figured by Peters[1] is not unlike *Galago*'s; that author only says the helix widens tolerably opposite to the antihelix, so that the anterior part of the latter is hidden. The transversely wrinkled character of the pinna in his delineation seems to indicate mobility and power of folding it as in *Galago*.

In *Galago* (woodcut, fig. 2, Pl. II. fig. 3, and Pl. III. fig. 5) the conditions are essentially similar; but the anterior fold of the helix is much smaller and less marked, while the fossa between the helix and antihelix just above the antitragus assumes more the form of a pit (no. 2*).

The greater size of the ear is mainly produced by the much greater extension of the fossæ of the helix and antihelix, together forming a uniform concave expansion (nos. 2 and 4) traversed by faintly marked transverse lines, which become transverse grooves when the ear is contracted in the way before noticed.

In *Nycticebus tardigradus* (woodcuts 3 & 4) the general form of the ear, as before said, resembles more that of *Lemur* than that of *Galago*. But the anterior fold of the helix is less marked than in *Lemur*, and the fossa between the helix and antihelix, where they diverge, is more enclosed and pit-like (fig. 4, no. 2*).

A remarkable character by which it differs from these genera is the presence and large development of a horizontal fold (woodcut, fig. 4, no. 3*), which appears to answer to the upper part of the anterior bifurcation of the human antihelix; though this is not so largely developed as the horizontal fold (no. 3) corresponding to the lower branch of the same bifurcation in Man. This latter fold is present as in *Lemur* and *Galago*; and thus between the two prominent, though short, horizontal folds first mentioned there is enclosed a deep, but small, fossa of the antihelix (woodcut, fig. 4, no. 4), having quite a pouch-like appearance.

The tragus and antitragus are so small as to be almost obsolete.

In *Arctocebus* a similar condition obtains as to the fossa and fold of the antihelix[2].

Tarsius[3] approaches the form of ear possessed by *Galago* and *Microcebus*; the tragus appears, however, to be relatively more marked; but the pit (=2*) above the antitragus is wider and shallower than in *Galago*.

Burmeister acutely observes that the peculiarities of structure in the ear of *Tarsius* are not strictly confined to it, but partly exist in Bats and in Rodents.

[1] Reise nach Mossambique, 1852, Säugethiere, pl. iii. p. 15.

[2] Huxley, P. Z. S. 1864, pp. 317, 318, fig. 1, *a*, *b*. He speaks of these branches of the antihelix as "the two singular transverse ridges," and quotes a previous description by Dr. John Alexander Smith, Roy. Phys. Soc. Edin. April 25, 1860.

[3] Burmeister, *op. cit.* p. 7, pl. i.

Cheiromys[1] differs little, if at all, from *Galago* in the configuration and development of the external ear; except, it may be, in the relatively diminished size of the expanded fossa of the antihelix, and in the shallower and broader condition of the pit (=2*) above the antitragus. In the general appearance and position of the ear-folds the Aye-Aye resembles *Lemur*; but size differentiates the one from the other.

3. *The Extremities* (*Manus and Pes*).

There is a striking diversity between the development of the various digits in Man and Apes and their condition in Lemuroids, *i. e.* the Anthropoidea and Lemuroidea.

While in the former group the four ulnar or peroneal digits are, without exception, well developed, the inner, *i. e.* radial or tibial digit, is subject to great variation, the pollex being quite rudimentary in *Colobus* and *Ateles*, while the hallux is diminutive in the *Simia* and *Hapale*.

In the second group, on the other hand, the innermost digit, whether of manus or pes, is invariably well developed; but some abnormality continually crops out in the index or third digit of one or other extremity,—for example, the claw-like nail so constant in the index of the pes, and in the index and third digit also in *Tarsius*, the extreme attenuation of the third digit of *Cheiromys*, the general shortness of the index of the manus and its rudimentary condition in *Arctocebus* and *Perodicticus*.

With regard to the fleshy pads of the palms of the hands we find the conditions to be as follows:—

In *Lemur* (woodcut, fig. 5) one very large pad, the largest of all (no. 1), occupies the position of the ball of the thumb in Man. In front of this a very considerable pad (no. 2) occupies the base of the root of the index. Another, much smaller, pad (no. 3) is placed behind the roots of the third and fourth fingers. Another pad, not quite so large (as that belonging to the index), (no. 4) is placed at the root of the fifth digit. Indistinctly below the last-mentioned pad, running along the ulnar border of the palm, are two others placed anteroposteriorly, one behind the other (nos. 5 and 5*). The anterior of these two (no. 5) is the smallest of all the pads. The posterior one (no. 5*) is of nearly the same size as that at the root of the index.

In *Galago* (woodcut, fig. 7), instead of one large pollicial pad there are two (nos. 1 and 1*) (separated by a deep furrow), placed one in front of the other. The anterior of these (no. 1*) is the larger, and projects freely forwards between the pollex and index.

The indicial pad of *Lemur* is represented by a very large one in *Galago* (no. 2), the anterior end of which projects between the second and third digits. The rest is as in *Lemur*, except that but one single pad (no. 5) appears to represent those two which in *Lemur* occupy the posterior part of the ulnar border of the palm. In *Microcebus myoxinus* Dr. Peters[2] says there are five palmar eminences, the three smaller at the

[1] Owen, Trans. Zool. Soc. vol. v. p. 43, and pls. iv.–xviii. Also Peters, 'Cheiromys,' Berlin, 1866, p. 82, and pl. i. fig. 1.

[2] Reise nach Mossambique, p. 15.

basis of the fingers, and two larger towards the root of the wrist. The last two we may suppose to correspond to nos. 1 and 5, 5* of *Lemur*.

Fig. 5.

Fig. 6.

Fig. 5. Palmar surface of hand of *Lemur niger*: nat. size. Fig. 6. Plantar aspect of foot of the same.

In *Nycticebus tardigradus* (fig. 9, p. 11) the conditions presented are the same as those in *Galago*, except that two small pads placed side by side (nos. 3 and 3*) take the place of that single pad which in *Lemur* and *Galago* is located between the roots of the third and fourth digits.

In *Tarsius* there is a single large oval pollicial pad; and Burmeister[1] further mentions that between the roots of the middle and other digits there are two very high round ones; and opposite the ball of the thumb, towards the outer border of the palm, there is a long figure-of-eight-shaped palmar cushion.

Cheiromys[2] in some respects more nearly approaches *Lemur* than it does the other genera, inasmuch as the pad at the base of the thumb is broad, flat (or very gently rounded), and with no marked tendency to duplication. Of the three somewhat smaller pads at the proximal ends of the index, annulus, and fifth digits, the middle one (that which in *Lemur* is equidistant between the third and fourth digits) is here in *Cheiromys* almost entirely opposite the annulus, the attenuated middle finger in a measure being excluded from its proper share of the palmar cushion.

[1] *Op. cit.* p. 9.

[2] Owen, *loc. cit.* p. 44; and Peters, 'Cheiromys,' p. 83, tab. i. fig. 2.

The pads on the plantar surface of the foot (*pes*) are less numerous and less distinct than those on the palmar surface of the hand (*manus*) in all three forms.

Fig. 7.

Fig. 8.

Fig. 10.

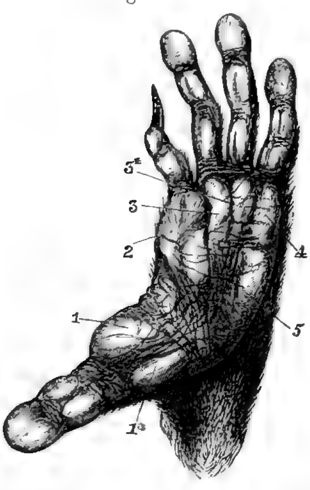


Fig. 9.

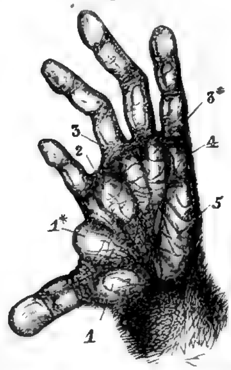


Fig. 7. Palmar surface of fore foot, and Fig. 8. Plantar surface of hind foot of *Galago crassicaudatus*. Fig. 9. Palm, and Fig. 10. Sole of *Nycticebus tardigradus*: all nat. size. The lettering corresponds to that in Figs. 5 & 6, and is referred to in the text.

In *Lemur* (fig. 6, p. 10) one large pad (no. 1), marked by so deep an antero-posterior furrow as almost to be divided into two, is placed between the first and second metatarsals. A considerable pad (no. 2) is placed beneath the root of the index, and two smaller subequal ones (nos. 3 and 4) respectively between the roots of the third and fourth and the fourth and fifth pedal digits. Another, elongated but narrower, pad (no. 5) occupies the peroneal border of the sole.

In *Galago* (woodcut, fig. 8) the pad beneath the hallux is not marked by so deep a furrow (if by any) as in *Lemur*. The other pads are similar, except that a rather shorter one occupies the place of that elongated pad which is placed beneath the peroneal border of the sole in *Lemur*.

A marked difference, indeed, is presented between *Lemur* and *Galago*, in the large extent of hairy surface at the hinder part of the sole corresponding with the elongated naviculare and os calcis.

In *Microcebus myoxinus* Peters[1] mentions that the naked anterior sole of the foot has six pads, of which that between the first and second toes is found particularly large. He does not state, however, whether there is a tendency to division in the hallucial eminence.

In *Nycticebus tardigradus* (woodcut, fig. 10) the pad beneath the hallux is marked by a depression which seems to correspond to the antero-posterior groove of *Lemur* opened out (nos. 1 and 1*). The pad beneath the root of the index (no. 2) has another, smaller pad placed immediately behind it, while the third and fourth digits have each their own, very small pad placed at the root of each respectively (nos. 3 and 3*). The pad at the root of the fifth digit (no. 4) is very imperfectly divided from the one bounding the peroneal side of the sole behind it (no. 5).

In *Tarsius*, according to Burmeister's description[2], there are three, unequal, elliptical, transversely wrinkled pads, of which the largest corresponds to the ball of the great toe; the middle one occupies the base of the second and third digits; and the smallest but longest one, partly applied to the outer border of the foot, is placed opposite the fourth and fifth digits.

In *Cheiromys* the plantar surface of the foot and the pads thereon correspond almost identically with those of *Lemur*. The peculiar delicate tracery or papillary structure and the fine parallel lines upon the pads themselves, both of the hand and foot, have been beautifully illustrated in Peters's monograph (*op. cit.* tab. i. figs. 2 and 4).

II. Muscular System.

1. *Muscles of the Head and Neck.*

a. *Epicranial and Auricular Regions.*

Occipito-frontalis.—This muscle is well marked in *Lemur catta*, and covers each side of the skull, its fibres being far more strongly developed posteriorly. Its origin and insertion are as in Man.

In *L. varius* the muscular fibres are very sparse, the entire sheet of aponeurotic and fibrous material being exceedingly delicate.

[1] *Loc. cit.* p. 15. [2] *Loc. cit.* p. 10.

In *Galago crassicaudatus* (see Pl. II. fig. 3, and Pl. III. fig. 6, *O.f*), although thin, it is a well-developed sheet, and nearly throughout muscular. Its continuation into the ear-muscles would seem to aid in producing the peculiar epicranial movements so characteristic of this species and its allies. In the specimen of *G. garnettii* dissected by us, it was remarkably thin, but otherwise similar to the above, as we observed also in *G. allenii.*

The Attollens aurem is represented by a broad and thin muscular layer, united above with the occipito-frontalis, and inserted into the upper part of the tragus.

In *G. crassicaudatus*, as in some degree also in *G. garnettii* and *G. allenii*, it is very strongly marked, being in fact a continuation of the broad occipito-frontalis. It seems to spread out as a thin and delicate sheet over the anterior part of the dorsum of the external ear for at least half its length.

Van Campen[1] mentions that in Potto its fibres mingle with the occipito-frontalis.

Our description of this muscle in *L. catta* seems to agree with Burmeister's account of the same muscle in *Tarsius*[2].

Attrahens aurem.—This is represented by some rather indistinctly separated fibres of the lower border of the occipito-frontalis muscle, which are inserted into the anterior part of the concha.

In *Galago crassicaudatus* (Pl. II. fig. 3, *At. a*) this (as well as the other auricular muscles) is well developed; and its fibres, imbedded in a thin sheet of fascia continuous above with the attollens and occipito-frontalis, arise from the posterior margin of the orbit, and are inserted as in *Lemur*. The fibres are most marked and numerous towards the helix. In some respects it may be said even to be stronger in *G. garnettii.*

In *Perodicticus*[3] it is short.

In *Tarsius*[4] it is less developed than in *G. crassicaudatus*, in this rather approaching to the *Lemurs.*

Retrahens aurem.—This is a narrow band of muscle arising from the superior curved line of the occiput as far forwards and inwards as its junction with the temporal ridge. It is inserted into the posterior part of the concha.

In *G. crassicaudatus* (Pl. III. fig. 6, *Re.a*[1], *Re.a*[2], *Re.a*[3]) the retrahens aurem is represented by at least three separate slips, much in the manner described by Burmeister in *Tarsius* (see below). The anterior slip is the largest.

In *Perodicticus*[3] it appears to be represented by two thin slips of muscle, but with the same attachments as in *Lemur catta.*

In *Tarsius*, Burmeister[5] says, there are four muscular bundles which compose the retrahens aurem. The first and largest arises from the upper part of the ligamentum nuchæ, the middle line of the occiput, and posterior part of the sagittal suture, becoming narrower as it reaches the upper part of the ear. The three other smaller bundles lie

[1] *Loc. cit.* p. 24. [2] *Loc. cit.* p. 31, tab. 3. fig. 1, η. [3] *Loc. cit.* p. 24.
[4] *Loc. cit.* p. 32, tab. 3. fig. 1 (ι). [5] *Loc. cit.* p. 32, tab. 4. fig. 1. K. 1, 2, 3, 4.

under the first; they spring from the lambdoidal suture close to each other, from above the middle of the insertion of the cleido-mastoid, and, running parallel, are inserted into the back of the ear. The longest is above, the shortest beneath.

The muscles of the external ear in the genus *Galago* are peculiar in their complexity; and their action has, as before said, been noticed by Mr. A. D. Bartlett in the P. Z. S. 1863, p. 231. *G. monteiri*, he says, "has the power of turning its ears back and folding them up when at rest," which phenomenon is well displayed in the excellent plate, no. xxviii., in the same volume.

The action (produced by muscles, the fibres of which are of the striped variety, and mainly by the retrahens aurem) consists in a folding downwards of the summit of the ear behind its posterior margin, producing a wrinkling of the ear, which is thrown into numerous transverse folds, reminding us of a fan closed, or of the reefing of a ship's sail. This evidently is by the muscular contraction acting from behind, namely, the powerful retrahens aurem and mingled fibres of the attollens. The former of these, covering more or less the dorsum of the ear, seems to drag the point backwards and downwards, and while so doing creases the membrane of the ear itself (Pl. II. fig. 4).

b. *Facial and Mandibular Regions.*

The ORBICULARIS PALPEBRARUM in *L. catta* surrounds the orbit as usual.

In *Lemur varius* it is figured by Cuvier, 'Planches de Myologie,' pl. 69. fig. i, *d*.

The circlet of muscular fibre representing this muscle in *Galago crassicaudatus* is broad, agreeing thus with the large orbit and eyelids which this animal possesses (Pl. II. fig. 3, *O.p*). In *G. allenii*, though a small animal, this muscle is very distinctly marked; and the fibres, firmly attached to the skin, as usual, form a subcircular band round the orbit.

In *Loris gracilis* it is, as might be expected, large, as represented by Cuvier[1].

It is very thin in *Tarsius*[2].

TEMPORALIS.—This is strongly developed (as Meckel says[3], "*surtout les makis l'ont plus fort que l'homme*), and has the usual origin and insertion; but its anterior portion is continued along the outer margin of the coronoid process, and is inserted by a distinct narrow tendon with a pit at the junction of the ascending ramus with the horizontal one.

Its insertion is not shown in Cuvier's figure[4] of *Lemur varius*.

In *L. xanthomystax* and in *L. nigrifrons* we found this muscle equally large; and the part giving rise to the aforesaid tendon is easily resolvable into a separate superficial layer of muscles. In this latter respect there is an approach to the condition found in some of the *Rodents*[5].

In the *Galagos* this muscle answers to the description above given of it in *L. catta*. See that of *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. fig. 6, and Pl. IV. fig. 11, *Te*).

[1] *Loc. cit.* pl. 67. figs. 1 and 2, *d*. [2] *Loc. cit.* p. 30, tab. 3. fig. 1, *a*. [3] Anat. Comp. vol. viii. p. 751.
[4] *Loc. cit.* pl. 69. fig. 1, *b*. [5] See Meckel, vol. viii. p. 577, and P. Z. S. 1866, p. 389.

In *Loris gracilis* it is rather small[1].

In *Tarsius*, according to Burmeister[2], it is double. The outer or anterior portion springs from the anterior half of the linea semicircularis of the frontal and temporal fossa. The inner and hinder part springs from the entire length of the same linea semicircularis.

In *Cheiromys*, Owen[3] says it derives many fibres from the strong temporal fascia.

MASSETER[4].—This muscle is rhomboidal in shape and arises from the whole length of the zygoma. It is inserted into the concavity outside the ascending ramus of the mandible and into its angle, pretty well shown in Cuvier's figure (pl. 69. fig. 1, *j*) of *Lemur varius*.

Substantially the same in the Galagos: that of *G. crassicaudatus* is shown in Pl. II. fig. 3, and Pl. III. figs. 5 & 6, *Ma*. In *Loris gracilis* it is of moderate size[5]. In *Tarsius*[6] it consists of two layers—an outer and anterior, and an inner or posterior one.

Owen[7] says that in the Aye-Aye the masseter consists of two portions, an external and an internal. "The external fibres pass downward almost parallel, to be inserted into the lower border of the posterior half of the mandible; they are separated by a thin glistening aponeurosis from the internal portion, the fibres of which pass a little forward as well as downward. These two portions blend together anteriorly, the inner portion is inserted into the outer surface of the broad ascending ramus. There is no trace of an accessory masseter such as exists in many Rodents."

ORBICULARIS ORIS.—In *Lemur catta* this is a very elongated narrow muscle, agreeing with the length of the jaws[8].

It is with some difficulty the fibres can be separated from those of the cheek and nasal muscles[9] in the Grand Galago (Pl. II. fig. 3, and Pl. III. fig. 5, *O.o*).

In *Loris gracilis* it is relatively larger than in *Lemur*, as shown by Cuvier in the sixty-seventh plate of his 'Planches,' fig. 1, *l*. In *Tarsius*[10] it is very weak.

Van der Hoeven speaks of its being much intermixed with the other lower facial muscles in the Potto[11].

NASAL MUSCLES.—In the Lemuroids generally, the naso-labial region being more or less elongated and produced, the nasal muscles proper, with those of the upper lip, form a broad and very extensive sheet reaching from the orbits to the nostrils. This sheet appears to represent the conjoined *zygomatici, levator labii superioris alæque nasi*, &c. (Pl. II. fig. 3, *Na.*).

The BUCCINATOR in the genus *Lemur* is also somewhat elongated in shape[12].

[1] Cuvier, pl. 67. figs. 1 and 2, *b*. [2] *Loc. cit.* p. 33, tab. iv. figs. λ, λλ. [3] *Loc. cit.* p. 59.

[4] Meckel, *l. c.* p. 752, considers it relatively more developed in the Lemurs than in Man.

[5] Cuvier, *l. c.* pl. 67. figs. 1 and 2, *j*. [6] *Loc. cit.* p. 32, tab. 3. fig. ϑ, and tab. 4. fig. 9, ϑϑ.

[7] *Loc. cit.* p. 59. [8] Cuvier, *l. c.* pl. 69. fig. 1, *l*.

[9] Meckel, *op. cit.* vol. viii. p. 751, alludes to this circumstance in speaking of the muscles of the lips in Quadrumana generally, and further notices the intimate relation of the cutaneous fibres with them.

[10] *Loc. cit.* p. 31, tab. 3. fig. 1, ζ. [11] *Loc. cit.* p. 24. [12] Cuvier, *l. c.* pl. 69. fig. 1, *k*.

It is well marked though not readily distinguished from the posterior fibres of the orbicularis oris in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. III. fig. 5, *Bu*).

In *Perodicticus*[1] it is very thin, otherwise much as in Man. The duct of Stenon passes through it above.

In *Tarsius*[2] it springs from the under surface of the malar bone and masseter muscle, from the surface of the superior maxillary bone joining the orbicularis oris; and its fibres extend to the mandible and orbicularis oris.

The distorted condition of the incisors and jaws in the specimen of Aye-Aye dissected by us interfered with the natural condition of the parts in the neighbourhood of the mouth.

External Pterygoid.—This arises from the upper surface of the maxilla and the outer surface of the palatine bone beneath the orbit. It is inserted into the neck of the mandible beneath the condyle.

Identical in the *Galagos* (Pl. V. figs. 17 & 18, *E.pt*). In *Tarsius*[3] it is said to spring in the orbit from the *os ethmoideum* near the optic foramen.

Internal Pterygoid.—This springs from the pterygoid fossa and the outer surface of the external pterygoid process, and is inserted into the inner side of the angle of the mandible.

That of *Galago crassicaudatus* is figured by us in Pl. V. figs. 17 & 18, *I.pt.*

In *Tarsius*[4] this is larger than the external pterygoid; it arises from the space between the two ascending branches of the pterygoid, and contains a strong internal tendon.

c. *Hyoidean and Inframandibular Regions.*

Sterno-cleido-mastoid.—This muscle is largely developed, and arises by a strong tendon from the manubrium, and by muscle from the inner third of the clavicle. As it passes forwards and upwards, the clavicular portion becomes covered by the sternal part[5]. The two portions are inserted into the skull behind the meatus auditorius externus.

Cuvier, in his 'Planches de Myologie,' pl. 68. fig. 1, letters a and b, quite agrees with the appearances we found, except that the sterno-mastoid (*b*) seems to consist of two parts, *i. e.* to be longitudinally divided. In the list of muscles in the text, however, a and a' are described as indicating the trapezius (*dorso-sus-acromien*); and at pl. 69. fig. 1, a large broad muscle, marked a and a', is represented as passing downwards and backwards from the neck and occiput to the clavicle. We, however, have found no such muscle apart from cutaneous fibres, though several specimens were examined by us to ascertain the correctness of the delineation.

In *Galago crassicaudatus* (Pl. III. fig. 5, *St.m*, and *Cl.m*, and Pl. II. fig. 3, *St.m*) and in *G. garnettii* it is tolerably strong, and there is only a moderate division into two parts. In *G. allenii*, on the other hand, it is rather feebly developed. In *G. peli*[6] the

[1] Van Campen, *op. cit.* p. 23.
[2] *Loc. cit.* p. 32.
[3] *Loc. cit.* p. 33.
[4] *Loc. cit.* p. 33, tab. 5. fig. 14.
[5] Meckel, Anat. Comp. vol. vi. p. 169.
[6] Kingma, *l. c.* p. 21.

thoracic portions of this muscle are said to be quite divided and to be so broad at its insertion as to meet above its fellow of the opposite side.

In *Loris gracilis* both portions of this muscle are largely developed[1].

In *Nycticebus tardigradus* it is as in *Lemur catta*.

Burmeister describes this muscle as divided into two in *Tarsius*[2], viz. (*a*) the cleido-mastoideus or larger portion, and (*b*) the sterno-mastoideus the smaller part. The former (*a*) arises from the upper border of the clavicle and is inserted upon the curved line of the occiput. The latter (*b*), a rounder muscle, springs from the upper end of the sternum, and is inserted into the skull behind the ear, but before the first part of the muscle.

Owen says that in *Cheiromys*[3] it is as we have above stated it to be in *L. catta*, except that the cleidal portion arises from the middle third of the clavicle.

STERNO-HYOID.—This muscle arises deeply within the thorax from the upper or inner surface of the sternum between the cartilages of the second and third ribs. It is inserted into the os hyoides just within the insertion of the omo-hyoid. It is closely united with its fellow of the opposite side.

Cuvier represents in *Lemur varius* the two sterno-hyoids as fused into one single muscle (*l. c.* pl. 68. fig. 1, *x*). In his pl. 69. fig. 1 the same muscle is erroneously marked *y*.

In *Galago crassicaudatus* (Pl. III. fig. 5, *S.hy*, *S.hy**, and *S.hy***) it is much as in *Lemur*, as is also the case in *Loris gracilis*[4] and Potto[5].

Each muscle is broad, but presents no difference in its attachment in *Tarsius*[6].

In *Cheiromys* Owen[7] says merely "they gradually contract as they ascend," and are closely connected together in the middle line.

The STERNO-THYROID also has origin deeply within the thorax and in common with the sterno-hyoid. It is inserted into the outer side of the posterior (lower) border of the thyroid cartilage, partly figured by Cuvier in his 'Myologie,' pl. 68. fig. 1, x^1, and also in pl. 69. fig. 1, where it is wrongly marked y^1, which letter in the list of muscles is said to designate the *thyro-pharyngien*!

In *Galago crassicaudatus* (Pl. III. fig. 5, *S.th*) as in the genus *Lemur*.

At the sternum these muscles are hardly resolvable into two bellies in *Tarsius*[8].

THYRO-HYOID.—This is as usual a continuation of the last, going from the outer side of the thyroid cartilage to the posterior cornua of the os hyoides. It is indicated by Cuvier in his 'Planches de Myologie,' pl. 68. fig. 1, *y*. For this muscle in *Galago crassicaudatus* see Pl. III. fig. 5, *Th.h.*

The OMO-HYOID is a very long and slender muscle, broader, however, anteriorly (above) than at its scapular end. It arises from the most prominent point of the

[1] Cuvier, *l. c.* pls. 6 & 7. figs. 1 & 2, *a*, *b*, b^1.
[2] *Loc. cit.* p. 37, tab. 5. fig. 13, *a*, *b*.
[3] *Loc. cit.* p. 58, pl. 22. figs. 1, 9, 9^1.
[4] *Loc. cit.* pls. 6 & 7. fig. 2, *x*.
[5] *Loc. cit.* p. 25.
[6] *Loc. cit.* p. 34, tab. 5. fig. 13, *a*.
[7] *Loc. cit.* p. 58.
[8] *Loc. cit.* p. 34, pl. 5. fig. 12, *σ*.

convex anterior (upper) border of the scapula[1], and is inserted into the hyoid just external to the insertion of the sterno-hyoid. There is no median tendon; and the triangles of the neck are long, each with an acute angle.

In *Lemur varius* it has been figured by Cuvier, pls. 68 and 69, fig. 1, *e*.

In *Galago allenii* the omo-hyoid is fairly represented towards its attachment to the hyoid, but as it leaves the scapula it is very closely applied to the anterior (inferior) margin of the levator anguli scapulæ. It is a broad and distinct strip of muscle in *Galago garnettii* and in *G. crassicaudatus* (Pl. III. figs. 5 & 6, and Pl. IV. figs. 13 & 14, *O.h*).

It is strong and without median tendon in *Loris gracilis*[2] and also in *Nycticebus tardigradus*[3].

In *Tarsius*[4] it is double-bellied and round near the hyoid.

In *Cheiromys* it is as in *Lemur*, according to Owen[5].

The Digastric is formed of two thick fleshy bellies with a long and strong median tendon. It arises in common with the stylo-hyoid, and has a broad insertion into the middle third of the inner side of the inferior border of the horizontal ramus of the mandible.

Meckel[6] also says that in *Lemur mongos* and *L. albifrons* the fibres of the anterior belly are arrested about the middle of the horizontal branch of the lower jaw. Indicated in *L. varius* by Cuvier, pl. 68. fig. 1, *q*.

The conditions found in *Lemur* obtain in *Galago crassicaudatus* (Pl. IV. fig. 11, *Di.*) and in *G. allenii*, where its anterior belly is rather the stronger one (Pl. III. fig. 5, *Di* and *Di**, the latter having a portion of the anterior belly removed to show the genio-hyoid muscle).

In *Nycticebus tardigradus*[7] it is double and with a strong median tendon.

Figured by Cuvier in his sixty-seventh plate, fig. 2, *q* (*Loris gracilis*). In this species S. van der Kolk found a rudimentary tendon[8].

In *Perodicticus*[9] the posterior belly is short and thick, the anterior one thinner. Attachments the same as in *L. catta*. This is also the condition in *Tarsius*[10].

The anterior bellies of the digastric are closely blended together in *Cheiromys*[11], and the posterior belly of each muscle is composed of two fasciculi of fleshy fibres.

The Mylo-hyoid is flat and strong. Its origin is from the body of the hyoid bone, and insertion into the horizontal ramus and mylo-hyoid ridge of the mandible.

In *Lemur varius* it is obscurely traced in pl. 68. fig. 1, *r*, of Cuvier's 'Recueil.'

Shown on the left side in *Galago crassicaudatus* (Pl.III. fig. 5, *My.h*).

In *Loris gracilis*[8] the mylo-hyoid is found between the anterior fascicles of the digastric muscle.

[1] As Meckel observes (*op. cit.* vol. viii. p. 770).
[2] Indicated by Cuvier in this species, *l. c.* pl. 67. fig. 2, *e*.
[3] P. Z. S. 1865, p. 243.
[4] *Loc. cit.* p. 48, tab. 4. fig. 1. no. 7.
[5] *Loc. cit.* p. 58.
[6] Anat. Comp. vol. viii. p. 752.
[7] P. Z. S. 1865, p. 241.
[8] *Loc. cit.* p. 44.
[9] *Loc. cit.* p. 25.
[10] *Loc. cit.* p. 34, tab. 5. fig. 13, *π*.
[11] *Loc. cit.* p. 58.

Van Campen[1] mentions its similar position in the Potto, and Burmeister[2] in *Tarsius*.

The STYLO-HYOID is a small but very distinct muscle in *Lemur catta*, arising in common with the posterior belly of the digastric, and being inserted as in Man.

In *L. varius* its insertion is shown by Cuvier, pl. 68. fig. 1, *s*.

It is of moderate size in *L. xanthomystax*, and is pierced by the tendon of the digastric muscle. This is contrary to what Meckel says occurs in the Lemurs; his words are[3], "dans les makis, où le muscle en question passe en dehors du digastrique, au bord postérieur du mylo-hyoïdien et au bout antérieur de l'abaisseur de l'hyoïde, sans s'implanter à l'os hyoïde."

The stylo-hyoid in the Grand Galago arises rather within and along with the stylo-glossus than in common with the digastric. See Pl. V. fig. 18, *Sy.h*, the digastric having been removed.

Burmeister[4] remarks that in *Tarsius* the digastric does not penetrate the stylo-hyoid muscle.

Besides the stylo-hyoid muscle, Meckel speaks[5] of another extra muscle as existing in the Lemurs but which is absent in Apes and in Man. This he terms the *masto-styloïdien*, in contradistinction to the true stylo-hyoid or elevator of the hyoid. This *masto-styloidien*, according to him, stretches from the tympanum to the styloid process, and differs from the stylo-hyoid and stylo-glossus, which come from the tympanic process.

The STYLO-GLOSSUS arises beneath the external meatus in front of the origins of the stylo-hyoid and digastric. It is inserted as usual into the outer side of the tongue.

In *Galago crassicaudatus* (Pl. V. fig. 18, *Sy.g*) it is similar.

This muscle presents no noteworthy difference in *Tarsius*[6] from what is said above of *Lemur catta*.

STYLO-PHARYNGEUS.—This muscle arises (behind the stylo-glossus and within the origin of the stylo-hyoid and digastric) from the surface of the auditory bulla, and is connected with the anterior cornua of the os hyoides. It is inserted as usual.

In *Galago crassicaudatus* (Pl. V. fig. 18, *Sy.ph*) and in *Perodicticus* this muscle is essentially as in *L. catta*[7].

d. *Vertebral Region, anterior and lateral.*

RECTUS CAPITIS ANTICUS MAJOR.—In *Lemur catta* this is a long and slender muscle which arises from the transverse processes of the cervical vertebræ from the second to the sixth, and is inserted into the basioccipital.

In *L. xanthomystax* tendons only go to the sixth, fifth, and fourth cervical vertebræ; but there is another layer beneath, which sends a slip to the third cervical.

In *Galago crassicaudatus* (Pl. V. fig. 16, *R.a.ma*) it would appear as if this muscle

[1] *Loc. cit.* p. 25.
[2] *Loc. cit.* p. 34, tab. v. fig. 13, *ν*.
[3] Anat. Comp. vol. viii. p. 770; see also p. 753.
[4] *Loc. cit.* p. 35, tab. v. fig. 12, *φ*.
[5] *Loc. cit.* vol. viii. p. 770.
[6] *Loc. cit.* p. 35, tab. v. fig. 12, *r*.
[7] *Potto*, l. c. p. 26.

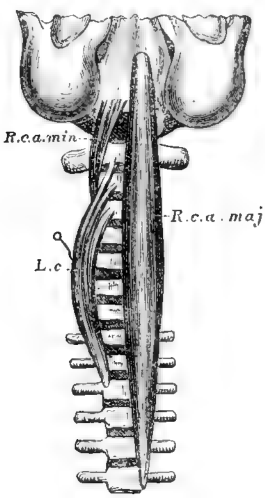
descended to the fourth dorsal vertebra, its fibres joining those of the first part of the longus colli. In another specimen this thoracic continuation was less distinct, the muscle, however, clearly went as far as the seventh cervical transverse process, there indefinitely merging into the said portion of the longus colli.

We noted in *Galago allenii* this muscle to be strongly developed. It arises by two tendons from the transverse processes of the seventh and sixth cervical vertebræ, and is inserted as in *Lemur catta*. A deeper portion, however, also exists, which comes from the upper cervical vertebræ (their transverse processes) to the atlas, and terminates with an insertion similar to that of the superficial portion. This may be the anterior division of the longus colli.

Special mention of this muscle is not made by S. van der Kolk and Vrolik, although they remark[1] that the long muscles of the neck give great power of flexion to this animal.

In our own recent examination of *Loris gracilis* we have found it to be like that of *Nycticebus tardigradus*. The latter animal, according to our observations[2], has the rectus capitis anticus major of great magnitude, and with an origin as far back (low down) as the body of the sixth dorsal vertebra. (See woodcut, fig. 11, *R.c.a.maj.*)

Fig. 11.



Deep muscles in front of the neck of the Slow Loris (*Nycticebus tardigradus*).

R. c. a. maj. Rectus capitis anticus major.
R. c. a. min. Rectus capitis minor.
L. c. Longus colli.

The skull is cut in such a transverse manner as to leave only the basioccipitals and tympanic bullæ present.—From P. Z. S. 1865, p. 242.

Van Campen[3] says it exists as usual in the Potto. *Tarsius*[4] has it arising from the five upper cervical vertebræ.

In *Cheiromys* this muscle is enormous, though not mentioned by Owen, who probably mistook it for the longus colli, which it in some respects resembles. It arises from the sides of the bodies of the first three dorsal vertebræ and transverse processes of all the cervical vertebræ except the first. It is inserted into the basioccipital and also into the inner side of the auditory bulla (Pl. VI. fig. 31, *R.a.ma*).

[1] *Stenops*, op. cit. p. 44. [2] P. Z. S. 1865, p. 241. [3] *Loc. cit.* p. 26. [4] *Loc. cit.* p. 39, tab. 5. fig. 14, *n*.

The RECTUS CAPITIS ANTICUS MINOR arises from the under surface of the base of the transverse process of the atlas, and is inserted into the basioccipital beneath the last.

It is of small size in *L. varius* and in *L. xanthomystax*.

In *Galago crassicaudatus* (Pl. V. fig. 16, *R.a.mi*) it is as in *Lemur*.

In *Nycticebus*[1] we have found it arising from the transverse processes of both axis and atlas, and being inserted into the exoccipital just within the periotic (see woodcut, fig. 11, *R.c.a.min*).

In *Tarsius*[2] Burmeister states that its fibres extend to the transverse process of the second cervical vertebra or even further back.

It is not mentioned by Owen in *Cheiromys*; but we have found it the same as in *L. catta* (Pl. VI. fig. 31, *R.c.mi*).

The LONGUS COLLI arises from the bodies of the first five dorsal vertebræ and from the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ. It is inserted by tendons into the hypapophysis of the atlas and into the corresponding parts of the bodies of the other cervical vertebræ.

Neither this muscle nor either of the two preceding is represented in those of Cuvier's plates which illustrate the myology of Lemuroids.

In *G. crassicaudatus* the longus colli *in situ* reaches from the basioccipital bone to the ventral surface of the first four dorsal vertebræ. On dissection it is found to consist of three portions as in Man. The first or inferior oblique portion of human anatomy arises by tendons from the transverse process of the sixth and seventh cervicals, and is inserted by several tendons into the sides of the bodies of the upper dorsal vertebræ (see Pl. V. fig. 16, *L.c*¹). The second or superior oblique (*L.c*²) has a fleshy cranial attachment underneath and posterior to the rectus anticus major; it sends three tendons to the tips of the second, third, and fourth cervical transverse processes. The third vertical portion (*L.c*³) covers the ventral surfaces of the whole of the cervical and one or more of the dorsal vertebræ; short, indistinct tendons proceed outwards to the transverse cervical processes.

In *G. allenii* it arises by tendons from the tips of the transverse processes of the sixth to the third cervical vertebræ, and from their bodies on the ventral surfaces. What we have described as a deeper portion of the rectus anticus major may in fact be a part of this muscle.

In *Loris* and *Nycticebus* it "arises from the fronts of the bodies of the four anterior dorsal vertebræ, and is attached to the bodies and transverse processes of all the cervical vertebræ, three distinct tendons going to the bodies of the atlas, axis, and third cervical vertebræ"[3]. That of *Nycticebus tardigradus* is delineated in woodcut, fig. 11, *L.c*, a hook dragging the muscle aside, the rectus capitis anticus major having been removed on that side.

[1] P. Z. S. 1865, p. 242. [2] *Loc. cit.* p. 39, t. 5. fig. 14, *o*. [3] Mivart & Murie, *l. c.* p. 242.

Van Campen divides this muscle in *Perodicticus*[1] into three parts. The lowermost stretches from the bodies of the first four dorsal to the transverse processes of the three lowest cervical vertebræ. The uppermost part springs from the transverse processes of the middle cervicals reaching to the ring of the atlas. The middle part has origin from the bodies of the three lowest cervical, and attaches itself to the bodies of the second and third cervical vertebræ.

In *Tarsius* Burmeister[2] observed two distinct portions,—the upper longish one springing from the transverse processes and bodies of the third, fourth, and fifth cervicals, and inserted into the anterior tubercles of the atlas; the lower portion, broader, comes from the bodies of the upper dorsal vertebræ, and is inserted into the bodies of the lowest cervical vertebræ from which the upper springs, reaching as far as the axis.

Owen says the longus colli in *Cheiromys*[3] is a powerful muscle, but does not give its entire attachments; he has probably mistaken for it the remarkably extended rectus capitis anticus major. It appears to consist of three portions. The first or lowest part arises from the sides of the bodies of the first three dorsal vertebræ (covered beneath by the rectus capitis anticus major) by two slips, and is inserted into the transverse process of the sixth cervical vertebra (Pl. VI. fig. 31, *L.c*^{1}). The second portion (superficial) arises from the transverse processes of the cervical vertebræ from the sixth to the third inclusive, and is inserted into the body of the atlas and axis; it is tendinous at its origin (Pl. VI. fig. 31, *L.c*^{2}). The third, or deepest, layer arises from the bodies of the cervical vertebræ from the seventh to the third inclusive; and its insertion is tendinous, and into the lower surface of the body of the axis (Pl. VI. fig. 31, *L.c*^{3}).

SCALENI.—These muscles[4] appear to consist of two distinct masses, both of which are situated entirely behind the axillary vessels and nerves, and the posterior one of which is perforated by the external respiratory nerve of Bell. It is the anterior of these two masses[5] which descends the further, and is inserted into the second and third ribs (the fourth rib, according to Meckel), in contact with part of the origin of the serratus magnus (Pl. IV. fig. 12, *Sca*).

They exist in very nearly the same condition in *L. varius*, only the long anterior portion descends to the fourth rib.

In *L. xanthomystax* the scaleni muscles are three or four in number. The longest slip springs from the fourth rib close to the cartilage; it proceeds forwards (upwards), and about the posterior (lower) third of the neck is joined by another slip which comes from the second and third ribs, in proximity and partial union with the serratus magnus. These two portions of scaleni are inserted by two tendons into the transverse processes of the second and fourth cervical vertebræ. A third portion of the scaleni

[1] *Loc. cit.* p. 26. [2] *Op. cit.* p. 39, tab. 5. fig. 14, *p*, *q*. [3] *Loc. cit.* p. 58.

[4] Figured by Cuvier in his 'Recueil,' pl. 69. fig. 2, 6^a & 6^b, and pl. 68. fig. 1, 6^1 (*Lemur varius*).

[5] The "scalenus posterior" of Meckel, *loc. cit.* p. 159.

comes from the anterior (upper) border of the first rib, and is inserted by two tendons into the transverse processes of the sixth and fifth cervical vertebræ. All these portions are placed outside the brachial plexus.

Galago crassicaudatus (Pl. IV. fig. 9, *Sca.*[1], and Pl. V. fig. 16, *Sca.*[1] & *Sca.*[2]) agrees with *L. varius.*

In *G. allenii* the scalenus medius arises as high as the transverse process of the fourth cervical vertebra. The scalenus posticus does not seem to reach higher than the sixth. The scalenus anticus is a small bundle of fibres which pass to the first rib in front of the lowest nerve of the brachial plexus.

In *Tarsius* there are three fasciculi (muscles according to Burmeister[1]) arising from the first three ribs, and going to the cervical vertebræ from the sixth to the first.

In *Cheiromys* this muscle is just as above described in *L. catta*, except that the anterior portion extends back to the fourth rib. Owen does not mention this muscle.

e. *Vertebral Region (Posterior and Superior).*

Splenius.—This muscle is very intimately connected with the transversalis cervicis, and arises from the spines of the first three dorsal vertebræ, the last cervical vertebræ, and ligamentum nuchæ. The larger and anterior (superior) portion of the muscle (the splenius capitis) is inserted into the occiput; the smaller and posterior (inferior) part (the splenius colli) into the transverse processes of the first three cervical vertebræ, as Cuvier has shown (pl. 71. figs. 1 and 2, I and I[1]).

In *L. varius* the splenius colli is inserted into the transverse processes of the first four cervical vertebræ, in *L. xanthomystax* only to the first three cervical vertebræ; but there is also a little separate slip carried onwards to behind the ear.

No line of demarcation exists in *Galago crassicaudatus* by which splenius capitis and splenius colli can be differentiated. The muscle representing the splenius capitis, or, it may be, both divisions (Pl. III. fig. 6, *Sp. cp*), arises from the uppermost second dorsal and spines of all the cervical vertebræ, and is inserted into the outer three-fourths of the superior curved line of the occiput.

In *G. allenii* the splenius capitis is as in *L. catta*; but we found a small slip between the splenius and longissimus, which may represent the splenius colli[2].

In *Nycticebus tardigradus* the splenius is exceedingly large; and our observation confirms Meckel's[3], that there is no splenius colli.

In *Tarsius*[4] it arises from the spinous process of the first dorsal vertebra. It goes mainly to the occiput; and a part (representing the splenius colli) is inserted into the transverse process of the atlas.

In *Cheiromys* it arises from the first five dorsal vertebræ.

Complexus.—This is large, and has origin from the transverse processes of the first

[1] *Loc. cit.* p. 37. tab. 4. fig. 9, *c.c.c.*

[2] P. Z. S. 1865, p. 243.

[3] *Op. cit.* p. 141.

[4] *Loc. cit.* p. 37, tab. 4. fig. 9, *d.*

four or five dorsal vertebræ, and all the cervical vertebræ. It is inserted into the occiput as usual, and internally to the splenius. Shown by Cuvier, pl. 71. figs. 2 & 3, L.

In *Galago crassicaudatus* (Pls. III. & IV. figs. 6, 9 & 10, *Co*) it only passes to the second dorsal.

In *G. allenii* it arises from the zygapophyses of the first eight dorsal vertebræ, and from the zygapophyses and transverse processes of the seventh, sixth, and fifth cervical vertebræ, the slips from each being somewhat separated. Insertion as in *L. catta.*

According to Meckel[1] there is an accessory slip in *Loris.*

In *Nycticebus tardigradus*[2] it arises from the dorsal spines as low as the third.

In *Tarsius*[3] the complexus is described as united with a biventer cervicis. The former of these is the broader, and springs from the transverse processes of the most anterior dorsal and most posterior cervical vertebræ, and goes to the occiput.

There is no BIVENTER CERVICIS in *Lemur catta*, according to our dissection; but Cuvier appears to have recognized a portion of the complexus as *digastrique du cou*, as it is represented in his 71st plate of his ‘Recueil,’ figs. 2 & 3, K.

This muscular division is demonstrated in *Galago crassicaudatus* (Pl. III. fig. 6, and Pl. IV. figs. 9, 10 & 11, *Bi.c*), its hindermost tendon reaching the sixth dorsal vertebra.

In *Tarsius*[4] this muscle is described (as already said) as united more or less with the complexus. It is the smaller and longer of the two, arises from the transverse processes of the six most anterior dorsal vertebræ, and is inserted into the occipital protuberance. It has no median tendon.

TRACHELO-MASTOID.—This is represented by a flat muscular band, which arises from the transverse processes of the first dorsal and last two cervical vertebræ; the insertion of this is into the outer region of the occiput.

Cuvier's figure represents this as having an origin somewhat more forwards, pl. 71. fig. 2, L^1.

In *Galago crassicaudatus* (Pl. IV. figs. 9 & 10, *T.ms*) its tendons attach themselves from the sixth dorsal vertebra forwards to the skull; fibres communicate also with the heads of the ribs. In *G. allenii* this arises from a few of the cervical vertebræ, and is inserted into the mastoidal region of the periotic.

It is said to be present in *Tarsius*, Burmeister remarking[5] that what must be taken as this muscle arises from the transverse processes of the second, third, and fourth cervical vertebræ, and goes to the transverse process of the atlas, and thence to the occiput.

RECTUS CAPITIS POSTICUS MAJOR.—This is thick, and extends from the spine of the axis to the occiput. It is covered at its insertion by the obliquus superior, but at the same time diverges from its fellow of the opposite side. Figured by Cuvier in *L. catta*, pl. 71. fig. 3, M^2. In the representation it would appear to be double, the indicating letter being so placed as to cover each portion.

[1] *Op. cit.* vol. vi. p. 146.
[2] P. Z. S. 1865, p. 243.
[3] *Loc. cit.* p. 37, tab. 4. fig. 4, *e*.
[4] *Loc. cit.* p. 37, tab. 4. fig. 4, *e*.
[5] *Loc. cit.* p. 38, tab. 4. fig. 8, *m*.

In *Galago crassicaudatus* (Pl. IV. fig. 11, *R.p.ma.*) an additional outer portion is manifest; this is noted in the same figure by an asterisk (*).

In *Tarsius* it is similar (Burmeister, tab. 4. fig. 4, *i*) in condition to that of *Lemur*; also in *Cheiromys*.

Rectus capitis posticus minor.—This extends from the anterior border of the atlas to the occiput, and is situated more in the middle line than the preceding.

This is said to be represented in *L. catta*, in Cuvier's 71st plate, fig. 3, M³; but the small portion of shading which that latter refers to is very indefinite, and not in the true situation of this muscle.

Depicted in the thick-tailed Galago, Pl. IV. fig. 11, *R.p.mi.*

In *Tarsius* it is similar (Burmeister, tab. 4. fig. 8, *k*); also in *Cheiromys*.

The Rectus lateralis is rather posterior in position, and resembles a deeper obliquus superior. It springs from the anterior surface of the transverse processes of the atlas, within its outer end, and is inserted into the cranium immediately beneath the outer end of the insertion of the obliquus superior.

It is clearly represented in *L. catta* by Cuvier, pl. 71. fig. 3, M⁴.

In *Tarsius* it is not mentioned. That of *Galago* is represented in Pls. IV. and V. figs. 11 & 16, *R.l.*

Obliquus superior.—This arises from the end of the transverse processes of the atlas, and passes inwards and forwards to the occiput, covering the insertion of the rectus capitis anticus major. Well shown by Cuvier in *L. catta*, pl. 71. fig. 3, N.

Figured by us in *Galago crassicaudatus*, Pl. IV. fig. 11, *O. s.*

In *Tarsius*[1] it is similar; also in *Cheiromys*.

The Obliquus inferior is the largest of these small muscles of the head and neck. It has origin from the spine of the axis, and is inserted into the transverse process of the atlas. Also well shown in pl. 71. fig. 3, N¹, of Cuvier.

Figured in *Galago crassicaudatus* (Pl. IV. fig. 11, *O. i*). In *Tarsius*[2] it is similar.

2. *Muscles of the Pectoral Limb.*

a. *Thoracic Region (anterior and lateral).*

Pectoral muscles.—As described by Meckel[3], these do not completely agree with the conditions exhibited in *Lemur catta*.

In the latter the Pectoralis major is very much extended antero-posteriorly, and consists of three more or less distinct portions. See Pl. IV. fig. 12, $P.ma^1$, $P.ma^2$, $P.ma^3$.

The most anterior or clavicular portion (which is the smallest, $P.ma^1$) arises from the sterno-clavicular articulation, and from the innermost fourth of the clavicle; it is inserted into the ulnar side of the deltoid ridge. It is closely connected, except at its origin and insertion, with the second portion of the pectoralis major on one side, and dips a little beneath the deltoid on the other, especially towards its insertion.

[1] *Loc. cit.* tab. 4. fig. 4, *g*. [2] *Loc. cit.* tab. 4. fig. 4, *h*. [3] *Loc. cit.* p. 276.

The second or sternal portion (which is the largest, *P.ma*²) arises from the whole length of the sternum, and from the sternal ends of the cartilages of the sixth, seventh, and eighth ribs. It has a broad tendinous insertion (about three quarters of an inch wide) into the margin of the bicipital groove in close juxtaposition to the insertion of the first portion.

The third or abdominal portion (*P.ma*³) is very much longer, in proportion to its breadth, than are the preceding parts. It arises from the sheath of the rectus muscle, its origin extending as far forwards as the posterior end of the origin of the second portion, and as far backwards as the cartilage of the tenth rib. Thin and delicate, it narrows as it proceeds forwards, and has an aponeurotic insertion beneath and in close union with the insertion of the second portion.

In *L. varius* the pectoralis major is very nearly the same as in *L. catta*. It, however, differs in having no portion arising from the clavicle, and in the one portion of the muscle being as tendinous as the other. Cuvier has represented (pl. 68) the pectoral muscles in this species; and they well agree with the conditions we have found to exist in *L. catta*, there appearing in his plates to be a distinct clavicular portion, not, however, represented by a distinct letter, the part answering to our first and second portions being marked *j*, and our third portion *j*¹. Towards its insertion the last-named part is represented as uniting with a slip of cutaneous muscle marked 5ᶜ.

In *Galago crassicaudatus* one portion only is clearly distinct (Pls. II., III., and IV. figs. 3, 5, 13, & 14, *P.ma*); for, as in *G. allenii*, it does not seem to be separable in the way described in our type. Only a few fibres arise from the clavicle; nor has it such an extensive posterior (inferior) origin as in *L. catta*. Its insertion, however, agrees with the Ringtailed Lemur.

In *G. peli*[1] it is said to consist of two layers, one from the clavicle and sterno-costal articulations, both inserted into the great tuberosity of the humerus.

In *Loris gracilis* the deep portion of the pectoralis major (our third part in *L. catta*) is relatively larger, and extends up beneath the superficial portion higher than in *Lemur*, as shown by Cuvier, pl. 67. fig. 2, *j* & *j*¹. It does not appear to have a clavicular origin.

In *Nycticebus* also there is no clavicular portion.

In the memoir on the Potto (*Perodicticus*), Van Campen[2] regards the pectoralis major as composed of two bundles. His figure of the same, though, leads one to believe that it is quite a single muscle.

Burmeister[3] says that in *Tarsius* this muscle is composed of but two portions—one, the smaller, coming from the clavicle and sternum, the other, larger portion from the sternum and cartilages of the ribs to the ninth. The insertions of these two portions are much as in the *Lemurs*.

¹ Kingma, *l. c.* p. 21. ² *Loc. cit.* p. 27, pl. 2. fig. 10, 1. ³ *Loc. cit.* p. 50, tab. 4. figs. 2, 17, & 15.

In *Cheiromys* Professor Owen[1] describes only two portions; and such we found to be the case: but in our specimen the clavicular portion arose by a tendon from the sternal end of the clavicle.

The PECTORALIS MINOR, which is a strong, thick muscle, arises from the sternum beneath the pectoralis major, its origin extending from the second to the sixth rib inclusive. Its insertion is into the capsular ligament of the humerus.

In *L. varius* Cuvier has figured it, pl. 68. fig. 1, j^2.

It is of large size in *Galago crassicaudatus* (Pl. III. fig. 5, *P. mi*, and Pl. IV. figs. 13 & 14, *P. mi*), and agrees with that of *Lemur catta*.

We failed to detect any trace of a pectoralis minor in *Galago allenii*.

Schroeder van der Kolk and Vrolik[2] state that in the *Loris* this muscle is present, its fibres intermingling with those of the pectoralis major. Its point of insertion is the internal tubercle of the humerus, previously passing before the coracoid process. This description agrees with Cuvier's figure, where it is represented as very small[3]. It exists distinctly in *Nycticebus tardigradus*.

In *Perodicticus* Van Campen[4] forcibly points out that this muscle is broad, and has not the same insertion as in Man, the Chimpanzee, and the Orang (*i. e.* the coracoid process), but goes to the greater tubercle of the humerus.

In *Tarsius*[5], where also it is strongly developed, its origin is from the second to the seventh rib, and its fibres, taking the same direction as the greater portion of the pectoralis major, are inserted close to each other into the sharp outer edge of the bicipital groove and ridge.

In *Cheiromys* it, according to Professor Owen[6], "arises from the side of the manubrium, and from the sternal ends of the first to the fifth ribs." "It is inserted by a broad tendon, spreading over the head of the humerus, to be attached to the great tuberosity." In our specimen it arose from the cartilages of the fourth, fifth, sixth, and seventh ribs.

SUBCLAVIUS.—This is thick and strong, and arises from the cartilage of the first rib. It is inserted into the outer two-thirds of the clavicle, and especially into the concavity on the hinder (under) surface of the bone towards its distal or outer end.

In *L. varius* Cuvier represents its insertion as extending outwards but little beyond the middle of the clavicle, pl. 68. fig. 1, *h*.

In *Galago crassicaudatus* (Pl. III. fig. 5, *Sb*) and in *G. allenii* it is relatively stronger, and is only inserted into the middle third of the clavicle.

Van Campen[7] says this muscle is small in the *Potto*.

In *Tarsius*[8] its insertion occupies the whole under surface of the clavicle.

[1] *Loc. cit.* p. 60, pls. xxii. & xxiii. figs. 1, 17.
[2] *Loc. cit.* p. 44.
[3] *Loc. cit.* pl. 67. fig. 2, j^2.
[4] *Loc. cit.* p. 27, pl. 2. fig. 10. 2.
[5] *Loc. cit.* p. 51, tab. 4. figs. 2, 18.
[6] *Loc. cit.* p. 60.
[7] *Loc. cit.* p. 28, pl. 2. fig. 10. 3.
[8] *Loc. cit.* p. 51, tab. 4. figs. 2, 19.

Professor Owen does not make mention of the subclavius in *Cheiromys*; but in our specimen it was well developed, and quite like that of *L. catta.*

b. *Shoulder and Scapular Regions.*

Deltoid.—As Meckel[1] observes, this muscle consists of three distinct portions.

The *first* of these arises from the middle third of the clavicle, and, descending obliquely somewhat outwards, closely joins the first part of the pectoralis major on the one side, and the second part of the deltoid on the other. (Pl. IV. fig. 12, D^1.)

The *second* and largest part of the deltoid arises from the acromion process only, and, descending vertically, is inserted into the deltoid crest on the outer surface of the humerus, extending considerably below the insertion of the first part of the pectoralis major.

The *third* and slenderest part arises at the posterior surface of the spine of the scapula, from a quarter of an inch distant from the vertebral margin to the posterior end of the metacromion process. It passes very obliquely downwards and forwards, and, joining the second portion of the muscle, is inserted into the outer margin of the deltoid crest of the humerus, the fibres passing beneath those of the second portion of the muscle.

In the other specimens of the genus *Lemur* we found this muscle existing in nearly a similar condition. In *L. varius* Cuvier represents it in three distinct portions in pl. 69. fig. 1, the clavicular portion being marked *k*, the two scapular portions k^1.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, 7, and Pl. IV. figs. 13, 14, D^1, D^2, and D^3) the three divisions of the deltoid, with their scapular, clavicular, and humeral attachments, are displayed.

We could not distinctly trace lines of separation in the deltoid of *Galago allenii*, although we remarked that the portion of the muscle between the attachments of the clavicle and coracoid process of the scapula seemed more fibrous than muscular. The third portion in *L. catta* was relatively smaller in *G. allenii*.

In *G. peli* this muscle is said to consist of two parts united by tendinous joints[2].

The deltoid is said by Meckel[3] to be simple in *Loris*. We found it single in *Nycticebus tardigradus*. In Cuvier's 'Recueil,' pl. 67. figs. 1 & 2, *k* and k^1 (*Loris*), there is but a faint indication of division between the parts answering to the two scapular portions of *Lemur*, and no indication of any separation between the clavicular and scapular portions.

In the anatomy of the Potto[4] (*Perodicticus*) no special mention is made of this muscle, and the figure of the shoulder-muscles displays but a slight tendency to division of the deltoid.

[1] *Op. cit.* vol. vi. p. 258.

[2] Kingma, *loc. cit.* p. 23.

[3] *Op. cit.* vol. vi. p. 258.

[4] *Loc. cit.* pl. 2. fig. 11.

This muscle Burmeister[1] described in *Tarsius* as composed of two parts; but that portion which springs from the middle of the clavicle he considers the broad part.

In *Cheiromys* Owen[2] remarks that the deltoid has the usual extensive origin and insertion, but speaks of no division. The scapular portion is shown by us (Pl. III. fig. 8, D^3); the two others also exist.

SUPRASPINATUS.—This arises not only from the supraspinous fossa, but also slightly from the posterior (inferior) side of the spine of the scapula towards its acromial end. The fibres converge to a very strong tendon, which is inserted into the radial or greater tuberosity of the humerus.

It is but very imperfectly represented in *L. varius* by Cuvier, pl. 68. fig. 2, *l*.

Figured in *Galago crassicaudatus* (Pl. III. figs. 5 & 6, and Pl. IV. figs. 13 & 14, *S.sp*).

In *Tarsius*[3] it occupies the supraspinous fossa only; and in *Cheiromys* no fibres spring from the infraspinous fossa, but they take origin as far as the very edge of the spine beneath the acromion process.

INFRASPINATUS[4].—This muscle arises from the infraspinous fossa, except the axillary border and the spine towards its acromial end. The fibres converge to a central tendon, which is inserted into a deep pit in the middle of the radial side of the radial tuberosity.

It reaches the ridge-like portion of the axillary border in *L. nigrifrons*.

Shown in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 6 & 7, and Pl. IV. figs. 13 & 14, *I.sp*).

In *Loris gracilis* Cuvier represents it as large (pl. 67. fig. 1, *m*).

In *Tarsius*[5] it is as in *L. catta*.

In *Cheiromys* it arises from the whole infraspinous fossa (Pl. III. fig. 8, *I.sp*).

The SUBSCAPULARIS[6] arises from the subscapular fossa as usual, and is very broadly inserted into the ulnar or lesser tuberosity of the humerus.

Figured in *Galago crassicaudatus* (Pl. III. fig. 5, and Pl. IV. figs. 13 & 14, *S*).

In *Tarsius*[7] it is strong and partially divided into three by tendinous intersections.

The usual origin of the subscapularis in *Cheiromys*, Owen remarks[8], is by three principal fasciculi, and its tendon of insertion is closely attached to the portion of the capsular ligament which it passes over. In our muscular individual this subdivision was indistinct.

TERES MAJOR.—A very large and powerful muscle, which arises from the superior (posterior) half of the axillary border of the scapula and from the flat surface at the posterior end of that border. It broadens out greatly as it descends, and has a glistening tendinous outer surface. Its insertion, which is almost an inch wide, is into the inner margin of the bicipital groove separating the two portions of the coraco-brachialis.

[1] *Loc. cit.* p. 49, tab. 3. fig. 1. no. 15.

[2] *Loc. cit.* p. 60, pls. 22 & 23. figs. 1 & 2. no. 15.

[3] *Loc. cit.* p. 48, tab. 3 & 4. figs. 1 & 9.

[4] Cuvier, *loc. cit.* pl. 69. fig. 1, *m* (*L. varius*).

[5] *Loc. cit.* p. 48, tab. 4. fig. I. 11.

[6] Cuvier, *loc. cit.* pl. 68. fig. 2, *n* (*L. varius*).

[7] *Loc. cit.* p. 49, tab. 3. figs. 2–13.

[8] *Loc. cit.* p. 59.

Meckel observes that it is large in the Makis (Lemurs), and is inserted into the second fifth of the humerus[1].

It is represented by Cuvier in *Lemur varius* (pl. 68. fig. 2, and pl. 69. fig. 1, *o*) and in *Loris gracilis* (pl. 67. fig. 1, *o*).

Shown in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, 7, and Pl. IV. figs. 13 & 14, *T. ma.*), but the surface is not so highly tendinous in this species as in *L. catta*.

In *Tarsius*[2] it is as in *L. catta*, except, of course, proportionally smaller.

Teres minor.—This is a very small and inconspicuous muscle; and there is therefore the less wonder that it should have escaped Meckel's[3] and Cuvier's[4] observation. It arises from the lower (anterior) half of the axillary border of the scapula, its origin extending rather further up (back) than, but not quite so far downwards (forwards) as, that of the long head of the triceps. It is inserted into the lower part of the radial tuberosity.

In *Galago crassicaudatus* this muscle (Pl. III. fig. 6, and Pl. IV. fig. 13, *T. mi.*) is of moderate size, and is attached quite to the neck of the scapula, and slightly covered by the infraspinatus.

We found in *Galago allenii* the teres minor to be comparatively larger than in *Lemur catta*; its fibres also arose more superficially upon the dorsum of the infraspinatus, being partly attached to the lower border of the spine of the scapula, chiefly about its middle; but it had a similar insertion.

Nycticebus tardigradus, like *Lemur catta*, has it small.

Burmeister[5] says that in *Tarsius* it is present, but weak.

In *Cheiromys*, Owen[6] mentions that it is not much inferior in size to the teres major; but in our dissection we have found it very much smaller than the teres major, yet very distinct and quite in the condition it presents in *Lemur catta*. As Professor Owen takes no notice of the infraspinatus, and as the teres minor is pretty closely connected with the latter muscle, he has probably mistaken the teres minor for it.

c. *Humeral Region* (*posterior and anterior*).

Triceps.—This muscle is very large and complex in *L. catta*, not only consisting of all the parts found in Man, but one of the heads described as single in him being here differentiated into four more or less distinct parts.

1. The long head is very tendinous at its origin, which occupies about half an inch at the lower (anterior) part of the axillary margin of the scapula.

2. The outer head arises from the postero-outer portion of the head of the humerus, beside the insertion of the teres minor.

[1] *Op. cit.* vol. vi. p. 262. [2] *Loc. cit.* p. 48, tab. 3. fig. 2. 12. [3] *Loc. cit.* p. 278.

[4] It is not figured in the Lemuroids of his 'Planches de Myologie.'

[5] *Loc. cit.* p. 48, tab. 3. fig. 1. no. 10. [6] *Loc. cit.* p. 59, pl. 23. fig. 2. 10.

The inner head is more or less divisible into two muscles, and is described as such by Burmeister.

3. The first or upper part of the inner head arises from the postero-inner side of the head of the humerus, as high as just beneath the insertion of the subscapularis, and considerably above the insertions of both the teres major and the short part of the coraco-brachialis.

4. The second or lower part of the inner head, which is spoken of by Burmeister as a distinct muscle, the "Anconeus sextus," is separated from the last-described part by a more or less marked interval, where the muscular spiral nerve passes. It arises from the inner side of the lower half of the shaft of the femur, the supinator ridge, and internal condyle, and occupies part of the intercondyloid space at the back of the humerus.

All these portions unite together and are inserted into the olecranon process of the ulna; but the second and third portions unite together very high up indeed. The long head joins at about the middle of the arm; the anconeus sextus of Burmeister joins the common mass at the olecranon, but is more or less connected with the rest of the muscle for the lower half of its extent.

Cuvier, in his posthumous 'Planches de Myologie,' distinguishes the usual three parts of the triceps and the dorso-epitrochlear, marked respectively in pl. 68. fig. 2, and pl. 69, fig. 1, of *Lemur varius*, by t, t^1, t^2, and t^3. The lower division of the internal head of the triceps is distinguished as the "ancone interne," and marked u^1. No external anconeus is separately indicated.

We ourselves have found it in *Lemur varius*, *L. niger*, and *L. nigrifrons* as in *L. catta*; also in the Galagos. Slight individual variations exist as to how far the anconeus sextus goes up—one being like what is mentioned in *Nycticebus*. The several portions of the triceps are figured in *G. crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, & 7, and Pl. IV. figs. 13 & 14, T^1, T^2, T^3, T^4).

In *G. peli*[1] it is described as consisting of six parts, namely, the three ordinary heads, together with an anconeus quartus (the ordinary anconeus of Man), the dorso-epitrochlear, and a distinct lower separation of the internal head.

In *Nycticebus* we did not find an anconeus sextus distinctly differentiated; for the musculo-spiral nerve pierces what is evidently the ordinary internal head.

In the *Potto* the anconeus sextus is not mentioned by Van Campen.

In *Tarsius* Burmeister[2] describes what answers to the lower part of the internal head of Man, as quite distinct, under the name of anconeus sextus. His arrangement of the great extensor of the forearm is as follows:—

A. Anconeus primus[3], or longus (the scapular head of Man).

B. Anconeus secundus[4] (the external head of Man).

C. Anconeus tertius[5] (the upper part of the internal head of Man).

[1] Kingma, *loc. cit.* pp. 25 and 26.
[2] *Loc. cit.* p. 53.
[3] Tab. 3. fig. 1. 22 *a*.
[4] Tab. 3. fig. 1. 22 *b*.
[5] Tab. 3. fig. 2. 22 *c*.

D. Anconeus quartus (the anconeus proper of Man).

E. Anconeus quintus [1] (the dorso-epitrochlear).

F. Anconeus sextus [2] (the lower part of the internal head of Man).

In *Cheiromys* Professor Owen [3] found the lower portion of the inner head of this muscle almost as distinct as it is asserted to be by Burmeister in *Tarsius*. In our dissection we can confirm this statement; but we found the origin of the upper part of the internal head (which is not distinctly mentioned by Professor Owen) to extend up as high as in *Lemur* and in the other forms already noticed. Thus the so-called triceps may here, as also in *Hyrax* (and, no doubt, in many other forms), be more correctly spoken of as the quadriceps extensor; and we remark that the aspect of the part called "sextus" by Burmeister, lying as it does beneath the others in the intercondyloid space, may perhaps be compared to the crureus of the thigh, so distinct in the Lemuroids.

ANCONEUS.—Evidently but the continuation of the triceps. It may be said to arise from the posterior aspect of the external condyle, and to be inserted into the radial border of the olecranon.

In Cuvier's 'Recueil,' pl. 69. fig. 1, no separate letter indicates the anconeus, but a darker shade seems nevertheless to point to its existence in *L. varius*.

The three species *L. varius*, *L. xanthomystax*, and *L. nigrifrons* do not entirely agree with the above description, inasmuch as the anconeus muscle crosses over much of the intercondyloid space.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and more distinctly in Pl. IV. fig. 13, *Anc*).

It is present in *G. peli* [4], and named anconeus quartus.

Van Campen says it is wanting in the Potto (*Perodicticus* [5]).

In *Tarsius* this is described as the anconeus quartus [6].

Very large and distinct in *Cheiromys*.

DORSO-EPITROCHLEAR.—This takes origin from the outer margin of the latissimus dorsi, near its insertion (*i. e.* just before it becomes tendinous); it broadens out into a thin muscular sheet, and becomes continuous with the fascia of the forearm [7] between its two insertions, which are into the inner condyle of the humerus and the olecranon.

It arises over the tendinous part of the latissimus dorsi and goes to the shaft of the ulna in *L. varius*, as Cuvier already has shown, pl. 69. fig. 1, t^3.

See *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, & 7, and Pl. IV. figs. 13 & 14, *D.ep*).

In *G. allenii* this muscle does not so broaden out as in *Lemur catta*, but it is also inserted into the inner side of the olecranon process.

In *Tarsius* Burmeister [8] notices this offshoot from the latissimus dorsi under anconeus quintus, as before mentioned by us in describing the triceps.

[1] Tab. 3. fig. 2. 22 *d*. [2] Tab. 3. fig. 2. 22 *e*. [3] *Loc. cit.* p. 61. [4] Kingma, *loc. cit.* p. 25. [5] *Loc. cit.* p. 34. [6] *Loc. cit.* p. 54. [7] Mentioned by Meckel, *loc. cit.* p. 267. [8] *Loc. cit.* p. 50, tab. 3. fig. 22, *d*.

It has been twice referred to by Owen in *Cheiromys*, pp. 59 and 61.

BICEPS[1].—With two distinct heads; the short head arises from the coracoid process, the long head from the superior margin of the glenoid cavity. The two heads unite a little below the middle of the arm and are inserted by a strong tendon into the posterior part of the tubercle of the radius.

In *L. niger* we found a slight approximation to the structure (next to be described) in *Galago*.

In all the Galagos we examined, the long head springing from the upper margin of the glenoid cavity is as in *Lemur*; but the coracoid head remains almost distinct from the former down to its insertion, receiving, however, a few fibres from the glenoidal portion about the bend of the elbow.

The coracoid portion is very remarkable, as it remains broad, flat, and muscular down to its insertion, which is into the superficial fascia covering the forearm. Its free margin projects forwards inside the arm at the end of the elbow more than does the supinator longus at the outside of the limb. This condition must powerfully assist the flexing action of the muscle. (Figured in *Galago crassicaudatus*, Pl. II. fig. 3, Pl. III. figs. 5 & 7, and Pl. IV. figs. 13 & 14, B^1, B^2.)

In *G. peli* it was found to have two heads by Kingma[2].

In a recent dissection of *Loris gracilis* made by us, the biceps sent but a single head to the scapula. Meckel[3] says the *Loris* has only a long head. Cuvier represents two heads, pl. 67. fig. 2, *r*, and r^1.

In *Nycticebus tardigradus*[4] we found but one head of origin, which agrees with W. Vrolik's earlier observation[5], although in the later conjoined memoir with S. van der Kolk[6] they speak of two heads.

Perodicticus[7], *Tarsius*[8], and *Cheiromys*[9] each possess double tendinous heads of origin to the biceps muscle. In *Cheiromys* the expansion mentioned as existing at the insertion of the muscle in *Galago* does not exist. We carefully looked for it.

CORACO-BRACHIALIS.—Double[10]; the long part arises exclusively from the inner side and deep surface of the strong tendon of the short head of the biceps, no muscular fibres arising from the coracoid process itself. Narrowing rapidly downwards, it is inserted into the inner border of the humerus as far down as the upper border of the perforation in the inner condyle.

The short part, which is very small, arises from the end and deep surface of the coracoid process, and is inserted on the posterior side of the inner margin of the

[1] Cuvier, *loc. cit.* pl. 68. fig. 2, pl. 69. fig. 1, *r* and r^1 (*L. varius*).
[2] *Op. cit.* p. 24.
[3] *Op. cit.* vol. vi. p. 291.
[4] P. Z. S. 1865, p. 244.
[5] Todd's Cyclop. of Anat. and Physiol. vol. iv. p. 218.
[6] *Op. cit.*, Rech. d'Anat. comp., le Genre *Stenops*, p. 45.
[7] *Loc. cit.* p. 34.
[8] *Loc. cit.* p. 51, tab. 3. figs. 1 and 2. nos. 20 *a* and 20 *b*.
[9] *Loc. cit.* p. 60, pls. 22 and 23. fig. 1. 20.
[10] Cuvier figures in *L. varius* this muscle as double; but both parts have the same letter *q*, pl. 68. fig. 2.

bicipital groove, between the insertion of the teres major and the high-reaching inner portion of the triceps.

The long head reaches down to the supracondyloid arch. This therefore corresponds to what, according to Mr. John Wood's[1] reading, is his "coraco-brachialis longus."

Meckel[2] says that this muscle is found divided in the *Makis* as in many other animals.

In *L. varius* we found the coraco-brachialis and biceps on the right side to be attached to the coracoid process by a sesamoid bone.

In *L. nigrifrons* it is also double. The long portion arises tendinous from the coracoid, and continues so, mingling the fibres of the second portion, to the middle of the humerus, where it becomes fleshy, and is inserted upon the supracondyloid arch. The short arch is also tendinous, but sooner becomes muscular.

In *Galago crassicaudatus* a long, strong, and a short weaker belly exist (Pl. II. fig. 3, Pl. III. fig. 5, and Pl. IV. fig. 14, $C.b^1$ & $C.b^2$).

This muscle has likewise a second slip in *G. allenii*, and the two parts have much the same origin and insertion as in *Lemur catta*. Also in *G. peli*[3].

In *Loris gracilis* and in *Nycticebus tardigradus*[4] we ourselves have found the coraco-brachialis to consist of two portions. S. van der Kolk and Vrolik[5], however, say nothing of the short head, although remarking that it proceeds as far as the internal condyle of the humerus.

Van Campen avers it is double in *Perodicticus*[6]; as likewise does Burmeister in *Tarsius*[7]; and Professor Owen records the same condition existent in *Cheiromys*[8].

Brachialis anticus[9].—This arises from the whole outer (radial) side of the humerus to its summit, being overlapped by the external part of the triceps; it also arises from the front of the humerus as far inwards as the insertion of the coraco-brachialis, but nevertheless it does not at all embrace the insertion of the deltoid. It is inserted into the coronoid process of the ulna.

In *Lemur varius*, *L. xanthomystax*, and *L. nigrifrons* this muscle is as in *L. catta*. There is no junction of the fibres with those of the supinator longus, although the muscles are indeed very close together.

The same in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. fig. 6, and Pl. IV. figs. 13 & 14, *B.a.*).

It is spoken of by Burmeister[10] in *Tarsius* as brachialis internus.

No substantial difference from *L. catta* in *Cheiromys*[11].

[1] Journ. of Anat. and Physiol. (Cambridge) 1867, vol. i. p. 49.
[2] *Loc. cit.* p. 281.
[3] Kingma, *l. c.* p. 24.
[4] P. Z. S. 1865, p. 244.
[5] *Op. cit.* p. 45.
[6] *Loc. cit.* p. 33.
[7] *Loc. cit.* p. 49, tab. 3. fig. 2, nos. 14 and 146.
[8] *Loc. cit.* p. 60, pl. xxiii. fig. 1, nos. 14 and 14 *b*.
[9] Figured in Cuvier's 'Recueil,' pl. 68. fig. 2, *s*, of *L. varius*, and pl. 67. fig. 1, *s*, in *Loris gracilis*.
[10] *Loc. cit.* p. 52, tab. 3. figs. 1, 21.
[11] *Loc. cit.* p. 60, pl. xxiii. fig. 1, no. 21.

d. *Brachial Region (Extensors).*

SUPINATOR LONGUS.—Has origin from the external condyloid ridge of the humerus; and its flat tendon is inserted into the radial border of the radius, rather more than half an inch above its lower end, and immediately below the lower end of the long insertion of the pronator teres.

This muscle in *L. varius*[1] is inserted into the styloid process.

In *L. xanthomystax* it is similar, the lowest portion being weak and closely applied to the radius. It seems also to pass to the pisiform bone and deep palmar fascia. We could only follow its unusually thin tendon in *L. nigrifrons* as far as the styloid process.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. figs. 13 & 14, *S.l*), where, as in *G. allenii*, it arises as high almost as the middle of the shaft of the humerus, and occupies the third fourth of that bone. Its tendon is inserted into the styloid process.

In *Tarsius*[2] it is substantially the same as in *L. catta*.

SUPINATOR RADII BREVIS.—This muscle arises by tendinous fibres from the external condyle and annular ligament, but not at all from the ulna. Winding round the shaft of the radius, it is inserted into the anterior surface of that bone on a line leading obliquely downwards and outwards, and conterminous with the upper parts of the insertions of the pronator teres and flexor longus pollicis.

That of *Galago crassicaudatus*, which obtains in the other species of the genus, as also in *Nycticebus*, is shown in Pl. IV. fig. 13, *S.r.b*.

In *Tarsius*[3] it is substantially as in *L. catta*.

It is not mentioned by Owen in his description of *Cheiromys*; but we find it in that genus to be quite similarly conditioned to that of *L. catta*.

The EXTENSOR CARPI RADIALIS LONGIOR arises below the supinator longus from the ridge leading from the external condyle. It terminates in a flat tendon which is very closely applied to that of the extensor carpi radialis brevior, and passes beneath that of the extensor ossis metacarpi pollicis, and then beneath that of the extensor secundi internodii pollicis. It is inserted into the radial side of the base of the second metacarpal.

In *L. varius* this and the following muscle are figured by Cuvier, pl. 69. fig. 1, δ & δ^1; and in *Loris gracilis*, pl. 67. fig. 1, δ & δ^1.

That of *Galago crassicaudatus* is shown in Pl. II. fig. 3, and Pl. IV. figs. 13 & 14, *E.c.r.l.*

EXTENSOR CARPI RADIALIS BREVIOR.—A little smaller than the extensor carpi radialis longior. It arises from the external condyle; and its fibres terminate above the middle of the forearm in a flat tendon, which passes down like that of the last-named muscle, and is inserted into the outer border of the bone of the middle metacarpal.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 13, *E.c.r.b*).

[1] It is figured by Cuvier, pl. 69. fig. 1, *v*; and in *Loris gracilis*, pl. 67. fig. 1, *v*.

[2] *Loc. cit.* p. 55, tab. 5. fig. 3. 23, and tab. 3. fig. 1. 23.

[3] *Loc. cit.* p. 56, tab. 3. fig. 4. 36.

Extensor communis digitorum.—This muscle arises from the common tendon attached to the external condyle, and from the intermuscular septa and fascia covering the middle of the forearm. The fibres are inserted in a penniform manner on each side of a median tendon, which, near the wrist, divides into two. These again unite and form a wide tendon on the back of the hand, which gives origin to four flat diverging tendons which are not united by connecting slips, and which are inserted as usual.

In the right manus of *L. varius* we found but three tendons—a fourth one, inserted into the fourth digit, appearing to represent the extensor minimi digiti.

In Cuvier's plate of this species the muscle is represented as sending four separate tendons to the four ulnar digits, pl. 69. fig. 1, ε.

In *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 13, *E.c.d*) and *G. allenii* this extensor and that of the minimi digiti are in close union, the former supplying tendons to the four digits. In the left arm of *G. crassicaudatus*, moreover, the fourth tendon sends a slip to the fourth digit, as well as to the fifth digit, and the third tendon sends one to the third digit as well as to the fourth digit. These extra slips are marked ** 4 & 3 in Pl. II.

In *Loris gracilis* this and the extensor minimi digiti also appear fused into one muscle, which splits into six tendons. Two of these go to the fifth digit, two go to the fourth digit, and the other two go to the index and third digit respectively. The arrangement of the tendons in this species is quite undefined in Cuvier's plate.

In *Nycticebus tardigradus*[1] the communis is also derived from the same belly as the minimi digiti; but the former ultimately subdivides into five tendons, whereof the fourth digit has two, one on its radial and one on its ulnar side.

In *Perodicticus*[2] this muscle has four tendons, two of which go to the fourth finger, one to the third, and one to the fifth finger.

Both in *Tarsius*, according to Burmeister[3], and in *Cheiromys*, according to Owen[4], the common extensor sends four tendons to the usual digits. The deeper-seated extensor with subsidiary tendons, which Professor Owen mentions in the latter animal, is evidently the same as that described by Burmeister in *Tarsius*, and which we take to represent the extensor minimi digiti. But independently of this last-mentioned muscle, we found in *Cheiromys* the indisputable extensor communis digitorum itself easily and clearly divisible into two fleshy bellies, more than halfway up the arm, each separate belly ending distally in a distinct tendon—that from the radial belly giving tendons to the index, third, and fourth digits, that from the ulnar belly giving a tendon to every digit except the pollex. The tendons, from where they diverge up to the digits, are more or less connected by an aponeurotic fascia, the two small tendons going to the attenuated middle digit (one of which comes from the ulnar belly, and the other from the radial one) being very intimately connected.

[1] P. Z. S. 1865, p. 247.

[2] *Loc. cit.* p. 36, tab. ii. fig. 11, *m*.

[3] *Loc. cit.* p. 62, tab. 3. fig. 1, no. 27, and tab. 5. fig. 2, no. 27.

[4] *Loc. cit.* pl. xxiii. fig. 2, no. 27.

In *Tarsius* Burmeister remarks that the four tendons of this muscle reunite into a single tendinous sheet on the back of the manus, from which sheet the four extensor tendons are given off.

Extensor minimi digiti.—A very small muscle with a very long tendon arising from the external condyle and the intermuscular septa. Its delicate tendon runs down beneath the annular ligament, and divides into two, which go to the ulnar side of the fourth and fifth digits respectively; that which goes to the fourth digit is joined by a delicate branch from the extensor indicis.

Meckel says in the *Lemurs* it attaches itself sometimes to the fourth and fifth digits.

On the left side of *L. varius* the extensor minimi digiti went to the fourth digit only, without being joined by another tendon from the indicis. In Cuvier's figure of this species, two tendons go to the fourth and fifth digits as usual, pl. 69. fig. 1, ϵ^1.

In *Galago crassicaudatus* this muscle is so united with the extensor communis digitorum as to be very little seen. Its tendon receives no slip from the extensor indicis, but bifurcates, its branches going to the fourth and fifth digits as in *L. catta* (Pl. II. fig. 3, and Pl. IV. fig. 13, *E.m.d*).

In *G. allenii* it also arises in common with, but rather to the outer side of, the extensor communis digitorum. Its tendons, two in number and very delicate, are inserted as in *L. catta*, but without the extra indicial slip.

According to our observations, both in *Loris gracilis* and *Nycticebus tardigradus*[1] it also has a common origin with the extensor communis, but seemingly has only one tendon, which goes to the fifth digit.

It appears to be inseparably united with the extensor communis digitorum in the Potto[2].

Burmeister[3] says, at its origin it is in close union with the extensor carpi radialis brevior, its tendon comes off higher than the extensor communis, and, splitting, proceeds to the fourth and fifth digits.

In *Cheiromys* it is described by Owen[4] as a slip of the extensor communis with tendons to the fourth and fifth digits; but we found that in this species the muscle is well developed, though in close union at its upper part with the belly of the extensor communis digitorum. Its tendons are as in *L. catta*, except that there is no slip from the index.

Extensor carpi ulnaris.—This muscle is about the same size as the extensor communis, but has a much stronger tendon. It arises from the external condyle, the margin of the ulna, the septa, and aponeurosis, and is inserted into the base of the fifth metacarpal.

The same in *L. varius* and *L. nigrifrons*; but in *L. xanthomystax* its tendon divides,

[1] P. Z. S. 1865, p. 247.

[2] *Loc. cit.* p. 36, pl. ii. fig. 11, *m*.

[3] *Tarsius*, p. 62, under head of extensor com. digitorum, tab. 3. fig. 4. 35.

[4] P. 62, under head of extensor digitorum communis, pl. xxiii. fig. 2. 27*a*.

part being inserted into the pisiform, and part into the fifth metacarpal. This arrangement is what Mr. John Wood has found in the human subject[1].

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 13, *E.c.u*). In *G. allenii* it is large; origin as in *L. catta.*

In *Tarsius* this muscle is represented in tab. 3. fig. 1. 28.

Extensor indicis.—This is a very slender muscle, and much shorter than the extensor secundi internodii pollicis. It arises from the radial surface of the ulna and the interosseous ligaments. Its tendon receives fleshy fibres down almost to the wrist, and then bifurcates, going to the index and third digits—that going to the third digit sending off a delicate slip to that tendon of the extensor minimi digiti which goes to the fourth digit.

The right and the left sides differed in the specimen of *L. varius* dissected by us. The left had only a single tendon, going to the index, while on the right side it divided into two tendons, going to the third digit and index respectively.

Cuvier figures this muscle in the above species, but very indistinctly. It seems, however, to go to the second and third digits, pl. 69. fig. 1, ϵ^2.

In *L. xanthomystax* the belly giving origin to the tendon of the third digit is so distinct that it may be regarded as a separate muscle. It is the largest and longest of the two, occupying fully the middle third of the ulna. This all but separate slip is evidently the homologue of the radial extensor of the third digit, noticed by Mr. John Wood in his dissections of the human body with reference to its muscular variations[2].

In *G. crassicaudatus* (Pl. II. fig. 3, *E.i*, and Pl. IV. fig. 13, $E.i^{1,2}$) and *G. allenii* there is no extra slip of tendon to the fourth digit; but both of these species possess, without doubt, a double extensor indicis, or, in addition to the indicial, an *extensor medii digiti* (Wood). The muscular fibres of the indicial division pass up the higher of the two, lying beneath the extensor secundi internodii pollicis.

According to Meckel[3] this muscle in *Loris* is double. The superior and smallest portion attaches itself to the index and radial side of the median digit. The inferior is inserted in the ulnar side of the middle (third) digit. But Meckel further observes that in the *Lemurs*, properly so called, the extensor indicis is single, and, indeed, much as we have found it in *L. catta.* In our dissection of *Loris gracilis* the extensor indicis ended in a single tendon to the index finger.

Nycticebus[4] differed in the insertion on the right and left limbs in the specimen examined by us. On the right, tendons were given to the index and fourth digits; on the left, to the fifth and index.

The same condition exists in *Perodicticus*[5]; but in *Tarsius*[6] it springs also from the

[1] Proc. Roy. Soc. 1866, vol. xv. p. 237, and p. 232. fig. 5, *a*.

[2] *Loc. cit.* p. 238, and p. 233. fig. 6.

[3] *Loc. cit.* p. 324.

[4] P. Z. S. 1865, p. 247.

[5] *Loc. cit.* p. 37, tab. ii. fig. 12, *o.o*.

[6] *Loc. cit.* p. 63, tab. 5. fig. 6, no. 38.

radius, and divides into two tendons, going respectively to the index and median fingers, the former being the stronger of the two.

Cheiromys[1] has, according to Owen, also two tendons with a similar insertion. In our specimen, however, we find this muscle to be very remarkably complex. Its tendon is readily divisible into three parts, side by side, the middle one is the largest, and supplies the middle finger, but sends off a branch to the tendon of the fourth digit; the radial one divides and goes to the third and index digit (that to the index being extremely delicate); the ulnar one of the three goes to the fourth digit only. The divisibility of this muscle into three is not entirely confined to the tendinous part, but is more or less traceable into the muscular belly itself.

The Extensor primi internodii pollicis is entirely wanting, as is also the case in all the Lemuroidea examined by us, as well as in *Perodicticus*, *Tarsius*, and *Cheiromys*.

Extensor secundi internodii pollicis[2].—This is a long, slender muscle with a long tendon, and arises from the radial surface of the ulna (its origin extending as far upwards as behind the greater sigmoid notch), and from the interosseus membrane. The tendon does not receive muscular fibres lower down than the middle of the fore-arm, and, proceeding over the tendons of the radial extensor, is inserted into the proximal end of the second phalanx of the pollex.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 13, *E.s.i.p*).

In *Tarsius* it is described under the name extensor pollicis longus[3].

The same in *Cheiromys*, described by Owen under the name of extensor longus pollicis[4].

Extensor ossis metacarpi pollicis[5].—This is a large and flat muscle arising from the middle four sixths of the posterior surface of the radius and from the interosseous ligament. Its very strong and flat tendon crosses those of the radial extensors, and, passing through a groove in the outermost part of the back of the radius, is inserted into the outer side of the base of the metacarpal of the pollex.

Substantially the same in *Galago*, *Loris*, *Nycticebus*[6], *Tarsius*, and *Cheiromys*. Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. figs. 13 & 14, *E.o.m.p*).

e. *Brachial Region (flexors).*

Pronator radii teres.—This muscle is largely developed, and has an exceedingly tendinous surface, especially towards its insertion. It arises from the internal condyle

[1] *Loc. cit.* p. 62.

[2] The tendon of this muscle is shown by Cuvier, pl. 69. fig. 1, ζ, in *L. varius*, and pl. 67. fig. 1, ζ, in *Loris gracilis*.

[3] *Loc. cit.* p. 63, tab. 3. fig. 4. 37.

[4] *Loc. cit.* p. 62, pl. xxiii. fig. 2, no. 37.

[5] Magnificent as is the posthumous work, on Myology, of Baron Cuvier, it nevertheless leaves much to be desired. Thus there is no view of the deep muscles of the forearm of the Lemuroids represented; so that this muscle, like the preceding and some others, has only its distal portion shown cropping out from beneath the superficial muscles. See pl. 69. fig. 1, ι, *L. varius*; pl. 67. fig. 1, ι, *Loris gracilis*.

[6] P. Z. S. 1865, p. 248.

and from the septum between itself and the flexor carpi radialis, but it takes no origin from the ulna. It is inserted for more than an inch along the outer margin of the radius and also into the anterior surface of the radius, between the insertion of the supinator brevis and part of the radial origin of the flexor longus pollicis.

In *L. varius* it is continued by strong muscular fibres as far down as the bottom of the shaft of the radius. Cuvier represents it as we have said, pl. 68. fig. 2, *x*.

In *G. allenii* it is large and very strong. It arises from the inner condyle and covers the median nerve; insertion into the shaft of the radius, its middle third. The external cutaneous nerve lies between it and the supinator longus. Alike in *Galago crassicaudatus* (Pl. IV. fig. 14, *P.r.t*).

In *Loris gracilis* Cuvier represents it very short as compared with *Lemur*[1]. Figured in *Nycticebus*, woodcut, fig. 12, *Pt.*

In *Tarsius*[2] it is substantially the same as in *Lemur*.

The FLEXOR CARPI RADIALIS[3] arises from the internal condyle by a strong tendon, and from the intermuscular septa. Its fibres terminate at about two-thirds down the forearm, in a tendon which is inserted in the ventral surface of the proximal end of the second metacarpal.

In *L. varius* it is figured by Cuvier, pl. 68. fig. 2; also in *Loris gracilis*, pl. 67. fig. 2.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 14, *F. c. r*).

PALMARIS LONGUS.—This muscle is about the same size as the flexor carpi radialis. It arises from the internal condyle and intermuscular septa, and a tendon begins to appear at the surface above the middle of the forearm; but muscular fibres continue to be inserted into it for two-thirds of its length; passing over the annular ligament, it becomes continuous with the palmar fascia.

Cuvier represents it as cut short in *L. varius*, pl. 68. fig. 2, *a*. Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 14, *Pa. l*). In *Tarsius*[4] it is as in *L. catta*.

FLEXOR CARPI ULNARIS.—This is rather large, and arises from the internal condyle, the inner edge of the olecranon and the upper five-sixths of the inner or, rather, posterior margin of the ulna. Its tendon, which becomes visible somewhat below the middle of the forearm, receives fleshy fibres as low down as the wrist, and is inserted into the pisiform bone and also into the ulnar side of the proximal end of the fifth metacarpal[5].

Alike in all the genera[6]. Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 14, *F.c.u*).

FLEXOR SUBLIMIS DIGITORUM.—This is a small muscle, and only arises from the internal

[1] Pl. 67. fig. 2, *x*.

[2] *Loc. cit.* p. 54, tab. 3. figs. 1 & 2. 32.

[3] Burmeister, in *Tarsius*, p. 58, tab. 3. figs. 1 & 2. 31; and tab. 5. fig. 4. 31.

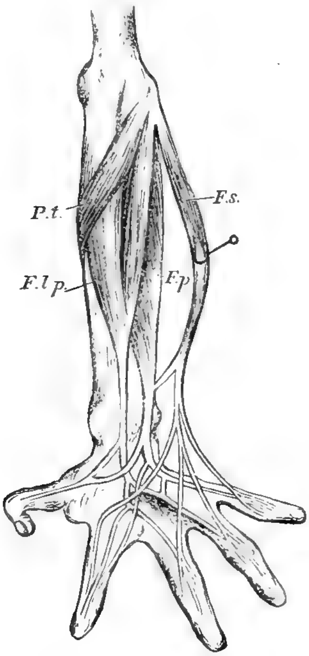
[4] *Op. cit.* p. 58, tab. 3. figs. 1 & 2. 30.

[5] In *L. varius*, figured by Cuvier, pl. 68. fig. 2, and also in *Loris gracilis*, pl. 67. fig. 2.

[6] That of *Tarsius* is described and figured by Burmeister, *op. cit.* p. 58, tab. 3. figs. 1 & 2. 29, and tab. 5. figs. 2, 3 & 4. 29.

condyle and the septum between it and that part of the flexor longus pollicis which arises from the same condyle. There is no median tendon; but from the deep surface of the muscle a small tendon is given off which joins the superficial surface of that of the flexor profundus (see woodcut, fig. 13,**). The main tendon of the flexor sublimis divides into four (of which that to the index is the largest), which are, as usual, the perforated tendons of the four ulnar digits.

Fig. 12.



Long flexor muscles and tendons of the hand in the Slow Loris (*Nycticebus tardigradus* (Linn.)).

P. t. Pronator teres.
F. s. Flexor sublimis digitorum.
F. p. Flexor profundus digitorum.
F. l. p. Flexor longus pollicis.

The hook represented dragging back the flexor sublimis passes over its median tendon.—From P. Z. S. 1865, p. 245.

In *L. varius* the small long tendon, on joining the profundus, exists as in *catta*; but the four perforated tendons to the digits are nearly of equal size, represented so by Cuvier, 'Myologie,' pl. 68. fig. 2, κ.

Delineated in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. fig. 14, *F.s.d*). The tendinous slip from this muscle to the flexor profundus digitorum in the latter Plate is indicated by **.

In *G. peli* Kingma[1] describes the four perforated tendons as splitting beneath the first phalanx of each digit, except that going to the fifth digit, which splits beneath the metacarpal. This he is disposed to consider a *lusus naturæ*; but Van Campen shows that the same thing exists in the Potto.

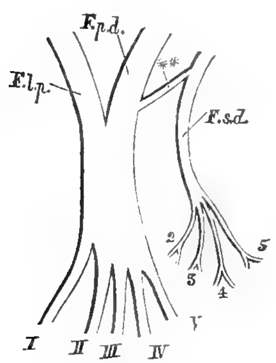
In the specimens of *G. allenii* we observed that the tendinous union with the profundus, when pursued up the arm, was that which formed the superficial slip on the middle and in front of the belly of the muscle.

[1] *Loc. cit.* p. 27.

In *Nycticebus*[1] (woodcut, fig. 15) and *Loris* there is a median tendon. In *Loris* we found no tendon going to the index (woodcut, fig. 14).

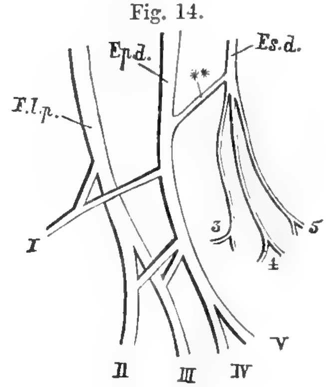
In *Perodicticus* it splits into three tendons; but Van Campen[2] says nothing of a tendon of union with the flexor profundus digitorum. It sends no tendon to the index digit.

Fig. 13.



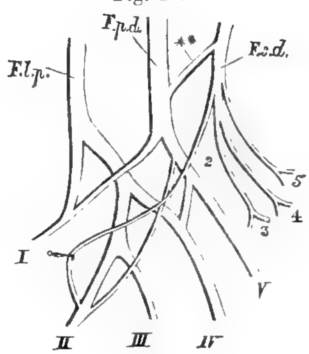
Lemur, *Galago*, and partly *Perodicticus*.

Fig. 14.



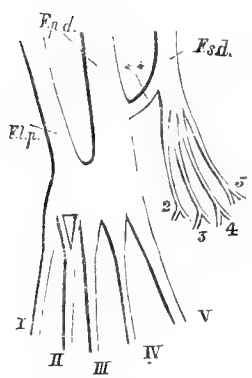
Loris gracilis.

Fig. 15.



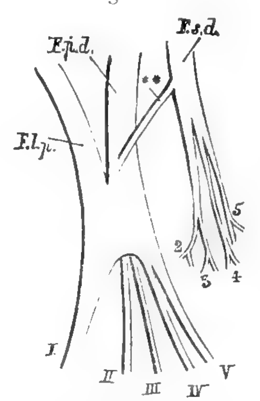
Nycticebus.

Fig. 16.



Tarsius.

Fig. 17.



Cheiromys.

Diagrams illustrating the distribution of the palmar tendons of the manus in several genera of Lemuroids. The same lettering is applicable in the different figures. I. II. III. IV. V. indicate respectively the digits and tendons of the deep flexors going thereto. *F. l. p.* Flexor longus pollicis. *F. p. d.* Flexor profundus digitorum. *F. s. d.* Flexor sublimis digitorum. 1, 2, 3, 4, 5. Numbers corresponding to the digits supplied by the flexor sublimis. The double asterisk represents the short tendon of union between the sublimis and profundus met with in each genus.

The arrangement of this muscle in *Tarsius*[3] is like that in *Lemur*, *Galago*, and *Loris*. Owen[4] says the flexor sublimis digitorum in *Cheiromys* divides into two fasciculi in

[1] P. Z. S. 1865, p. 245, figs. 2 and 3, *F. s.*

[2] *Loc. cit.* p. 35.

[3] *Op. cit.* p. 59, tab. 3. fig. 3. no. 33.

[4] *Loc. cit.* p. 63, pl. xxiii. fig. 3. no. 33.

the middle of the forearm, these again subdividing into four tendons, besides the extra short tendon of union with the flexor profundus, which is given off from the inner or back part of the ulnar division.

In our dissection of this species we find the flexor sublimis to be a very large muscle indeed, and its divisions somewhat different from those described by Owen. Its difference of size, indeed, as compared with the same muscle in *Lemur* and *Galago*, is remarkable. It may be described as consisting of two portions. The first, a most superficial portion (which is the wider of the two), arises from the internal condyle, intermuscular fascia, and outer border of the tibia for its upper half. It sends a single strong tendon to the fourth digit. The second and more rounded or compressed portion arises also from the inner condyle, below the last, but has no origin from either bone of the forearm. At the lower third of the forearm it is divisible into two bellies and their tendons; the middle tendon (derived more from the radial half) joins the deep flexor muscle; the radial tendon subdivides into two, going to the index and third digits respectively. The ulnar tendon supplies the fifth digit only. (See woodcut, fig. 17.)

Flexor profundus digitorum.—A considerably larger muscle than the flexor sublimis. It arises from the upper two-thirds of the anterior surface of the ulna, the interosseous membrane, the coronoid process, and the adjacent part of the ulna external to the insertion of the brachialis anticus. It is from this last part that the slip comes which joins the flexor longus pollicis. The muscle ends in a strong tendon (smaller, however, than that of the flexor longus pollicis) which at the wrist receives on the radial side of its superficial surface the delicate tendon (woodcut, fig. 13**) from the flexor sublimis. Immediately after this it unites with the tendon of the flexor longus pollicis, and with it forms the deep and perforating tendons of the digits, taking, however, little, if any, share in the formation of that of the pollex.

In *Galago crassicaudatus* and in *G. allenii* this muscle may be described as having three distinct heads of origin. The most internal and slightly the largest muscular bundle (Pl. IV. fig. 14, $F.p.d^1$) arises from the posterior and internal surface of the olecranon process from the internal condyle and intermuscular fascia. Muscular fibres proceed as far as the upper end of the upper third of the forearm on the ulnar side; but on the radial margin there is a strip of tendon as high as the lower end of the upper third. A separate tendon goes as far as the wrist, where it joins the broad common tendon of the three portions of the muscle.

The second head of origin (the smallest) (Pl. IV. fig. 14, $F.p.d^2$) lies to the outer side of the last, and arises by a short tendon from the front aspect of the inner condyle, close to the perforation. The belly of this portion goes fully as far as the middle of the forearm, and ends in a narrow, delicate tendon, which joins the broad common tendon above the wrist upon its inner side.

The third portion of the flexor profundus (Pl. IV. fig. 14, $F.p.d^3$), as large as the first head, arises by fleshy fibres from the upper and anterior third of the ulna, below the lesser sigmoid notch, and from the interosseous membrane.

These three form a broad tendon along with the flexor longus pollicis just above the wrist joint, which ultimately subdivides as in *Lemur*.

Although Van der Kolk and Vrolik do not mention this muscle in *Loris* separately from the flexor longus pollicis or the peculiarity in the tendons, yet we ourselves find in *Loris gracilis* that it has origin and tendinous insertions almost like *Nycticebus tardigradus*, differing in that it forms exclusively the tendon of the fourth and fifth digits and contributes bridge-like slips to the three radial ones (woodcut, fig. 14).

In *Nycticebus tardigradus*[1] it may be regarded as having but one extensive head of origin, which, after receiving its slip from the flexor sublimis, bifurcates, sending a tendon to the pollex, another delicate one to the index, another to the fourth, and exclusively forms the fifth (see diagram, fig. 15). Professor Huxley[2] did not find the delicate tendon which joins the index tendon of the flexor longus pollicis either from this or the flexor sublimis.

Van Campen[3] describes this along with the flexor longus pollicis as one muscle in *Perodicticus*. He says that it consists of two separate parts, the tendons of which unite together, arising from the condyle, &c., and ending in four tendons going respectively to the pollex, the third, fourth, and fifth digit. The author remarks that the index digit receives no tendon. This might almost have been anticipated from the all but aborted condition of the index digit.

The flexor profundus and the flexor longus pollicis are described by Burmeister in *Tarsius*[4] as one enormous muscle, they together having five heads of origin.

The first springs from the internal condyle beneath and attached to the flexor carpi radialis; its under surface is tendinous.

The second head comes from the inner side of the radius, and joins the first.

The third head springs deeply under and close to the first, from the anterior surface of the internal condyle.

The fourth head comes with oblique fibres from the upper border of the ulna, and lower down joins the third head.

The fifth head, which is the largest, springs from the olecranon and upper end of the ulna, joining the third and fourth heads and then receiving the slip from the flexor sublimis. After this it joins the tendon of the first and the second heads. Then the thumb and the index finger have their deep flexor tendons mainly derived from the first and second heads. Those of the fourth and the fifth fingers mainly come from the tendon of the fifth head, that of the middle finger mainly from the third and fourth heads.

[1] P. Z. S. 1865, p. 245, fig. 2.

[2] Hunterian Lectures, 1864, Med. Times and Gazette, Aug. 6, vol. ii. no. 756, p. 145.

[3] *Loc. cit.* p. 36.

[4] *Loc. cit.* pp. 60 and 61, tab. 3. figs. 1 and 3. no. 34 &c.

From this it appears to us that the first and second heads represent the flexor longus pollicis, the other three heads constituting the flexor profundus digitorum, which thus exclusively supply the third, the fourth, and the fifth digits (woodcut, fig. 16).

In *Cheiromys* we find but a single head to this muscle, but a very large one, extending from the internal condyle more than three-fourths down the forearm. Its tendon receives the tendinous communication (woodcut, fig. 17, **) from the sublimis, and immediately below this becomes adherent to the tendon of the flexor longus pollicis. It supplies exclusively the tendons of the fourth and fifth digits, and in great part that of the pollex, the portion from the sublimis merging in this pollicial portion. The thumb thus derives power from the profundus and sublimis as well as from its own powerful flexion. The tendinous fibres for the pollex derived from the profundus and sublimis cross over (are superficial to) the strong tendon of the flexor longus pollicis.

FLEXOR LONGUS POLLICIS.—This is by far the largest muscle of the forearm, and is closely connected (at and near the interosseous membrane) with the flexor profundus, while about halfway down the forearm it receives a distinct slip from that muscle.

It consists of two portions, which unite a little above the middle of the forearm. One part arises from the whole anterior surface of the radius (from the tubercle above to near the pronator quadratus below) and from the interosseous membrane.

The other portion springs from the septum between it and the flexor sublimis and from the internal condyle. The slip from the flexor profundus joins the deep surface of the first and radial portion just below its junction with the second part. The muscle gives origin to a very strong tendon, which at the wrist becomes intimately united with that of the flexor profundus, and with it forms the deep flexor tendons, that for the pollex being given off from the radial side of the conjoined tendon a little below the junction.

Only a fraction of this muscle is represented by Cuvier in his delineations of the myology of the Lemuroids, pl. 68. fig. 2, λ.

Lemur varius and *L. nigrifrons* present no difference from *L. catta*; and the Galagos are substantially the same. That of *Galago crassicaudatus* is figured in Pl. IV. fig. 14, $F.l.p^1$, and $F.l.p^2$. In *G. peli* no distinct flexor longus pollicis is described by Kingma.

In *Loris gracilis* there is a greater resemblance to the condition found in *Nycticebus*, to be described presently; but it sends no tendon to the third and fourth digits. It contributes to form the deep flexor tendon of the pollex and those of the index and third digits, but supplies no digit exclusively, as in the latter genus.

Contrary to what obtains in *Lemur* and *Galago*, *Nycticebus tardigradus* has the flexor longus pollicis remarkably distinct from the flexor profundus, which, moreover, it considerably exceeds in size. It supplies exclusively the deep flexor tendon of the third digit, and contributes to form that of the hallux and fourth digit and the main part of that of the index.

This muscle ceases to be so distinct in *Perodicticus*[1], and more resembles its condition as existing in *Lemur* and *Galago*. Its distribution is as before stated in describing the flexor profundus.

In *Tarsius* the flexor longus pollicis seems to be represented by the first two bellies of the deep flexor muscle described by Burmeister[2]. It supplies alone the pollex, and almost exclusively the index.

As to *Cheiromys*, our specimen does not present precisely the same conditions as those described by Professor Owen[3]. It is readily resolved into three distinct heads, the middle one of which is very delicate, and has a long tendon extending high up, *i. e.* above the middle of the forearm.

This head takes origin, deeply, from the anterior surface of the humerus, just above the trochlea, beneath the head next described.

This second head springs from the inner condyle and intermuscular fascia in close union with the palmaris longus and flexor sublimis. It constitutes a large fleshy belly to the middle of the forearm, where it joins the other heads.

The third and deepest head arises from the middle third of the shaft of the radius. This broad portion continues fleshy almost to the wrist.

These three heads unite to form a broad, strong, flat tendon, which becomes adherent at the wrist to that of the profundus. Immediately below this it divides into two tendons, which supply the second and third digits; and fibres from its superficial surface join others from the flexor sublimis and profundus to form the flexor tendon of the pollex. We failed to observe that convergence of fibres upon the third digit which is mentioned by the learned Professor.

The PRONATOR QUADRATUS arises from the ridge on the ulnar side of the lowest fourth of the ulna, and is inserted into the lowest fourth of the outer margin of the radius.

Alike in all the other genera[4]. In *Galago crassicaudatus* it is figured (Pl. IV. fig. 14, *P. q*).

f. *The Hand, Palmar and Dorsal Surfaces.*

PALMARIS BREVIS.—This is distinct, though small, and arises from the fascia covering the pisiform bone, and is inserted into the skin on the ulnar side of the palm.

It is also distinctly present in *L. varius*, *L. xanthomystax*, and *L. nigrifrons*.

If present, not satisfactorily made out by us either in the *Galagos*, *Loris*, or *Nycticebus*.

Our specimen having been skinned, we are unable to speak of this muscle in *Cheiromys*; and it is not described by Owen.

LUMBRICALES.—These are four in number. The outermost springs from the radial side of the deep flexor tendon of the index, and is inserted into the radial side of that digit.

[1] *Loc. cit.* p. 35.

[2] *Loc. cit.* p. 61, tab. 3. figs. 1 & 3, no. 34.

[3] *Loc. cit.* p. 63, pl. xxiii. fig. 4.

[4] *Tarsius*, *loc. cit.* tab. 5. figs. 3, 4, & 5, no. 39.

The next one springs from the radial side and superficial surface of the deep flexor tendon of third digit, and is inserted into the radial side of the same digit.

The third springs from the radial side of the tendon of the next digit, and is inserted into the same side of the same, or fourth digit.

The fourth arises from the ulnar side of the tendon going to the fourth digit, and is inserted into the radial side of the fifth digit.

In *L. varius* and *L. xanthomystax* they are also strong and well developed. The third lumbrical muscle comes more from the surface and between the fourth and fifth tendons, and not alone from the radial side of the fourth digital tendon.

As far as can be judged from the figure given by Cuvier[1], the lumbricales of his specimen, *L. varius*, appear to agree with the conditions of our *L. catta*.

In *Galago crassicaudatus* the lumbrical muscles are four in number, and arise and are inserted on the radial sides of the deep flexor tendons (Pl. II. fig. 3, L^1, L^2, L^3, L^4, and Pl. IV. fig. 14, L^1, L^2, L^3, L^4).

In *G. allenii* we did not find the first of the above-described four lumbricales in *L. catta*; but the three present corresponded to the three last of *L. catta*.

In *Nycticebus tardigradus* there are four radially inserted lumbricales[2].

In *Perodicticus*[3] there are but three lumbricales.

There are four lumbricales in *Tarsius*[4] which spring from the radial sides of the flexor tendons.

In *Cheiromys* we only find three, the first springs from the ulnar side of the flexor tendon of the index, and is inserted into radial side of the third digit. The second one springs from the radial side of the tendon of the fourth digit, and is inserted into the same side of that digit. The third one springs from the ulnar side of the tendon of the fourth digit, and is inserted into the radial side of the fifth digit.

The Abductor pollicis is not very distinct, its inner side being so closely connected with the outer part of the flexor brevis. It arises from the annular ligament external to the tendon of the flexor carpii radialis, and from the sesamoid bone in front of the trapezium. It is inserted into the base of the outer side of the first phalanx of the pollex.

In *L. varius*[5] and *L. xanthomystax* the abductor pollicis arises from the ossicle outside the trapezium.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. figs. 14 & 15, *Ab. p*).

It is well represented by Burmeister in *Tarsius*, tab. 5. fig. 4, no. 41.

Adductor pollicis[6].—This is a large and powerful muscle arising from the whole length of the third metacarpal bone and from the fascia on the palmar surface of the base of the second metacarpal. It is inserted with the inner part of the flexor brevis pollicis.

[1] Pl. 68. fig. 2, φ.
[2] P. Z. S. 1865, p. 247, fig. 4.
[3] *Loc. cit.* p. 36.
[4] *Loc. cit.* p. 65, tab. 3. fig. 3, no. 47.
[5] Figured by Cuvier, pl. 68. fig. 2, ξ.
[6] Recueil, pl. 68. fig. 2, ρ.

Insertion in *L. xanthomystax* the proximal end of the first phalanx; there appears also to be a small, but distinct, slip of this muscle arising proximally to the larger superficial portion; this arrangement is somewhat similar to that of the muscles of the foot.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. figs. 13, 14, & 15, *Ad. p*), whereas in *G. allenii* it is not nearly so strong as in *L. catta*. The fibres which pass to the second metatarsal are hardly distinguishable from the deep palmar fascia.

In *Tarsius*[1] the adductor of the pollex appears to consist of two parts.

In *Cheiromys* this muscle arises from the second metacarpal, and from the fascia on the palmar surface of the proximal part of the third metacarpal. A distal fascicle of this muscle is separated by a distinct interval, and represents a transversus manus. The similarity of structure (as regards muscles) of the manus and pes is strikingly shown in the Aye-Aye by the form of the adductor pollicis with its distinct slip homotypal with the transversus pedis.

FLEXOR BREVIS POLLICIS[2].—The greater part of this muscle is external to the long flexor tendon of the pollex. It arises from the trapezium and annular ligament, and is inserted into the base of the first phalanx of the pollex.

Displayed in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. IV. figs. 14 & 15, *F. b. p*).

Burmeister represents this muscle in *Tarsius*, *loc. cit.* tab. 5. fig. 4, no. 43.

OPPONENS POLLICIS.—This muscle is represented but by a comparatively few fibres, which arise from the trapezium, and are inserted into the base of the metacarpal bone of the pollex.

In *L. xanthomystax* it is large and strong.

In *Tarsius* it is quite as in *L. catta*, and is well represented by Burmeister, *loc. cit.* tab. 5. fig. 5, no. 49.

In the specimen of *Cheiromys* dissected by us this muscle was destroyed on the skinning of the body.

FLEXOR BREVIS MINIMI DIGITI.—This seems to be scarcely distinct from the abductor, with which it is inserted. It arises from the unciform bone and annular ligament.

Both *L. varius* and *L. xanthomystax* have it distinctly separate from the abductor, and it is comparatively strong.

In *Galago crassicaudatus* the flexor brevis minimi digiti is tolerably clearly defined (it is represented in Pl. II. fig. 3, and Pl. IV. figs. 14 & 15, *F. b. m. d*). It is somewhat indistinct in *G. allenii*, but with an origin and insertion as in *L. catta*.

Figured in *Nycticebus tardigradus*, P. Z. S. 1865, p. 247, fig. 4.

In *Tarsius* this is described by Burmeister as a division of the abductor digiti minimi, p. 66, tab. 5. fig. 42, *b*.

We have found it tolerably distinct in *Cheiromys*.

The ABDUCTOR MINIMI DIGITI is a considerable muscle, which takes origin from the

[1] *Loc. cit.* p. 65, tab. 5. figs. 4 & 5, no. 45.

[2] Well defined in pl. 68. fig. 2, *o*, of the 'Myologie.'

pisiform bone, and is inserted by a long flat tendon into the outer side of the base of the first phalanx of the fifth digit.

Substantially the same in all the other genera of Lemuroids. It is shown in pl. 68. fig. 2, *v*, of Cuvier's 'Recueil,' *Lemur varius*, and by us in *Galago crassicaudatus*, Pl. II. fig. 3, and Pl. IV. figs. 14 & 15, *Ab.m.d*, in *Nycticebus tardigradus*, P. Z. S. 1865, p. 247, fig. 4, and in *Tarsius*, tab. 5. fig. 5. 42 *a*.

The OPPONENS MINIMI digiti is very distinct. It arises from the unciform bone and annular ligament, and is inserted into the whole length of the metacarpal bone of the fifth digit.

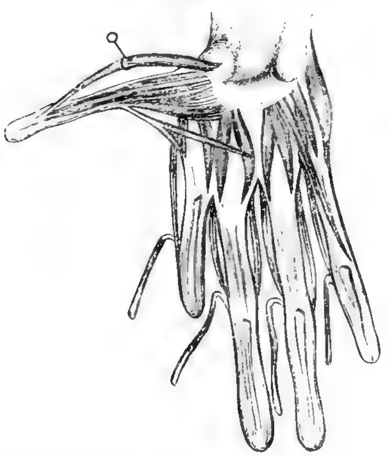
In *Galago crassicaudatus* and in *G. allenii* this muscle is small, but distinct (Pl. IV. fig. 15, *Op.m.d*). It is indicated in the enlarged view of the palmar surface of the manus of *Nycticebus*, *infra*, woodcut, fig. 18.

It is not mentioned by Burmeister in *Tarsius*; and in *Cheiromys* we have found it as in *L. catta*.

INTEROSSEI.—The interossei muscles of the hand resemble those existing in Man. Each digit, except the pollex, has in fact a pair of interossei (which are, indeed, true flexores breves); the outer one of the fifth digit, however, is described separately under the name of "Abductor minimi digiti."

Those of *Nycticebus tardigradus* are delineated in the accompanying woodcut, fig. 18.

Fig. 18.



Enlarged and somewhat diagrammatic view of the palmar surface of the hand in the Slow Loris, to show the small muscles of the pollex and fifth digit, also the interossei and insertions of the lumbricales. The latter are cut short and reflected.—From P. Z. S. 1865, p. 247.

In the genus *Galago* the interossei of the manus, so far as appearance and attachment are concerned, might with propriety be divided into dorsal and palmar; but as their action is mainly abduction and flexion, it may suffice to describe them as short palmar flexors. Considered thus, each metacarpal bone, excepting the thumb, is provided with a double interosseous muscle, the opponens minimi digiti being reckoned as one of these. Besides these eight, there are two superficial interosseous slips on the palm. These arise side by side from the ligaments and deep carpal fascia close to the proximal ends of the two median metacarpals. The one is inserted into the ulnar side of the second metacarpal; the other also by a short tendon into the fascia on the radial side of the fifth metacarpal, its distal end. The distribution of the so-called dorsal interosseal slips almost agrees with the condition described in *Tarsius*. Those of the Grand Galago are drawn in Pl. II. fig. 3, and Pl. IV. fig. 13, I. I. I. I; and in the enlarged view, Pl. IV. fig. 15, the two interossei superficiales are marked Is. Is.

Burmeister[1] describes the interossei as consisting of internal and external ones.

According to him the internal interossei[2] are four in number, and spring deeply between the metacarpals. The first attaches itself to the ulnar side of the index. The second divides into parts, going respectively to the ulnar side of the third digit, and to the radial side of the fourth digit. The third to the ulnar side of the fourth digit. The fourth is inserted to the radial side of the fifth digit.

The external interossei, as he states[3], spring from the dorsal side of the metacarpals; they also are four in number. The first (abductor indicis) is inserted into the radial side of the first phalanx of the index. The second divides, and goes to the adjacent sides of the second and third digits. The third goes to the adjacent sides of the third and fourth digits. The fourth is inserted into the adjacent sides of the fourth and fifth fingers.

In *Cheiromys*, in addition to the ordinary interossei, we find a small more superficial layer which arises in the deep fascia of the carpus, and divides into two small bellies. One of these is inserted into the ulnar side of the index digit, the other into the radial side of the fifth digit. The ordinary interossei form a considerable body of muscle on the dorsum of the fourth and fifth metacarpals.

3. *Muscles of the Trunk.*

a. *Ventral Region (Thoracic and Abdominal Parietes).*

SUPRACOSTAL MUSCLES.—On each side of the thorax, between the long insertion of the scaleni and origin of the pectorals, but superficial to the intercostal muscles, there are two small but very distinct muscles. These appear to be the variety so named by Mr. John Wood in his paper on "Additional Varieties in Human Myology," read before the Royal Society in June 1865[4]—and also to two unnamed extrapectoral muscular bundles described and figured by Van Campen in the Potto[5] (*Perodicticus*) as early as 1859.

We ourselves have observed equivalent muscles (though unpublished) in several Mammals, *e. g.* the Common Zebra, Brown Bear. Giraffe, &c.

But Cuvier, in those plates which form his posthumous 'Recueil de Myologie' (the

[1] *Loc. cit.* p. 66. [2] *Loc. cit.* tab. 5. fig. 5, no. 46. [3] *Loc. cit.* tab. 5. fig. 3, nos. 44 & 48.

[4] P. 381, and reprint from the Proceedings of the Royal Society, 15 June, 1865, p. 3, fig. 1, *d*.

[5] *Loc. cit.* p. 27, pl. 2. fig. 10.

preface of which bears the date 1849), has figured a single, but very large, supracostal muscle in *L. varius*, pl. 69. fig. 2. 18; this he has called sternocostal.

The first supracostalis muscle in *Lemur catta* arises by tendinous fibres from the cartilages of the fourth, fifth, sixth, and seventh ribs, and is inserted into the first rib just external to the origin of the subclavius, and crossing over the anterior end of the rectus (Pl. IV. fig. 12, *Sp.co*[1]). The second supracostal muscle in the same animal arises from the fourth and fifth ribs, just external to the outer ends of their cartilages, and closely connected with the fourth and fifth digitations of the serratus magnus. It is inserted, by a distinct though delicate tendon, into the first rib (Pl. IV. fig. 12, *Sp.co*[2]).

This muscle was absent in our specimen of *L. varius*, and, if present, not distinct in *L. nigrifrons.*

In *L. xanthomystax*, on the contrary, the first supracostal, as described in *L. catta*, was present, and with nearly the same attachments. What might represent the second supracostal we were rather doubtful about. A second small slip did exist on the right side only; but this lay rather to the inner side, and therefore probably may have been a portion of the sternal prolongation of the rectus muscle.

In *Galago crassicaudatus* and in *G. allenii* a few fibres only appear to pass forwards and outwards over the anterior prolongation of the rectus from the third to the first rib. This strip may be considered the first supracostal muscle (Pl. V. fig. 16, *Sp.co*).

We found a supracostal in *Nycticebus tardigradus* extending from the third to the first rib.

In the *Potto*, Van Campen found two supracostals (as already mentioned), and has well represented them.

Such muscular slips are not recorded by Burmeister in *Tarsius*, nor by Owen in *Cheiromys*; but in our specimen of the latter we find one remarkably large supracostal, having a tendinous origin from the cartilage of the third rib close to the sternum, and inserted into the first rib just external to the insertion of the subclavius, and just over the external half of the insertion of the rectus. The scalenus is immediately external to it.

Triangularis sterni.—In *Lemur catta* this is represented by a tolerably thick and continuous muscular layer reaching from the ensiform cartilage to the second rib. Inwardly it is attached to the sternum; and outwardly, by a series of serrate prolongations, it goes to the costal cartilages from the seventh to the second. It is noticed by Burmeister in *Tarsius.*

In *Cheiromys* we found this muscle well developed, arising as usual and passing from the sternum by digitations to the cartilages of the ribs, reaching from the third rib to the eighth inclusive.

External oblique[1].—This is a very elongated muscle which arises by digitations from the ribs, from the fifth to the twelfth inclusive, the three uppermost digitations being

[1] Very imperfectly represented by Cuvier in *L. varius*, pl. 68. fig. 1. 13, and in *Loris gracilis*, pl. 67. figs. 1 and 2. 13.

interposed between corresponding digitations of the serratus magnus. It also arises from the lumbar fascia, beneath the latissimus dorsi and behind (below) that muscle, and from the anterior spine of the ilium. It is inserted into the aponeurosis of the abdomen, and is closely connected anteriorly (above), at its inner border, with the rectus.

The fascia forms a wide, rather elongated abdominal ring, the inner pillar of which is much the stronger, and is inserted into the anterior margin of the pubis. The fibres composing the external pillar are more delicate, and interlace with those covering the cremaster, which muscle is much developed.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5 & 6, and Pl. IV. fig. 9, *Ex. o*).

In *Nycticebus tardigradus*[1] there is no variety in its attachments.

Perodicticus[2] has it springing from eight of the lower ribs.

Tarsius[3] from the cartilages of all the ribs to the third uppermost.

Internal oblique.—Fleshy laterally, but aponeurotic for a wide space towards the middle line of the body. It arises from the outer half of the crural arch, from the spine of the ilium, and the lumbar fascia beneath the external oblique. The fibres ascend and are inserted into the aponeurosis of the abdomen and the cartilages of the four hindmost ribs.

In *L. varius* and in *L. xanthomystax* this is as in *L. catta*, except that in the latter it is inserted into three only of the costal cartilages.

In *Galago crassicaudatus* this muscle (Pl. III. fig. 6, *In.o*) is only partially brought into view between the erector spinæ and external oblique, a portion of the latter muscle being removed. In *G. allenii* the internal oblique is pretty much intermixed with the transversalis, but corresponds tolerably well in its attachments to the above description of *L. catta*.

According to Van Campen, in *Perodicticus*[4] this muscle is thinner than the external oblique, and its tendinous aponeurosis close to the fascia lata to form a distinct Poupart's ligament. It is attached to the three hindmost ribs.

It presents no peculiarities in *Tarsius*[5].

In *Cheiromys* we find it muscular up to the margin of the rectus, and not aponeurotic as in *Lemur catta*.

The Transversalis is much more muscular than is the internal oblique. It arises from the spine of the ilium and from the fascia enclosing the erector spinæ, also from the inner surfaces of the hindmost four or five costal cartilages.

This muscle continues fleshy much further towards the middle line of the abdomen than does the internal oblique; and a very wide space intervenes between its hinder (lower) border and the brim of the pelvis, as it takes no origin from the crural arch.

In *L. varius* and *L. xanthomystax* it is scarcely more fleshy than is the internal oblique; that is to say, they are both so.

[1] P. Z. S. 1865, p. 248.
[2] *Loc. cit.* p. 28.
[3] *Op. cit.* p. 45, tab. 3. fig. 1, no. 1.
[4] *Potto*, p. 29.
[5] *Loc. cit.* p. 45, tab. 4. fig. 2. no. iii.

In *G. allenii* the transversalis is pretty much interwoven with the internal oblique, but corresponds tolerably well in attachments with what has been said of *L. catta*.

Perodicticus[1] has this muscle rather thin; fibres from it and the internal oblique go to form a cremaster.

In *Tarsius*[2] it is very thin and difficult to separate.

In *Cheiromys* it is very closely adherent to the internal oblique, and is not more muscular than the latter.

Rectus abdominis.—In *Lemur catta* this muscle, arising as usual, is inserted with strongly marked tendinous fibres into the first rib, the outer margin of the manubrium, and the sternal end of the cartilages of the second rib. We could find no indication of any of the nine tendinous intersections stated by Meckel[3] to exist in *Lemur mongos*. It is very broad at its origin.

In *L. varius* the muscular fibres stop at the second rib, and a tendon proceeds to the first one. Only a delicate tendon goes to the second rib at its sternal end. There is also a tendinous intersection, oblique in direction, and situated about two inches in front of the pubis. In this species Cuvier has only represented a small part of the thoracic portion of this muscle, pl. 69. figs. 1 and 2. 15.

In *L. xanthomystax* it nearly corresponds to what is said above of *L. catta*, and is strong and fleshy, excepting in the pectoral region, where it is thin. On the left side of the specimen examined by us, its fibres appeared to be continuous with the external oblique; and thus the digitations of this muscle may by Meckel[4] have been considered to belong to the rectus abdominis.

It is also continued by a long band of longitudinal fibres to the first rib in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. fig. 5, and Pl. V. fig. 16, *R.ab*).

In *G. allenii* it arises from the first rib, and receives slips from opposite the fourth, fifth, and sixth ribs. It reaches the cartilages of the lower ribs; and its fibres unite with the external oblique.

Nycticebus tardigradus[5] has the muscular band carried to the first rib.

In *Perodicticus*[6] and *Tarsius*[7] there are no tendinous intersections, but each has a similar insertion into the first rib.

In *Cheiromys* this muscle is not noticed by Owen any more than are the other abdominal muscles. We found it to ascend to the first rib in a broad, flat, muscular band, becoming tendinous at the second rib, the tendon being inserted into the middle third of the first rib. It passed beneath the supracostal, and at so great a distance from the sternum that at first we thought it was the second supracostal (of *L. catta*), which muscle may perhaps form part of it. The tendon of the subclavius meets that of the rectus on the inner side of the latter. This muscle has no tendinous intersections. It is remarkably broad at its pubic origin.

[1] *Loc. cit.* p. 29. [2] *Loc. cit.* p. 46, tab. 4. fig. 9. no. iv. [3] *Loc. cit.* p. 201. [4] *Loc. cit.* p. 201.
[5] P. Z. S. 1865, p. 248. [6] *Loc. cit.* p. 28. [7] *Loc. cit.* p. 45, tab. 4. figs. 2 & 9. no. ii.

Pyramidalis.—We could find no distinct trace of this muscle in either *Lemur catta*, *L. varius*, *L. nigrifrons*, or *Nycticebus tardigradus*, nor in the Galagos.

Its presence in *G. peli* is denied by Kingma[1].

Van Campen and Burmeister agree also as to its absence in the *Potto*[2] and *Tarsius*[3].

It is also absent in *Cheiromys*; but the breadth of origin of the rectus in this and other forms of Lemuroids suggests that the pyramidalis may be present but included in the former.

b. *Dorsal Region (superficial layer).*

Trapezius.—This in *Lemur catta* is a very thin muscular layer, its anterior (cervical) portion being entirely aponeurotic. It arises from the ligamentum nuchæ as far forwards as about the middle of the neck, also from the spines of the first nine dorsal vertebræ. It is inserted into the whole length of the anterior margin of the spine of the scapula to the extremity of the acromion, and by aponeurosis into nearly half the length of its posterior margin. This muscle is crossed and covered at the anterior part of its insertion by the levator claviculæ.

In *L. varius*[4] and *L. xanthomystax* the anterior part of its origin was not aponeurotic, but muscular. The latter has an origin from the eighteenth spinous process; and its posterior fibres cover those of the latissimus dorsi at the spine.

In *Galago* it is almost the same as in *Lemur catta*. See *G. crassicaudatus*, Pl. II. fig. 3, and Pl. III. figs. 6 & 7, *Tz* and *Tz**, where it is entirely muscular and reaches backwards to the eleventh dorsal spine.

In *Nycticebus* it only reaches as far as the fifth dorsal vertebra.

It is small in *Loris gracilis* (see Cuvier, pl. 67. fig. 1, a^2).

In *Tarsius*[5] its origin extends to about the twelfth dorsal vertebra.

In *Cheiromys*, according to our specimen, it was almost entirely muscular, and not crossed by the levator claviculæ, but, on the contrary, entirely hid the latter. It arises from the whole length of the ligamentum nuchæ, the back of the skull, and the first seven dorsal vertebræ (Pl. III. fig. 8, *Tz* and *Tz**).

The depressor scapulæ.—A muscle of this kind has been described by Burmeister[6] in *Tarsius*, and also by Kingma[7] in *Otolicnus peli*. The latter speaks of it as a delicate muscular layer arising from the lumbar fascia, becoming thicker and narrower further forwards, and attaching itself to the anterior inner angle of the scapula, covering part of the latissimus dorsi.

In *Lemur* (*L. niger*) the rhomboideus is quite distinct from latissimus dorsi. There is no depressor scapulæ.

In all the Galagos we found the rhomboideus well defined from the latissimus dorsi,

[1] *Loc. cit.* p. 28.
[2] *Op. cit.* p. 28.
[3] *Loc. cit.* p. 45.
[4] Indistinctly figured by Cuvier, pl. 69. fig. 2, a^2.
[5] *Loc. cit.* p. 46, tab. 3. fig. I. 1, and tab. 4. fig. I. 1.
[6] *Loc. cit.* p. 46, tab. 3. figs. 1, 2.
[7] *Loc. cit.* p. 22.

and no trace of a depressor scapulæ, except on the right side of one specimen of *G. crassicaudatus*, where a few muscular fibres arise from a delicate fascia immediately beneath the latissimus and run on into the teres major, being more or less adherent to the posterior vertebral angle of the scapula (Pl. III. fig. 7, *D. sc*).

In *Nycticebus* the rhomboid is well defined below, and there is no depressor scapulæ.

In the *Potto*[1] such a muscle appears to be absent.

In *Tarsius*[2], as before said, this is stated to exist, arising as a thin, long muscle from the lumbar fascia in the region of the last rib and adjacent parts. It passes forwards, overlapping the latissimus dorsi, and is strongly inserted into the posterior vertebral angle of the scapula. It is said to be in relation with the trapezius, and to cover the teres minor and infraspinatus.

In *Cheiromys* we found no distinct muscle; but, as we have said, a portion of the conjoined rhomboideus and latissimus dorsi (more belonging to the former muscle, however) is inserted into the posterior vertebral angle of the scapula and adjacent portion of its axillary margin. See Pl. III. fig. 8. This appears to answer to Kingma's separate muscle.

Rhomboideus[3].—In *Lemur catta* it is less extensive in its origin than as described by Meckel[4] in the Lemurs generally. It arises from the spinous processes of the last two cervical and first four dorsal vertebræ, and is inserted into the vertebral border of the scapula.

In *Galago crassicaudatus* (Pl. III. figs. 6 & 7, *Rh*) it has attachment from the third cervical to fourth dorsal vertebræ.

In *G. allenii* we found one side to have but a single rhomboideus muscle, with a similar origin and insertion to that of *Lemur catta*; but on the opposite side of our specimen there appeared a very slight separation of the fibres, sufficient to indicate a rhomboideus major and minor, the latter of which seemed the larger of the two.

There is but one rhomboid muscle in *Nycticebus*[5], which has a higher origin than in *L. catta*, namely, from between the fourth and fifth cervical neural spines down to the fifth dorsal.

In *Perodicticus*[6] it is similar, the major and minor being united.

There are said to be two rhomboidei in *Tarsius*[7]; but one of them is evidently our rhomboideus capitis.

Cheiromys has a largely developed single rhomboideus, which is entirely muscular. It arises from the ligamentum nuchæ for the whole length of the neck and from the first two dorsal vertebræ. (Professor Owen has not described this muscle, nor yet the following one.) Its posterior margin is fused with the latissimus dorsi, so that no limit

[1] *Loc. cit.* p. 31.
[2] *Loc. cit.*
[3] See Cuvier, pl. 69. fig. 1, c^1, c^2 (*L. varius*).
[4] Anat. Comp. vol. vi. p. 244.
[5] P. Z. S. 1865, p. 242.
[6] *Op. cit.* p. 31.
[7] *Op. cit.* p. 47, tab. 4. fig. 1. 6.

between them can be defined; and its hindmost part is inserted into the posterior vertebral margin and adjacent part of the axillary border of the scapula[1] (Pl. III. fig. 8, *Rh*).

Rhomboideus capitis.—An exceedingly long and thin strip. It arises from the occiput, and is inserted, by a very delicate tendon, just beneath the anterior end of the insertion of the single rhomboideus muscle. At its insertion it is closely attached to the levator anguli scapulæ.

In *L. varius* Cuvier represents it as rather strong (*l. c.* pl. 69. fig. 2, *c*). Its insertion is shown in *L. catta*, pl. 71. fig. 1, *c*.

If at all present in *Galago allenii*, it is most intimately united with the trapezius; and in *G. crassicaudatus* the tendency to separation from the conjoined rhomboideus major and minor is very faint, as is delineated in Pl. III. fig. 6. Its presence is noted by Kingma in *G. peli*[2].

In *Nycticebus* this muscle presents nearly the same conditions as in *Lemur catta*. In the *Potto* the existence of this muscle is not noticed by Van Campen.

In *Tarsius*[3] a rhomboideus capitis is evidently present, but is said only to extend to the ligamentum nuchæ.

In *Cheiromys* this muscle is rather fleshy. Its insertion into the anterior vertebral angle of the scapula is also covered by that of the single rhomboideus.

Levator claviculæ.—In *Lemur catta* this is a long band of muscular fibres which arises from the ventral surface of the transverse process of the atlas, and is inserted into the spine of the scapula—not, however, into the true acromion process, but into the triangular backwardly (downwardly) projecting metacromion-like process, which is so strongly developed in *Lemur*. At its insertion it overlaps[4] and is entirely superficial to the trapezius, the insertion of which last is continued on to the very extremity of the acromion process. This, combined with its very different origin, makes it difficult to understand how Meckel[5] could have thought that this muscle might "dans les Makis" be easily taken for the otherwise absent clavicular portion of the trapezius.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, & 7, and Pl. IV. figs. 13 & 14. *L.cl*). The presence of this muscle is noted by Kingma[6] in *G. peli*.

We found it present also in *Loris gracilis* and in *Nycticebus tardigradus*[7], but with an insertion only into the outer end of the clavicle, as Cuvier seems to have found it[8].

This muscle is absent, according to Van Campen, in the *Potto*[9]. Burmeister, in *Tarsius*[10], describes this muscle under the name of the levator anticus scapulæ.

It is not distinctly mentioned by Owen as existing in *Cheiromys*, but in our specimen was very largely developed and inserted broadly into rather more than the middle third

[1] This part is probably the depressor scapulæ.
[2] *Loc. cit.* p. 23.
[3] *Loc. cit.* p. 47, tab. 4. fig. 2. The smaller and upper muscle marked with the figure 6.
[4] As shown by Cuvier in *L. varius*, pl. 69. fig. 2, *d*.
[5] *Op. cit.* vol. vi. p. 238.
[6] *Loc. cit.* p. 22.
[7] P. Z. S. 1865, p. 243.
[8] *Loc. cit.* pl. 67. fig. 2, *d*.
[9] *Loc. cit.* p. 31.
[10] *Loc. cit.* p. 46, tab. 4. fig. 1. 3.

of the spine of the scapula. Unlike that in *Lemur* the muscle inferiorly is entirely overlapped and hidden by the trapezius (Pl. III. fig. 8, *Lc*).

Levator anguli scapulæ.—This is so closely united at its posterior (lower) end with the serratus magnus, that it may be regarded as the cervical portion of the latter muscle[1]. It arises from the root of the transverse process of the atlas, and from the transverse processes of all the other cervical vertebræ, and is inserted into the border of the scapula from midway between the insertions of the omohyoid and rhomboideus capitis to the insertion of the latter, into the delicate tendons of which some of its fibres are inserted. It is not covered by the rhomboideus, its insertion being anterior to the insertion of that muscle.

Meckel says, "dans les *Loris* et les Makis proprement dits il se rend seulement à l'atlas" (*loc. cit.* p. 236); but then he attributes an extensive cervical origin to the serratus magnus (*l. c.* p. 248).

What may either represent a large levator anguli scapulæ or a continuation into the neck of the serratus magnus, is figured in *Galago crassicaudatus* (Pls. III. & IV. figs. 6 & 9, *L.a.s=S.mg*).

In the *Potto*[2] it arises from the transverse processes of the five most anterior cervical vertebræ.

In *Tarsius*[3] to the transverse processes of the six hindermost cervical vertebræ.

c. *Dorsal Region* (*deep layer*).

Serratus magnus.—Arising from the first eight ribs by as many digitations, that from the first rib being the broadest, it is inserted into the whole vertebral margin of the scapula posterior to the insertion of the levator anguli scapulæ. It is nearly coequal in extent with the rhomboideus. This muscle is closely connected with the long insertion of the scalenus at the third rib; and its three hindermost (lowest) serrations interdigitate with those of the external oblique.

In *L. varius* it appears to have attachments to the whole of the cervical vertebræ.

In *L. xanthomystax* it is in union with the second slip of the scalenus.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5 & 6, Pl. IV. figs. 13 & 14, and Pl. V. fig. 16, *S.mg*) the combined serratus magnus and levator anguli scapulæ arise from all the transverse processes of the cervical vertebræ and the first eight ribs. Insertion the vertebral margin of the scapula. In *G. allenii* to the seventh rib.

In *Nycticebus* it arises from the first ten ribs.

In *Perodicticus*, according to Van Campen[4], this muscle arises from eleven ribs.

In *Tarsius*[5] it springs by eight digitations from the second to the ninth rib.

We have found it in *Cheiromys* quite as in *L. catta*.

[1] The two muscles spoken of are indicated by one letter by Cuvier in *L. catta* and *L. varius*, pl. 69. fig. 2, and pl. 71. figs. 1, 2, 3, g.

[2] *Loc. cit.* p. 31.

[3] *Loc. cit.* p. 47, tab. 4. fig. 1. 5.

[4] *Loc. cit.* p. 28.

[5] *Loc. cit.* p. 48, tab. 3. fig. 1. 8.

LATISSIMUS DORSI[1].—This arises from the spines of the dorsal vertebræ from the sixth backwards, and from the lumbar fascia; it is inserted as usual. We could detect no trace[2] of any slips going to the pectoralis major as mentioned by Meckel[3], and as is the case in the Lemurs.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. figs. 5, 6, & 7, and Pl. IV. figs. 13 & 14, *La.d*).

In the *Potto*[4] it springs from the ten hindermost dorsal vertebræ.

In *Tarsius*[5] it is as in *L. catta*, but overlapped by the depressor scapulæ.

In *Cheiromys*[6] from the last five ribs and the common tendon of the erector spinæ. As has been said, its outer margin is fused indistinguishably with the rhomboideus.

For the DORSO-EPITROCHLEAR muscle, see *antea*, p. 32.

SERRATUS POSTICUS ANTERIOR[7].—This is a thin, small muscle which has origin by a delicate aponeurosis from the last cervical and the first four dorsal vertebræ, and is inserted into the second, third, fourth, fifth, and sixth ribs.

In *L. varius* it is also inserted into the first rib. In *L. xanthomystax* it has the same number of insertions, namely six, but it is altogether more aponeurotic than muscular.

In *Galago crassicaudatus* (Pl. III. fig. 6, and Pl. IV. fig. 9, *S.p.a*) as in our type *L. catta*.

In *G. allenii* it arises by aponeurosis from the third and fourth last cervical vertebræ and the anterior dorsal vertebræ, and is inserted into the third, fourth, and fifth ribs.

This muscle is wanting in *Perodicticus*; or at least Van Campen says so[8].

In *Tarsius*[9] it has six serrations, extending from the second to the seventh rib.

In *Cheiromys* this muscle is as in *L. catta*, excepting that it only reaches the fifth rib.

SERRATUS POSTICUS POSTERIOR.—This is very indistinctly marked. It appears to arise from the fascia lumborum, and to be inserted into the last four or five ribs, not counting the very short thirteenth rib.

The muscle and its digitations are clearly defined in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. III. fig. 6, and Pl. IV. fig. 9, *S.p.p*), where its attachments are as in *Lemur catta*.

We only noticed two digitations in *Nycticebus tardigradus*.

According to Van Campen[10] this muscle in *Potto* "is there as ordinary."

In *Tarsius*[11] it has six digitations; from the seventh to the thirteenth rib, and is stronger than the serratus posticus anterior.

In *Cheiromys* it is, in our specimen, distinctly marked, and inserted by broad digita-

[1] See Cuvier, *l. c.* pl. 68. fig. 1, and pl. 69. fig. 1, I. in *L. varius*, and pl. 67. fig. I. in *Loris gracilis*.

[2] Cuvier in his figure of *L. varius*, pl. 68. fig. 1, 5[c], represents a slip as coming from the latissimus dorsi, joining the third part of the pectoralis major near its insertion; it is, however, spoken of as cutaneous.

[3] *Loc. cit.* p. 267. [4] *Loc. cit.* p. 30. [5] *Loc. cit.* p. 50, tab. 3. fig. 1. 16.

[6] *Loc. cit.* p. 59. [7] See Cuvier, pl. 71. fig. 1. 10. [8] *Loc. cit.* p. 31.

[9] *Loc. cit.* p. 39, tab. 4. figs. 1 & A. [10] *Loc. cit.* p. 31. [11] *Loc. cit.* p. 39.

tions into the last six ribs, interdigitating with the external oblique. Owen does not refer to this muscle.

SACRO-LUMBALIS[1].—Rapidly narrowing after emergence from the general mass of the erector spinæ, the sacro-lumbalis is inserted by tendons into the posterior (inferior) borders of all the ribs, except the thirteenth, taking fresh origin (as the accessorius) by tendons springing from the anterior (superior) margins of the nine or ten hindermost ribs.

In *L. xanthomystax* it has attachments by muscular fibres to all the twelve ribs present; the outer tendons are attached to the nine anterior ribs only.

Figured in *Galago crassicaudatus* (Pl. III. fig. 6, and Pl. IV. figs. 9 & 10, *S.l*).

In *G. allenii* it is small and thin, and branches from the longissimus rather behind (below) the last short rib. It is attached to all the ribs.

Its attachment to the ribs in *Nycticebus tardigradus* is from the fifteenth to the first.

In *Tarsius*[2] it appears to agree very nearly with *L. catta*, as it does substantially in *Cheiromys*.

The CERVICALIS ASCENDENS is the continuation of the preceding muscle (sacro-lumbalis) forwards. It is separately inserted by a single tendon into the transverse process of the seventh cervical vertebra.

See dissection of *Galago crassicaudatus* (Pl. IV. fig. 9, *C.as*).

Burmeister[3] speaks of a continuation of the sacro-lumbalis to the transverse process of the seventh cervical vertebra; but the muscle he compares with the cervicalis descendens has nothing to do with it, but is the cervical part of the semispinalis.

LONGISSIMUS DORSI[4].—Having origin from the parts adjoining the conjoined lumbar muscular mass, this is ultimately inserted into the anapophyses and transverse processes of the lumbar and dorsal vertebræ by tendons.

In *Nycticebus* its origin is from the eleventh dorsal vertebra; the other Lemurs, *Galago*, *Tarsius*, and *Cheiromys*, agree with *L. catta*. It is shown in *Galago crassicaudatus* (Pl. III. fig. 6, and Pl. IV. figs. 9 & 10, *Lo.d*).

The TRANSVERSALIS CERVICIS continues the foregoing muscle to the transverse processes of the seventh, sixth, fifth, and fourth cervical vertebræ.

In *L. varius* and *L. xanthomystax* it extends up to the third cervical vertebra.

It is delineated in *Galago crassicaudatus* (Pl. IV. fig. 9, *Tr.c*).

In *Nycticebus tardigradus* it reaches from the seventh to the second cervical vertebra inclusive. In *Tarsius*[5] this muscle continues up to the atlas, being attached to the six first cervical vertebræ.

SPINALIS DORSI.—We could not satisfactorily define this as a distinct muscle in *Lemur catta*, as it seemed inseparable from the fibres of the longissimus dorsi. The other genera examined by us did not exhibit any clear line of demarcation.

[1] Figured by Cuvier in *L. catta*, pl. 71. fig. 2, C.

[2] *Loc. cit.* p. 40, tab. 4. fig. 4, B.

[3] *Loc. cit.* p. 40.

[4] Figured by Cuvier in *L. catta*, pl. 71. fig. 2, B.

[5] *Loc. cit.* p. 38, tab. 4. fig. 4, *f*.

SEMISPINALIS, as usual, extends forwards, upwards, and inwards from the metapophyses to the spinous processes. Of its two parts the semispinalis dorsi is thick in the lumbar region, and with strong and rather short tendons; but in the dorsal region it is more slender and the tendon much longer, the latter extending over four or five vertebræ. The other part, the semispinalis colli[1] is thick, and the tendons are short and inconspicuous.

We have dragged out these muscles and slightly exaggerated their tendons in *Galago crassicaudatus* (Pl. IV. figs. 10 & 11, $\frac{1}{2}$ *Sp.c* and $\frac{1}{2}$ *Sp.d*).

In *Tarsius* the cervical portion of this muscle is compared by Burmeister[2] to the cervicalis descendens.

MULTIFIDUS SPINÆ.—In *Lemur* this, as in Man, fills the grooves between the transverse and spinous processes. It is very fleshy all along the spine; and though the tendons are distinctly seen going from the former to the latter, yet the whole mass is very continuous.

See *Galago crassicaudatus* (Pl. IV. figs. 10 & 11, *Ml.s*), each muscular bundle being divided from its fellow, so that the continuity of the whole mass is lost.

4. *Muscles of the Tail.*

Caudal Region (Dorsal and Ventral Surfaces).

LEVATOR CAUDÆ EXTERNUS.—This is evidently more or less the continuation backwards of the longissimus dorsi. It arises from the upper (posterior) surfaces of the lumbar and sacral transverse processes, and from the proximal caudal vertebræ. It consists of numerous fleshy bellies, ending in very long and slender tendons, which pass inwards and backwards to be inserted into the caudal metapophyses. This muscle is considerably larger than the levator caudæ internus. In *L. varius* it arises by five tendons from the metapophyses of the lumbar vertebræ.

Displayed in position in the Grand Galago, Pl. II. fig. 3, *L.c.e*, and with the tendons dragged out in Pl. VI. fig. 25, *L.c.e.*

LEVATOR CAUDÆ INTERNUS.—This division forms the continuation backwards of the semispinalis and the muscles internal to that. It arises from the spinous processes of the sacral vertebræ, and is inserted by tendons into the caudal metapophyses, being continued backwards as a series of fleshy bundles between the caudal zygapophyses and the middle of the dorsum of the tail. Shown in *Galago*, Pl. II. fig. 3, *L.c.i*, and tendons separated, Pl. VI. fig. 25, *L.c.i.*

The above two caudal muscles in the short-tailed genera, as might be expected, are very imperfectly developed; yet distinct rudiments of both exist. The former muscle in *Nycticebus* has a very few fleshy fibres, with an outer border of tendon continued from the loins on the backs of the sacral vertebræ almost to the coccygeal ones, where very fine tendons, like a fascia, seem to proceed to the end of the tail. The latter muscle

[1] Figured by Cuvier in *L. catta*, pl. 71. fig. 3, E.

[2] *Loc. cit.* p. 38, tab. 4. fig. 4, *r*.

has a similar appearance to that described, and overlies it, the two filling the flattened surface between the spines and tips of the transverse processes.

Pubo-coccygeus and ilio-coccygeus.—These muscles are represented by a broad, flat sheet of muscle arising from the sacro-iliac synchondrosis and the fascia investing the psoas parvus, also from the inside of the so-called "horizontal" ramus of the pubis, as far as the symphysis. Their united insertion is into the chevron bone placed between the third and the fourth caudal vertebræ.

Partly shown in Pls. II. and VI. figs. 3 & 25, and severed, excepting origin and insertion, in Pl. V. fig. 19, *P. & i. c.*

In the Slow Loris the united representative of the above is comparatively of large size, though thin. It covers the obturator internus from near the pubis to the posterior end of the brim of the pelvis, and is inserted on the under surface of the third caudal element.

The Sacro-coccygeus arises by considerable fleshy bellies from the ventral surface of the bodies of all the sacral and the first five caudal vertebræ. It is continued backwards between the chevron bones and transverse processes of the caudal vertebræ with numerous long tendons, like the levator caudæ externus.

Indicated in position in *Galago crassicaudatus* (Pl. II. fig. 3, *S.c*), and with tendons apart (Pls. V. and VI. figs. 19 & 25, *S.c*).

Nycticebus has this well developed and muscular; it is partly united to the internal sphincter ani and to the surface of the infra-coccygeus, and is inserted on the caudal vertebræ.

The Ischio-coccygeus has origin from the spine of the ischium and the part immediately anterior (superior) to it, above (behind) the acetabulum. Expanding in a fan-like manner, it is inserted into the tail beneath the transverse processes of the first four caudal vertebræ.

It exhibits little or no difference in the Galagos, see Pl. VI. fig. 25, *Is.c.*

It is broad and strong in the Nycticebinæ, and drags the abortive tail well downwards and forwards, so that this organ in the live animal almost seems absent.

The Infra-coccygeus arises by muscular fibres from the last sacral and the first five caudal vertebræ. It connects together the chevron bones of contiguous vertebræ for about half the length of the tail.

In *Galago* it connects the caudal vertebræ in the middle line below, but barely attains the sacrum (Pl. V. fig. 19, *I.c*).

The two small infra-coccygeal muscles in the Slow Loris lie close together, and appear as a narrow muscular riband lying on the inferior sacral surface. Tendons cannot be traced into the rudimentary tail.

Intertransversarii caudæ.—This muscle (or series of muscles) is, as Meckel remarks of *Ateles*[1], of considerable size at the root of the tail. It arises from the dorsum of the

[1] *Loc. cit.* vol. vi. p. 179.

thick transverse process of the first sacral vertebra, also from the fascia connected with the upper (posterior) margin of the ilium.

It gives origin to tendons which are inserted upon the caudal transverse processes, which it connects together, the tendons arising from the posterior transverse process of one vertebra and going to the anterior transverse process of the vertebra next but one behind that from the transverse process of which it springs.

These semiunited series of muscular bellies and tendons are seen in position in the Thick-tailed *Galago*, Pls. V. & VI. figs. 19 & 25, *It.cd*, and a segment of the tail with two muscles of the one side hooked out in Pl. VI. fig. 26, *It.cd.*

These can hardly be said to be present in the short-tailed genera. We could not define them in *N. tardigradus.*

5. *Muscles of the Pelvic Limb.*

a. *Pelvic Regions* (*Dorsal and Ventral aspect*).

GLUTEUS MAXIMUS, or Ecto-gluteus of Owen[1].—In *Lemur* this is a very large and powerful muscle[2], with an extensive origin and also an extensive insertion. Its origin is partly aponeurotic and partly muscular. It arises by aponeurosis from the anterior superior (posterior superior of Man) angle of the ilium, from the lumbar fascia (at its posterior part), and from the spines of the sacral vertebræ. It arises by muscular fibres from the inferior anterior (anterior superior of Man) spines of the ilium and from the transverse processes of the first three caudal vertebræ. The part which arises by muscle from the inferior anterior spine of the ilium is that which is described as the tensor fasciæ latæ by Burmeister in *Tarsius*, and is connected only by aponeurosis with the part which arises from the anterior superior angle of that bone—this aponeurosis covering over the gluteus medius lying beneath. This muscle is inserted (gliding over the outside of the peroneal trochanter) into the third trochanter, and into the posterior surface of the femur side by side with the adductor magnus, and very closely connected with it. No fibres are inserted into the aponeurosis of the thigh.

There is a certain distinctness between the part arising from the pelvis and that coming from the tail; the long supracaudal muscles passing above the origin of the caudal part, and beneath that of the sacral portion.

In *L. xanthomystax* and *L. nigrifrons* the insertion extended right down to the external condyle.

In *Galago* the aponeurotic interval is less perceptible, and there is a strong tendon running along the inferior margin of the part inserted into the third trochanter. See

[1] In the Trans. Zool. Soc. vol. v. pp. 15, 65, Prof. Owen has proposed the terms "ecto-," "meso-," and "ento-," for the gluteal muscles respectively, as indicating their relative position; for in Mammals their proportional volume is not the same as in Man.

[2] Figured by Cuvier in *L. varius*, pl. 70. fig. 1, *a*; and in *Loris gracilis*, pl. 67. fig. 1, *a*.

dissections of *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 21, and Pl. VI. fig. 25, *G.mx*[1], *G. mx*[2], *G.mx*[1*], and *G.mx*[2*]).

In *Nycticebus* the aponeurotic interval is slight; and there is no origin from the tail.

In the *Potto*, according to Van Campen[1], it is partly inserted into the great trochanter.

In *Tarsius*[2] this muscle is very similar to its homologue in *L. catta*; but its caudal portion, as in *Galago*, is more distinct, and is described by Burmeister as the pyriformis.

The same in *Cheiromys* as in *L. catta*, except that it arises from the first two caudal vertebræ, and has no aponeurotic interval.

Gluteus medius[3], or Mesogluteus of Owen.—This is very thick and fleshy, and arises from the whole outer surface of the ilium and from the aponeurosis separating the levator caudæ externus and the intertransversarii caudæ from the ischiococcygeus and pyriformis. It is inserted into the outer side of the peroneal trochanter, near its posterior margin, anterior to and below the insertion of the pyriformis, with which muscle the posterior portion of the gluteus medius is closely united.

In some specimens of *Lemur* examined by us the inferior portion (anterior of Man) was more or less separable, so much so as to suggest the possibility of its being a scansorius. Such a separate part appears to exist in *Tarsius*, and is described by Burmeister (p. 69, and tab. 4. fig. 5. no. 6) as a part of the gluteus minimus.

The gluteus medius of *Galago crassicaudatus* is depicted in Pl. VI. fig. 25, *G. md.*

The Gluteus minimus, or Ento-gluteus of Owen, is much smaller than the other glutei[4], and arises from the posterior and lower part of the outer surface of the ilium. It is inserted by a narrow tendon into a projecting tubercle in the middle of the sharp anterior margin of the peroneal trochanter.

This muscle in *L. nigrifrons* arose from the whole inferior (anterior) border of the ilium.

In *Galago crassicaudatus* and in *G. allenii* it is quite distinct from the gluteus medius, but very small and short, arising only round the upper part of the acetabulum. It rather corresponds with the gemelli in appearance than with the ordinary glutei (Pl. VI. fig. 25, *G. mi*).

In *Perodicticus* Van Campen[5] says that the gluteus tertius is inserted into the trochanteric fossa.

In *Tarsius* it appears to be as in *L. catta*; but Burmeister[6] describes as a part of it what in our Lemuroids forms a part of the gluteus medius.

It is the same in *Cheiromys*[7] as in *Lemur catta.*

The Scansorius does not exist as a distinct muscle in any of the Lemuroidea.

Pyriformis.—A large muscle[8] which, at its anterior border, is closely connected with

[1] *Loc. cit.* p. 39.
[2] *Loc. cit.* pp. 68, 69, tab. 3. fig. 1. 4, 4*a*, & 7.
[3] Figured by Cuvier in *L. varius*, pl. 70. fig. 2, a[1], and by Owen, *loc. cit.* p. 66, pl. xxv. fig. 3. no. 51.
[4] Indicated by Cuvier in *L. varius*, pl. 70. fig. 2, a[2].
[5] *Loc. cit.* p. 39.
[6] *Loc. cit.* p. 69, tab. 4. fig. 6. no. 6.
[7] See Owen, *l. c.* p. 66.
[8] Figured by Cuvier, pl. 70. fig. 2, f.

the gluteus medius. It arises from the inferior (anterior) surface of the sacrum, reaching as high up as the middle of the auricular surface. Converging as usual, it is inserted into almost the very summit of the posterior border of the peroneal trochanter, beneath the insertion of the gluteus medius.

This muscle is connected with the gluteus medius by tendon as well as by muscular fibre, both in *L. varius* and *L. nigrifrons*. In *L. xanthomystax* it is also partly adherent to the gluteus medius, but still more distinct than in those two species.

Galago agrees with *Lemur*, excepting that the muscle reaches no higher than the lower part of the sacro-iliac synchondrosis (Pl. V. fig. 19, and Pl. VI. fig. 25, *Py*).

In *Tarsius*, as before said, Burmeister[1] has described as pyriformis a part of the gluteus maximus He says, indeed, that a double pyriformis exists in this genus. His first pyriformis (tab. 4. fig. 5. no. 7) is part of our gluteus maximus; his second part is described as a triangular muscle springing from the sacrum and going to the thigh; this portion appears to be the pyriformis proper. We are inclined to doubt the accuracy of the delineation of this muscle.

It is described by Professor Owen in *Cheiromys*, p. 145.

GEMELLUS SUPERIOR.—This springs from the spine of the ischium, and is inserted into the anterior (upper) part of the deep surface of the tendon of the obturator internus, and, in common with it, into the trochanter fossa.

The gemelli are figured by Cuvier in *L. varius*, pl. 70. fig. 2, *e* and e^1.

The other genera present similar characters. Illustrated in *Galago crassicaudatus*, Pl. VI. fig. 25, *G.s*, and in *Tarsius*, *l. c.* p. 70. tab. in fig. 6. no. 8, *b*.

GEMELLUS INFERIOR[2].—This, which is larger than the preceding, arises from the upper (posterior) surface of the tuberosity of the ischium and from the lower part of the so-called "ascending" ramus of the ischium. It is inserted into the posterior (inferior) surface of the tendon of the obturator internus and also into the adjacent part of the tendon of the obturator externus, and also between them both into the trochanteric fossa. The two gemelli muscles are closely connected together, especially at their origin.

That of *Galago crassicaudatus* is shown in Pl. V. fig. 21, and Pl. VI. fig. 25, *G. i.*

When describing the pectineus, Owen[3] mentions that "beneath it are strong and thick gemelli converging from their origin on the anterior surface of the pubis and ischium to the interspace between the small and large trochanter."

OBTURATOR EXTERNUS[4].—A very thick layer with origin from the whole external circumference of the obturator foramen and from the lower half of the obturator membrane. It is inserted, by a very strong tendon, into the lowest portion of the fossa behind the peroneal trochanter.

[1] *Loc. cit.* p. 69, tab. 4. fig. 5. no. 7, *a*.

[2] *Tarsius, loc. cit.* pl. 70. tab. 4. fig. 6. no. 8, *a*.

[3] *Loc. cit.* p. 66.

[4] *Tarsius, loc. cit.* p. 71, tab. 4. fig. 6. no. 10.

In *Lemur xanthomystax* it was observed by us to cover the whole of the obturator membrane.

Represented in *Galago crassicaudatus* (Pl. V. fig. 21, *Ob. e*).

The OBTURATOR INTERNUS, which has much tendinous fibre on its surface, arises from the whole internal circumference of the obturator foramen, except, perhaps, on its upper posterior side. It is inserted immediately above the insertion of the obturator externus.

We consider the tendon very strong in *Galago allenii*. The muscle in *G. crassicaudatus* is shown in Pl. V. fig. 19, and the tendon of insertion Pl. VI. fig. 25, *Ob. i.*

QUADRATUS FEMORIS.—This is a very voluminous muscle. It arises from the tuberosity of the ischium immediately in front of the origins of the biceps and semimembranosus (*i. e.* these origins are superficial to it), but extending slightly further inwards towards the middle line of the body and still further outwards. It is inserted into the back of the femur for the whole interspace between the insertion of the gluteus maximus and that of the adductor magnus. It lies in the same plane as the last mentioned muscle, and is intimately connected, on its inner side, with the adductor brevis.

In *L. varius* it is shown by Cuvier, 'Myologie,' pl. 70. fig. 2, *b*.

Displayed in the dissections of *Galago crassicaudatus* (Pl. V. fig. 21, and Pl. VI. fig. 25, *Q. f*).

In *Nycticebus* it is not large, but is the reverse in *Loris gracilis*.

This muscle is not mentioned by Van Campen in *Perodicticus*; but perhaps he has taken the adductor magnus for it.

In *Tarsius* it appears to be as in *L. catta* from the description; but only a small portion is represented in Burmeister's plate 70. figs. 4, 6, no. 12.

ILIACUS.—In *Lemur catta*[1] it arises from the internal surface of the ilium external to the ilio-pectineal line, and is inserted by a tendon common to it and the psoas magnus into the peroneal trochanter.

In the genus *Lemur* it can hardly be said to be double; but in *Galago* (*i. e.* in *G. garnettii* and *G. allenii*) the disposition is not perfectly the same in each animal, although it may be considered as arising in two portions. In *G. garnettii* the portion from the ilium is small, and only arises from the anterior superior spinous process of Man. The second portion, coming from the body of the last lumbar vertebra, joins the abovementioned; and they have undoubtedly a single insertion, namely, by a strong, flat tendon into the border of the tibial trochanter, being very slightly connected with the insertion of the psoas magnus, which is fleshy. *G. crassicaudatus* with this, Pl. V. figs. 19 & 20, *Il.*

In *G. allenii* the first or innermost portion arises from the whole anterior border of the ilium, excepting as much as is occupied by the second slip. It is inserted into the tibial trochanter by muscular fibres. The obturator nerve passes between the upper

[1] Cuvier has only shown a small portion of this muscle in *L. catta*, pl. 70. figs. 2 & 3, *i*.

part of the muscle and the psoas magnus. The second division of the iliacus in *G. allenii* has a similar but rather higher origin, to the anterior superior spinous process. It lies outside the last and is the more laterally compressed of the two. Its insertion into the trochanter is by a strong, broad tendon, the three tendons of the psoas muscles and the iliacus being close together.

The subvertebral muscles, psoas, iliacus, &c., in *Loris gracilis* answer exactly the condition described by Meckel (*l. c.* p. 374), viz.:—there is an inner tendinous psoas parvus attaching itself inferiorly (posteriorly) to the front of the lowest lumbar vertebra, but no insertion into the ilium or pubes: secondly, there is a normal psoas and iliacus; and the fourth muscle of Meckel (query, our external iliacus?) arises nearly as high as the dorsal vertebræ, and, quite separate below, ends in a strong, round tendon inserted into the tibial trochanter.

In *Nycticebus tardigradus*[1] there appears to be but one large muscular mass representing the iliacus. It arises from the sides of the bodies of the lumbar vertebræ below the third, and from the front of the sacrum, but it has no origin from the ilium.

Van Campen has remarked nothing peculiar in this muscle in *Perodicticus*[2], nor has Burmeister in *Tarsius*[3].

In *Cheiromys* it is as in *L. catta*; our specimen agrees with Owen's description.

Psoas magnus.—Arises from the bodies and transverse processes of the last three lumbar vertebræ, and joining the iliacus it is inserted along with it, by a common tendon, into the tibial trochanter.

In *L. varius*, *L. xanthomystax*, and *L. nigrifrons*, however, it can only be separated with difficulty from what seems in these animals a single iliacus.

In *Galago crassicaudatus* (Pl. V. figs. 19 & 20, *Ps.m*) and in *G. allenii* it is like *L. catta*; but in *G. garnettii* we especially noted that it also arose very broadly from the inner surface of the ilium.

In *Nycticebus*[1], as already hinted at, it arises from the last two dorsal and six upper lumbar vertebræ.

In *Tarsius*[4] this muscle is said to be double, and arises as high as the last dorsal.

Psoas parvus.—This is a very large muscle, about as large as the psoas magnus. It arises from the bodies of the last dorsal and first three lumbar vertebræ, and ends in a very strong and expanded tendon, which, as it were, binds down the psoas magnus, and is inserted into the iliopectineal eminence.

In *L. xanthomystax* it arises from the second, third, and fourth lumbar vertebræ, and is equally as strong as in *L. catta*, ending in a similar tendinous insertion.

In *Galago crassicaudatus* (Pl. V. figs. 19 & 20, *Ps.p*) the muscle is long but not nearly so large as the psoas magnus. It has a fleshy origin from the fronts of the bodies of the third, fourth, and fifth lumbar, but not from the dorsal vertebræ.

[1] P. Z. S. 1865, p. 248. [2] *Loc. cit.* p. 140. [3] *Op. cit.* p. 67, tab. 4. fig. 5. no. 3.
[4] *Loc. cit.* p. 67, tab. 4. fig. 2. 2 & 2 *a*.

It ends in a narrow but strong tendon inserted into the prominence at the brim of the pelvis.

In *G. allenii* the same, but only from the three upper lumbar vertebræ.

In our specimen of *Loris gracilis* it was either absent or only subvertebral.

In *Nycticebus* it is much as in *L. catta*, but arises only from the second and third lumbar vertebræ[1].

In *Tarsius* it is like *L. catta*, but is represented as bifurcating, allowing (as Burmeister shows in his plate) the iliacus and psoas magnus to pass between[2].

In *Cheiromys* it is quite like *L. catta*, and not at all ill defined.

Quadratus lumborum.—This muscle is represented by a series of tendons with a very small quantity of muscular fibre, and extends backwards from the eleventh dorsal vertebra to the inner surface of the ilium.

In *L. varius* it reaches no further forwards (higher) than the anterior edge of the last dorsal. In *L. xanthomystax* it springs from the third last or tenth dorsal vertebra. In *L. nigrifrons* it is like *L. catta*.

Displayed in position on the one side and dragged out on the other in the partial dissection of *Galago crassicaudatus* (Pl. V. fig. 19, *Q.l*).

In this animal as in *G. garnettii* the quadratus lumborum is much as in *L. catta*, and is in close relation with the iliacus. It is composed of a series of tendons and intervening muscular fibre arising from the bodies and transverse processes of the last dorsal and three anterior lumbar vertebræ. Somewhat like the spinalis dorsi, this muscle sends tendons backwards to the transverse processes of the two hindermost lumbar vertebræ, and one to the crest of the ilium.

Its attachments in *Loris* and *Nycticebus* are the two transverse processes of the lumbar vertebræ from about the fourth downwards to the ilium.

In *Tarsius*[3] it seems to be essentially similar; and in *Cheiromys* it is quite as in *L. catta*.

b. *Femoral Region.*

The Pectineus[4] arises from the so-called horizontal ramus of the pubis, external to the origin of the gracilis. It is inserted into the ridge leading from the tibial trochanter to the linea aspera.

This muscle in *Galago crassicaudatus* is figured in Pl. V. figs. 19 & 20, *Pe*.

In *Loris*, as Meckel says, this muscle is very strong, and there are four adductors besides.

In *Tarsius* it is as in *L. catta*. Burmeister considers it the antagonist of the quadrator femoris[5].

[1] Mivart and Murie, *loc. cit.* p. 248. [2] *Loc. cit.* p. 67, tab. 4. fig. 2. 1. [3] *Loc. cit.* p. 68.

[4] The muscle named pectineus in Cuvier's plate of *L. varius* is evidently rather a psoas magnus. See pl. 70. fig. 3, *k*; but in *Loris gracilis* it is correctly marked, pl. 67. fig. 2, *k*.

[5] *Loc. cit.* p. 71, tab. 5. fig. 1. 13.

Rectus femoris.—This muscle arises from the prominent posterior inferior (inferior anterior) spinous process of the ilium by a very strong tendon, and also, as in Man[1], by a branch of the same tendon from the anterior (superior) margin of the acetabulum. It is considerably overlapped by the vastus externus, and is inserted as usual into the patella in common with the other parts of the (here very distinct) quadriceps extensor.

See Cuvier, pl. 70. figs. 1, 2, & 3, *p* (*L. varius*), and pl. 67. figs. 1 & 2, *p* (*Loris gracilis*.

It has most certainly a double tendon of origin in *L. varius*, *L. xanthomystax*, and in *L. nigrifrons*.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. figs. 19 & 20, and Pl. VI. fig. 25, *R.f*). It is double-headed. In *Galago garnettii* the united tendon extends for two-fifths of the whole length of the muscle. In *G. allenii* the muscular portion is as long as the lower two-thirds of the femur, which is likewise the case in the Grand Galago.

There is a double tendon in *Nycticebus*, in *Cheiromys*[2], and in *Tarsius*[3].

Vastus internus[4].—In *Lemur catta* this is a small muscle arising from the inner surface of the femur, its origin extending beside the insertion of the psoas and iliacus.

Cuvier figures it in *L. varius* (see his 'Recueil,' pl. 70. fig. 3, *n*) and in *Loris gracilis* (*l. c.* pl. 67. fig. 2, *n*); that of *Galago crassicaudatus* is shown by ourselves (Pl. II. fig. 3, and Pl. V. figs. 19 & 20, *V. i*).

In *Tarsius*[5] this muscle is said to be divisible into two layers, the lower one of which seems to be an internal division of our crureus.

Vastus externus[6].—A very long muscle indeed, and embracing the whole outer side of the thigh, even overlapping the rectus. It arises from the outer and anterior margin of the peroneal trochanter and from the outer side of the third trochanter, and it is inserted as usual.

Cuvier figures it in his 'Recueil,' pl. 70. fig. 1, *m* (*L. varius*), and pl. 67. fig. 1, *m* (*Loris gracilis*).

It is uncommonly large in *Galago crassicaudatus*, and, if at all, is very indistinctly divided. Exhibited in Pl. II. fig. 3, Pl. V. fig. 19, and Pl. VI. fig. 25, *V. e*.

In *Loris* and *Nycticebus* it is very much smaller relatively than it is in the *Lemurs* and *Galagos*.

In *Cheiromys* it is of great size and single, as in *Lemur* and *Galago*.

In *Tarsius* this muscle is not only of very large size, but separable into two distinct

[1] Henley mentions a single origin!

[2] *Loc. cit.* p. 66, pls. xxiv., xxv. figs. 1–3, no. 16.

[3] *Loc. cit.* p. 72, tab. 4. fig. 5. 16, and tab. 3. fig. 1. 16.

[4] Owen, *Cheiromys*, *l. c.* p. 66, pl. xxiv. and xxv. figs. 1 and 2, 18.

[5] *Loc. cit.* pp. 72, 73, tab. 3. fig. 1. 18, and tab. 4. fig. 5. 18 *a*.

[6] Trans. Zool. Soc. vol. v. p. 66, pl. xxv. figs. 1 & 3, no. 17.

muscles, named by Burmeister, the one vastus externus (his no. 17), and the other cruralis (his no. 19)[1].

These two muscles are again separable, according to him, into a superior and inferior layer, as is also the case with regard to the vastus internus, as Burmeister says that the exterior muscles are divisible into two distinct layers, making in all seven exterior muscles of the thigh. The first layer consists, besides the rectus femoris, of the vastus externus, the vastus internus, and the cruralis; the second layer of the so-called deep vastus externus, deep vastus internus, and deep cruralis.

Of these seven muscles as many as two (namely, the cruralis and the superficial vastus externus) correspond to our vastus externus of *L. catta*. Burmeister's deep cruralis is our crureus; his deep vastus internus has no representative in the Lemuroids examined by us, unless, as we think, it is a separable inner part of our crureus, and his deep vastus externus a similar external portion of the same.

CRUREUS.—This is a very distinct and separate muscle, extending along the whole length of the femur. It is narrow and somewhat compressed at its upper part, and arises from the whole of the front and middle of the outer side of the femur as high as its neck, extending round that bone from the insertion of the gluteus maximus on one side to that of the adductor magnus on the other. It has a broadly tendinous glistening surface, and is inserted as usual.

In *L. varius* there can hardly be said to be a subcrureus present; but the crureus muscle itself descends on either side of the condyles, while the main tendon passes on to the patella. The muscle is figured in this species by Cuvier, *l. c.* pl. 70. fig. 2, *o*.

In *L. nigrifrons* we found a distinct subcrureus muscle; this lies beneath the lower tendinous part of the crureus, and it covers almost the lower half of the shaft of the bone. It is most muscular on the outside.

In *Galago crassicaudatus* (Pl. V. figs. 19 & 20, and Pl. VI. fig. 25, *Cr.*), as in other species of the genus examined, the crureus is much as in *L. catta*, the fibres reaching very far round, but not quite to the linea aspera.

In *Nycticebus tardigradus* the crureus presents the same characters as in *L. catta*.

In *Tarsius*[2] this muscle is described as the cruralis inferior (no. 16 *a*) (the deep cruralis before spoken of). In this animal it is very large, and two smaller portions of it are separable, and described by Burmeister respectively as vastus externus inferior (no. 17 *a*) and vastus internus inferior (no. 18 *a*).

In *Cheiromys* the crureus is exactly the same as in *L. catta*; and what Professor Owen describes as an outer division of the muscle is in our specimen inseparable (except artificially) from the vastus externus. Professor Owen[3] says "The outer division of the crureus (fig. 3, 19) is rather a distinct muscle, which might be termed the deep-seated vastus externus; it arises from the fore and outer part of the femur to the condyloid

[1] *Loc. cit.* p. 72, tab. 3. fig 1.

[2] *Loc. cit.* p. 73, tab. 4. fig. 5.

[3] Trans. Zool. Soc. vol. v. p. 66, pl. xxv. figs. 2 & 3.

expansion, and is inserted by a fascia into the outer part of the ligamentum patellæ and capsule of the knee-joint."

The SARTORIUS, a wide and thin muscle, arises from the inferior (anterior) margin of the ilium at its posterior (lower) half, and is inserted in common with the gracilis into the tibia.

Cuvier figures it in *L. varius* (*l. c.* pl. 70. fig. 3, *t*) and in *Loris gracilis* (*l. c.* pl. 67. fig. 2, *t*). That of *Galago crassicaudatus* is delineated in Pl. II. fig. 3, and Pl. V. fig. 19, *Sa.*

Burmeister describes and figures it in *Tarsius*, p. 73, tab. 3. fig. 1. 15; and Owen in *Cheiromys*, p. 64, pls. 24, 25, no. 15.

The GRACILIS is very broad, especially at its origin, which extends along the whole length of the symphysis pubis, nearly half the anterior (superior) margin of the so-called horizontal ramus of the pubis, and for about a quarter of an inch along its so-called descending ramus. It passes downwards and outwards, and at rather more than an inch from its insertion it becomes intimately connected with the semitendinosus, and afterwards with the sartorius, the three being inserted by a common tendon into the outer side of the anterior surface of the tibia, about half an inch below the patella.

It is figured by Cuvier in *L. varius* (*l. c.* pl. 70. fig. 3, *u*) and in *Loris gracilis* (*l. c.* pl. 67. fig. 2, *u*). The gracilis in *Loris gracilis* has two heads, as Meckel says; but the apparent third head is really the semitendinosus, which muscle also joins the gracilis in *Nycticebus.*

In *Galago* it is inserted along with the sartorius, which partially overlaps and hides it. *G. crassicaudatus* (Pl. II. fig. 3, and Pl. V. figs. 19 & 20, *Gr*) shows its origin and insertion, the muscle being relatively smaller than in our type.

There is little or no difference presented in *Nycticebus*[1]. We did not find the division spoken of by Meckel[2].

In *Tarsius*[3] it is very small indeed, the smallest of all the thigh muscles.

In *Cheiromys*[4] it is much as in *Lemur catta.*

ADDUCTOR MAGNUS.—This is the longest, largest, and most externally inserted of the adductors. It has a strongly tendinous origin from the margin of the so-called descending ramus of the pubis; the origin of the posterior part of the gracilis being superficial to it. It is inserted into rather more than the middle third of the femur.

The distinction between this muscle and the adductor brevis is not defined in Cuvier's plate of *L. varius*, but they are together marked l^1 and l^2, pl. 70. fig. 3. The same is the case in *Loris gracilis*, pl. 67. fig. 2, l^1 and l^2.

In *L. xanthomystax*, the limb having been separated from the body, the origins of the adductors were severed; therefore the origin of the following slip was not noticed.

[1] P. Z. S. 1865, p. 249.
[2] Anat. Comp. vol. vi. p. 397.
[3] *Loc. cit.* p. 74, tab. 3. fig. 1, no. 14.
[4] *Loc. cit.* p. 65, pl. 64. no. 14.

The slip referred to, viz. a roundish belly, terminating in fascia in the middle of the length of the femur, near the insertion of the conjoined adductors magnus and brevis.

With an origin similar to that of the Ringtailed Lemur, the adductor magnus in *Galago crassicaudatus* has an insertion for two-thirds of the upper and postero-inner shaft of the femur (Pl. V. figs. 19, 20, & 21, *Ad. m*).

In *Nycticebus tardigradus* the adductor magnus arises from the tuberosity of the ischium for a breadth of 0″·4, and is inserted by a broad linear interval from the base of the great trochanter to the lower two-thirds of the shaft. This muscle is not perforated by the femoral artery.

According to Burmeister the adductor muscles in *Tarsius*[1] are two in number. The inner springs from the descending ramus of the pubis, and also from the ascending branch of the ischium, and is inserted into the inner side of the linea aspera for rather more than half the shaft of the femur. The posterior adductor springs by tendon from the tuberosity and the rest of the ascending branch of the ischium, and is inserted into the posterior surface of the femur above the last (tab. 4. fig. 5. 12). The inner one of Burmeister seems in the main to be our adductor magnus, which, however, is the outermost adductor as regards its insertion.

In *Cheiromys* we find it is quite as in *L. catta*. What Professor[2] Owen describes as the adductor magnus, is evidently our quadratus femoris, as we are inclined to think is the case with the adductor magnus of Van Campen[3].

Adductor longus.—This the shortest, smallest, and most internally inserted of the adductor muscles. It arises from the anterior upper extremity of the symphysis pubis and from the so-called horizontal ramus of the pubis, beneath the gracilis. It becomes entirely aponeurotic near its insertion, which is into the femur just within and in close union with that of the adductor brevis.

This muscle appears in Cuvier's plate of *L. varius*[4] to be confused with the pectineus, what is described as the pectineus being really the psoas. In his figure of *Loris gracilis*, however, they are represented distinctly[5].

It is not quite so short in *L. nigrifrons*, and it is muscular, with an insertion almost to the upper part of the adductor magnus.

A narrow strip-like plane of muscular fibres represents the adductor longus in the Thick-tailed Galago (Pl. V. figs. 19 & 20, *Ad. l*). Its origin is as in *L. catta*, and insertion like that of *L. nigrifrons*. It is in close apposition with the pectineus.

We found a slight difference in the right and left legs of *Nycticebus tardigradus*. The condition in the former was much as in *L. catta*. We noted that the upper margin of its insertion was conterminous with the pectineus, but that the adductor longus descended fully 0″·3 below it. In the left limb there seemed to be a division between the two

[1] *Loc. cit.* p. 71.
[2] *Loc. cit.* p. 65, pl. xxv. fig. 3.
[3] *Perodicticus, l. c.* p. 41.
[4] Pl. 70. fig. 3, *l*.
[5] Pl. 67. fig. 2, where *l* points to the adductor longus, and *k* to the true pectineus.

planes of its fibres, so that two muscles could be reckoned—the smaller being the anterior with a less insertion into the femur.

In comparing Burmeister's description with our own, we cannot say whether this muscle or adductor brevis is represented by his posterior adductor.

In *Cheiromys* it is exactly as in *L. catta.* What Owen[1] describes as the adductor longus, is apparently both our adductor longus and adductor brevis.

The ADDUCTOR BREVIS[2] is a shorter muscle than the adductor longus, but is much thicker at its origin, where it is more or less separable into two parts, which become completely blended together below. It arises from the pubis beneath the origin of the gracilis; and its fibres, radiating as it descends, are inserted into the back of the femur internally to the insertion of the adductor magnus. Its insertion extends about ·4 of an inch higher up the femur than that of the adductor magnus, but does not extend so low down as that muscle by as much as 1·2 inch.

Figured in *Galago crassicaudatus* (Pl. V. figs. 19 & 21, *Ad. b*).

In *Nycticebus* the adductor brevis is longer than the adductor longus, and is much narrower; it arises by a narrow tendon just in front of the tuberosity of the ischium, beneath the gracilis. The fibres below join those of the adductor magnus, and they are inserted together.

Van Campen[3] speaks of a fourth adductor as existing in *Perodicticus*, arising from the horizontal ramus of the pubis, beneath the pectineus, and going to the small trochanter of the femur. As before said, we cannot determine the representative of this muscle in *Tarsius.*

In *Cheiromys* we found the adductor brevis substantially as in *L. catta*, its tendency to division quite as much pronounced.

TENSOR VAGINÆ FEMORIS[4].—We are inclined to agree with Meckel in considering this muscle to be absent in *Lemur*, as the part so named by Burmeister in *Tarsius* seems rather to be a mere portion of the gluteus maximus. In all our Galagos but one we also failed to detect any trace of this muscle; in one specimen of *G. crassicaudatus*, however, there appeared to be some muscular fibres arising from the crest of the ilium and inserted into the fascia lata, which was of unusual strength. We have not, however, thought proper to introduce this into our plate as a distinct muscle, partly because of its very exceptional occurrence, and partly because we do not feel sure that it is not rather to be considered an exceptional development of the gluteus maximus.

In *Nycticebus* some fibres come from the lower belly to the groin, which may represent the muscle in question.

In *Tarsius*[5] the muscle described as tensor fasciæ latæ is, according to our view, only part of the gluteus maximus.

[1] *Loc. cit.* p. 65, pl. xxv. fig. 2, no. 12.

[2] As before said, in Cuvier's figures this is not marked off from the adductor magnus.

[3] *Loc. cit.* p. 42.

[4] This muscle is not represented in Cuvier's plates of the Lemuroids.

[5] *Loc. cit.* p. 68, tab. 3. fig. 1, 4 *a*.

Professor Owen found in *Cheiromys* a condition similar to that which we noticed in our *Galago crassicaudatus*; for he says[1] "the tensor vaginæ femoris is represented by a small fasciculus from the anterior superior spine of the ilium, which extends into the fascia covering the fore and outer part of the thigh." In our specimen, however, we find no trace of such a structure.

The BICEPS FEMORIS[2] arises by a long and very strong tendon from the outermost and most posterior part of the tuberosity of the ischium. The tendon is continued in the substance of the muscle, and on its inner surface, for more than half its length. The fibres spring from this tendon in a penniform manner, but very many more taking origin from its outer than its inner side. Those fibres which spring from the posterior part of the outer side of the tendon are inserted into the aponeurosis connecting this muscle with the vastus externus. All the other fibres radiate and are lost in the fascia investing the outer side of the leg.

In *L. varius* the tendon is only for nearly half the length of the muscle, and hardly quite so far in *L. nigrifrons.*

The biceps in *Galago* is simpler than in *Lemur*. It has a long, strong tendon of origin from the tuberosity of the ischium, and a very moderately thick belly, ending in an equally very strong, but flattened, tendon, which is inserted into the outer tuberosity of the tibia. See *G. crassicaudatus*, Pl. II. fig. 3, *B.f*, and Pl. V. fig. 25, *B.f.* Kingma[3] says it is single in *G. peli.*

Loris gracilis, while resembling our type, has this muscle, the semimembranosus, and the semitendinosus remarkably connected at their origins.

In *Nycticebus*[4] it is as in *Lemur catta*, but it is inserted only outside the lower leg.

Burmeister figures it in *Tarsius*[5].

Cheiromys in the main agrees with *L. catta*; Owen's[6] partly muscular origin is only the origin in common of this muscle and the semitendinosus. His origin from the femur is only its adhesion to the vastus externus.

SEMIMEMBRANOSUS[7].—This muscle is round and fleshy at its middle, flat and tendinous at its origin, and very narrow and entirely tendinous at its insertion. It arises from the tuberosity of the ischium, beneath the biceps, but not extending so far backwards, also from the so-called ascending ramus of the ischium at its posterior margin. It is inserted by a strong, round tendon, which passes beneath the internal lateral ligament into the head of the tibia.

In *L. varius*, figured by Cuvier, 'Myology,' pl. 70. figs. 2 & 3, *s*, and in *Loris*, pl. 67. fig. 2, *s*.

[1] *Loc. cit.* p. 64, pls. xxiv. & xxv. figs. 1–3.

[2] Figured in *Lemur varius* by Cuvier, pl. 70. figs. 1, 2, & 3, *q*, and in *Loris gracilis*, pl. 67. figs. 1 & 2, *q*.

[3] Observationes de *Otolicno peli*, p. 30.

[4] P. Z. S. 1865, p. 249.

[5] P. 74, tab. 3. fig. 1. no. 20.

[6] *Loc. cit.* p. 65, pl. xxv. fig. 1. 20.

[7] *Nycticebus tardigradus*, P. Z. S. 1865, p. 249; *Tarsius*, p. 74, tab. 3. fig. 1. no. 22; *Cheiromys*, p. 65, pl. xxv. figs. 2 & 3. nos. 20 & 22.

Delineated in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 19, and Pl. VI. fig. 25, *S.mb*). Substantially it is the same in *G. allenii* as in *L. catta*, but it does not arise from the ascending ramus of the ischium.

In *Nycticebus*, *Tarsius*, and *Cheiromys* it is nearly as in *L. catta*.

SEMITENDINOSUS [1].—Arising in common with the biceps from the outer margin of the tuberosity of the ischium, and also in great part from the tendon of origin of the last-mentioned muscle, it is inserted into the tibia in common with the gracilis. It has no origin from the caudal vertebræ.

In Cuvier's representation of *Lemur varius*, pl. 70. fig. 2, *r*, the distal part of this muscle is represented as bifurcating, the larger portion joining the gracilis as usual, but the smaller portion passes to the outside of the leg in conjunction with the biceps.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 19, and Pl. VI. fig. 25, *S.t*).

In *Cheiromys*, according to Professor Owen [2], this muscle is double, having an additional slip arising from the second caudal vertebra adjoining the caudal origin of the gluteus. Our observation confirms this statement.

c. *Tibio-fibular Region of Leg* (*extensors*).

TIBIALIS ANTICUS [3].—This muscle is quite single, and only of a moderate size. It arises from the upper two-thirds of the peroneal surface of the tibia, as far back as the interosseous membrane. Its insertion is into the anterior end of the tibial margin of the entocuneiform, and not at all into the metatarsal of the hallux. Part of the outer border of this muscle is in contact with part of the inner margin of the peroneus longus.

L. varius, *L. xanthomystax*, and *L. nigrifrons* (Pl. VI. fig. 27, $T.a^1$, $T.a^2$) possess what may be considered a double tibialis anticus muscle. The larger portion or division ($T.a^1$) answers to the condition above described in *L. catta*. The smaller portion ($T.a^2$) has an origin along with the larger one, but superficial and perinead to it. Its small but distinct belly gives origin, at its lower end, to a slender tendon which is inserted into the plantar surface of the proximal end of the first metatarsal. This tendon runs in the same groove as the other part of the tibialis anticus proper, and lies in front of it.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 22, and Pl. VI. figs. 25 & 29, *T.a*), *G. garnettii*, and *G. allenii* it is very large and broad. Its relations to the peroneus longus, peroneus brevis, and extensor longus digitorum, as well as insertion, are the same as in *L. catta*.

There is no division in *Loris gracilis* or in *Nycticebus tardigradus* [4].

[1] Figured by Cuvier in *Loris gracilis*, pl. 67. fig. 2, *r*; by Burmeister in *Tarsius*, p. 74, tab. 3. fig. 1. no. 21.

[2] *Loc. cit.* p. 65, pl. xxv. fig. 1, *a*.

[3] Figured by Cuvier in *L. varius*, pl. 70. figs. 1 & 3, *δ*, and in *Loris gracilis*, pl. 67. fig. 1, *δ*.

[4] P. Z. S. 1865, p. 249.

In *Tarsius*[1] it is as in *Lemur catta*.

In *Cheiromys* Professor Owen[2] only speaks of a single tibialis anticus muscle and tendon answering to that described in *L. catta*; but in both limbs of our specimen there was a double tibialis anticus precisely similar in its conditions to that above described in *L. varius*, *xanthomystax*, and *nigrifrons*.

Extensor longus digitorum[3].—This in the right leg of *L. catta* dissected by us was a long, slender and flat muscle, with the edge forwards and overlapped towards its middle by the junction of the tibialis anticus with the peroneus longus. It arose from the head of the tibia, the interosseous membrane, and the inner side of the fibula, but not from its head. It gave origin to four tendons, which went to the four peroneal digits, those going to the second and third digits being joined by the corresponding tendons of the extensor brevis, while that going to the fourth was joined by the peroneus quarti as well as by the corresponding tendon of the extensor brevis, and that going to the fifth digit by the peroneus quinti digiti.

In the left leg of the same animal we observed that a long, prominent tendon on the front edge of the muscle was that of almost a distinct muscle by itself, which had a very small muscular belly reaching as low down as the whole upper third of the leg. Its delicate tendon, when raised from the belly of the true extensor longus digitorum, could be traced singly as far as the ankle and in the front of the foot. It bifurcated, going to the second and third digits. A slip united that going to the third digit with the long extensor tendon of the fourth digit.

Is this a representative of the extensor indicis of the arm?

In *L. xanthomystax* the arrangement is like that of the left leg of *L. catta*; and in *L. varius* also, except that there are only tendons to the third, fourth, and fifth digits.

The condition of the specimen of *L. nigrifrons* which we dissected was not the best for accuracy as regards this muscle. The following was what we observed. In the partially injured right foot the small tendinous slip noticed in *L. varius* and *L. xanthomystax* was visible; this sent a slip to the second and third digits, as in the two last-mentioned species. The extensor brevis also joined the tendons of the extensor digitorum. There was, moreover, a minute (broken) tendon going to the fourth digit, as also a very long, thin tendon joining the fifth; where this last tendon came from was not made out by us. In the left foot (Pl. VI. fig. 27, *E.l.d*) the main tendon splits into two, whereof one supplies the second and third digits, the other the fourth and fifth. But the fourth also gives off a slip which unites it to the third and second.

In *G. crassicaudatus* (Pls. II. & VI. figs. 3 & 25, *E.l.d*) this muscle gives off three tendons, the outermost one going almost exclusively to the fifth digit, the middle one bifurcating, one branch going to the fourth digit, the other joining a branch of the inner-

[1] Burmeister, *loc. cit.* p. 75, tab. 3. fig. 1. no. 24, and tab. 5. figs. 6 & 7. 24.

[2] *Op. cit.* p. 67, pl. xxv. figs. 1 & 3. no. 24.

[3] See Cuvier, pl. 70. fig. 1, ζ, in *Lemur varius*.

most of the three tendons; this innermost tendon also bifurcates, one branch going to the index, the other joining the branch of the median tendon before mentioned, and, together with it, forming the extensor tendon of the third digit.

In *G. garnettii* it corresponds in the main with that in *L. catta*. The inner and outer slips of tendons are in it given off highest.

In *G. allenii* we satisfied ourselves that the junction of the extensor longus digitorum with the peronei does not exist; in other respects the arrangement agrees with that of *L. catta*.

In *Nycticebus tardigradus*[1] "it is a very slender muscle, the smallest of the leg-extensors and flexors of the lower limb; yet it has a double origin, as also in *Cheiromys*. The smaller head arises by a thin muscular bundle from the outer side of the tuberosity of the tibia, with also a small pencil of fibres coming from the inner side of the head of the fibula; the larger origin consists of a rhombidal, flat, muscular fasciculus attached to the inner side of the middle third of the fibula. The muscle gives a tendon which splits into four subdivisions, sending one to each of the four outer digits, that to the index being smallest. *Loris gracilis* agrees with the above.

In the *Potto*[2] it divides into three tendons (bound together by a thin aponeurosis), going to the third, fourth, and fifth digits respectively.

In *Tarsius*[3] it is double, and has both origins from the fibula; its tendons go one to the outer toes, the other, larger, to the fourth and fifth digits.

In *Cheiromys* this muscle, according to Professor Owen[4], only arises from the tibia and interosseous membrane, but in two portions, the two tendons of which, passing through distinct sheaths, go to the four outer digits. In our specimen it has also a slight origin from the tibia; but the muscular part cannot be said to be double, and it passed below through a single sheath.

The EXTENSOR PROPRIUS HALLUCIS[5] is a slender muscle, similar to the extensor longus digitorum. It arises, beneath the last mentioned muscle, from the head of the tibia, also from the interosseous membrane and the middle third of the tibial border of the fibula. It is inserted into the base of the second phalanx of the hallux.

Does the second head of the tibialis anticus in *L. xanthomystax* represent the extensor proprius hallucis? This is certainly not the case in *L. nigrifrons*, where there is a double tibialis anticus besides an extensor proprius hallucis (Pl. VI. fig. 27, *E.p.h*).

In the other genera it is as in *Lemur catta*; that of *Galago crassicaudatus* is shown in Pl. II. fig. 3, and Pl. VI. fig. 25, *E.p.h.*

Though called extensor, this is a remarkably powerful abductor, being the muscle which throws the hallux away from the index, as in the action of spanning in Man. It antagonizes the peroneus longus exactly. These two muscles having nearly a similar origin, the foot is in a manner slung in a sling, and they rotate the entire pes as far

[1] P. Z. S. 1865, p. 250.
[2] *Loc. cit.* p. 43.
[3] *Loc. cit.* p. 79, tab. 4. fig. 5, no. 35.
[4] *Loc. cit.* p. 68.
[5] *Tarsius*, p. 79, tab. 4. fig. 5, 39, and tab. 5. figs. 6 & 9, no. 39.

back as the ankle, facilitated by the peculiar tarsal joint. This peculiarity of the foot or pes is well seen in the *Galagos*, in *Perodicticus*, and *Nycticebus*.

PERONEUS LONGUS[1].—This is rather a large muscle overlapping the extensor longus digitorum, and meeting the tibialis anticus on the front of the leg towards its middle[2]. It arises from the posterior part of the head of the tibia and from rather more than a fourth of the outer side of the fibula. Its fibres are inserted in a penniform manner into a long and strong tendon, which passes behind the external malleolus, and is inserted into the proximal end of the metatarsal of the hallux on its plantar side.

In the three other Lemurs examined the origin of this muscle was as far as the half of the fibula, and its tendon was very small. That of *L. nigrifrons* is displayed in Pl. VI. fig. 27, *P. l.*

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. VI. fig. 25, *P. l*).

In *Cheiromys* it is the same, except, as Owen correctly says, from the upper two-thirds of the fibula (*l. c.* p. 67, pl. xxv. figs. 1–3, no. 25).

PERONEUS BREVIS[3].—It arises from about the lower third and four-fifths of the anterior surface of fibula, and is muscular down to the ankle. Its flat and broad tendon winds round the outer malleolus, and is inserted into the peroneal side of the base of the fifth metatarsal bone.

There is no difference (*L. xanthomystax*) in the origin; but the tendon is separated into two below, which, as they come to the back of the foot, again unite as in the Lemurs generally. A single tendon is shown in *L. nigrifrons*, Pl. VI. fig. 27, *P. b.*

A split tendon of insertion, pierced by the tendon of the peroneus quinti digiti, is manifest in *Galago crassicaudatus*, Pl. VI. fig. 25, *P.b* and *P.b**; and the muscle and what appears as a single tendon in Pl. II. fig. 3, *P.b* and *P.b**. In *G. garnettii* it arises from the middle third of the shaft of the fibula, but in *G. allenii* nearly the whole length of that bone. The insertion in both is as in *L. catta*.

The PERONEUS TERTIUS is entirely absent in *Lemur catta*, as also in all the Lemuroidea examined by us. The record of dissection of *Perodicticus*, *Tarsius*, and *Cheiromys* agrees.

PERONEUS QUARTI DIGITI[4].—This muscle is as small and has a tendon as delicate as the peroneus quinti digiti. It arises from the outer surface of the fibula below and outside the muscle last mentioned and beneath the peroneus longus. Its tendon passes down side by side with that of the peroneus quinti to the external malleolus, where it passes to the inside of the tendon of the peroneus brevis. About the middle of the fifth metacarpal it joins the tendon of the outermost part of the extensor brevis, and with it

[1] Figured by Cuvier, 'Recueil,' pl. 70. fig. 1, ϵ, for *Lemur varius*, and for *Loris gracilis*, pl. 67. fig. 1, ϵ.

[2] *Nycticebus tardigradus*, P. Z. S. 1865, p. 250, fig. 6, *P. l.* *Tarsius*, p. 77, tab. 3. fig. 1, no. 25, and tab. 5. figs. 6, 7, 10, no. 25.

[3] Cuvier in *Lemur varius*, pl. 70. fig. 1, ϵ'; figured also in *Tarsius*, p. 77, tab. 3. fig. 1, no. 26, and tab. 5. figs. 6, 7, & 10, no. 26.

[4] Not distinguished by separate lettering in Cuvier's 'Myologie,' though a tendon is represented as going to the fourth digit, and there is a slight division as if to form our peroneus quarti and quinti (pl. 70. fig. 1, ϵ^2).

is inserted into the extensor sheath of the fourth digit; thus the muscle, though it arises externally to the peroneus quinti digiti, is inserted internally to it.

L. varius, *L. xanthomystax*, and *L. nigrifrons* (Pl. VI. fig. 27, *P.4.d*) quite resemble *L. catta* as regards this muscle.

Not present in *Galago crassicaudatus*, *G. garnettii*, or in *G. allenii*.

Neither this muscle nor that of the peroneus quinti digiti are mentioned either by Van Campen in *Perodicticus*, or by Owen in *Cheiromys*. Nevertheless in our specimen of the last-mentioned animal we found it distinctly present, and exactly conditioned as in *L. catta*. It is, however, described by Burmeister[1] under the name extensor longus quarti digiti.

PERONEUS QUINTI DIGITI[2].—This is a very small muscle indeed, with a long and very delicate tendon. It arises from the anterior surface of the fibula below, underneath the peroneus longus, but above the origin of the peroneus quarti digiti. The delicate tendon passes down the outside of the tendon of the peroneus brevis, and is inserted into the peroneal side of the extensor sheath of the fifth digit.

In *L. varius* and *L. nigrifrons* (Pl. VI. fig. 27, *P.5.d*, *P.5.d**) exactly the same conditions obtain.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. VI. fig. 25, *P.5.d*), where, as in *G. garnettii*, it has a similar origin and insertion to that in *L. catta*, but its tendon keeps to the inner side of that of the peroneus brevis until after having passed the ankle. In *G. allenii* the extreme tenuity of the tendon is alone remarkable.

The peroneus quinti digiti exists in *Nycticebus tardigradus*[3]; but we did not find it, or the peroneus quarti digiti, in *Loris gracilis*.

Meckel[4] seems to have had both the peroneus quarti and quinti muscles in view when alluding to a third peroneus with tendons to the fourth and fifth digits being present in the *Lemurs*.

As has been said, Van Campen is silent as to its existence in the *Potto*.

In *Tarsius* it is described by Burmeister[5] as the extensor longus digiti minimi.

In *Cheiromys* we found this muscle exactly similar to its condition in *L. catta*.

d. *Tibio-fibular Region of Leg* (*flexors*).

GASTROCNEMIUS[6].—This muscle is rather small, and arises by two heads of nearly equal size, each with a sesamoid bone. The two fleshy bellies unite in the middle of the leg with the strong tendo Achillis, which is inserted, as usual, into the tuberosity of the os calcis.

[1] *Loc. cit.* p. 79, tab. 4. fig. 5, no. 38, and tab. 5. fig. 6, no. 38.

[2] See Cuvier, pl. 70. fig. 1, ϵ^2 (*L. varius*).

[3] P. Z. S. 1865, p. 250.

[4] Vol. vi. p. 438.

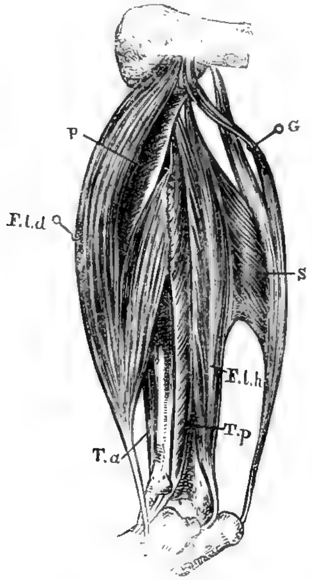
[5] P. 79, tab. 4. fig. 5, no. 37, and tab. 5. fig. 6, no. 37.

[6] Cuvier's 'Myologie,' pl. 70. figs. 1 & 3, *a*; in *Tarsius*, pl. 67. figs. 1 & 2, *a*; and in *Cheiromys*, *loc. cit.* p. 66, pls. xxiv. & xxv. figs. 27, *a*, *b*.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 22, and Pl. VI. fig. 25, *Ga*).

In *Nycticebus tardigradus* and *Loris gracilis* it is exceedingly small. (See woodcut, fig. 19.

Fig. 19.



Hind limb between knee and ankle in the Slow Loris, from P. Z. S. 1865, p. 251.

P. Popliteus.
G. Gastrocnemius.
S. Soleus.
F. l. d. Flexor longus digitorum.
F. l. h. Flexor longus hallucis.
T. a. Tibialis anticus.
T. p. Tibialis posticus.

Soleus[1].—A long and narrow muscle, fleshy in the middle and tendinous at each end, though more so above than below. It arises from the posterior side of the head of the fibula, and not at all from the tibia, becomes adherent to the inner surface of the tendo Achillis at about the middle of the leg, and is continued down with it to the calcaneum, into which the two tendons have a common insertion.

Meckel[2] says it arises from the whole of the fibula in *Loris gracilis*; and we found it to be attached to that bone for a considerable extent, viz. from its lower five-sixths.

In the Grand Galago (Pl. VI. fig. 25, *So*) it very nearly agrees with what obtains in *Nycticebus tardigradus*[3], where it is flat and rhomboidal, and without any tendon. Arising from the posterior margin of the head of the fibula and inner border of the flexor longus hallucis, it loses itself in the conjoined belly of the gastrocnemius.

Perodicticus[4] has this muscle similarly to *Nycticebus*, namely, fused with the gastrocnemius.

In *Tarsius*[5] it is a long, round, spindle-shaped muscle arising from the head of the fibula, and joins the tendo Achillis below the muscular portion of the gastrocnemius.

Plantaris.—A very strong muscle arising from the peroneal condyle of the femur in common with the head of the gastrocnemius of that side; it ends rather below the middle of the leg, in a strong tendon, which passes to the tibial side of the tendo

[1] Cuvier, pl. 70. fig. 3, ℭ.
[2] Anat. Comp. vol. vi. p. 421.
[3] *Loc. cit.* p. 251, fig. 5.
[4] *Loc. cit.* p. 44.
[5] *Loc. cit.* p. 76, tab. 4. fig. 7, no. 28.

Achillis, and ultimately behind it, passing beneath the os calcis (from which and from the lowest part of the tendo Achillis it is separated by a bursa), and becomes continuous with the plantar fascia.

Figured by us in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. VI. fig. 25, *Pla*). Kingma says that he sought in vain for this muscle in *G. peli*[1].

It was absent in the specimens of *Nycticebus* and *Loris* examined by us, and, according to Van Campen's dissection, is absent in the *Potto*[2].

In *Tarsius*[3] the plantaris arises from the external condyle side by side with the gastrocnemius, and passes down, attaching itself to the calcaneum and plantar surfaces of the foot.

The Flexor longus digitorum[4] is a very long, but rather small, muscle arising from the upper two-thirds of the posterior surface of the tibia, below the popliteus, and from the peroneal side of the head of that bone, its uppermost part ascending between the tibia and the rotator fibulæ, and above and across the interosseous membrane to the front of the leg, so as to be in contact with the summit of the posterior margin of the tibialis anticus. It is inserted by a strong tendon which passes on the tibial side of the tendon of the flexor longus hallucis. It then gives off a delicate tendon which joins a corresponding and larger one from the flexor longus hallucis (to form the flexor tendon of the hallux), and afterwards becomes intimately blended with the main part of the tendon of the last-mentioned muscle, the two giving rise to the four perforating tendons of the four outer digits, but the flexor longus digitorum forming almost exclusively that of the fifth digit, and but a small part of those going to the second, third, and fourth digits.

Shown in the Grand Galago, Pl. II. fig. 3, in Pl. V. figs. 22, 23, & 24, and Pl. VI. figs. 25, 28, & 29, *F. l. d.*

We find in *Loris gracilis* precisely the same condition as in *Nycticebus* (presently to be described), with the exception that the tendons to the four outer digits are all given off at the same height.

In *Nycticebus tardigradus*[5] the flexor longus digitorum has three origins and three bellies—one origin from the inner condyle of the femur, another from the inner border of the tibia joining the last, and the third origin is from the posterior surface of the tibia below the popliteus.

This muscle is described in *Perodicticus*[6] as consisting of two separate parts uniting into a common tendon in the plantar aspect of the foot, and representing both the flexor longus digitorum and flexor longus hallucis. It springs from the tibia, fibula, and interosseous membrane, but not from the femur. In this respect, both in its origin

[1] *Loc. cit.* p. 31.
[2] *Loc. cit.* p. 44.
[3] *Loc. cit.* p. 76, tab. 4. fig. 7, no. 29, and tab. 5. figs. 8, 9, & 10, no. 29.
[4] Cuvier, pl. 70. fig. 3, . (*L. varius*), and pl. 67. fig. 2, ι (*Loris gracilis*).
[5] P. Z. S. 1865, p. 252, figs. 5 & 6.
[6] *Loc. cit.* pp. 44, 45.

and slight subdivision of its tendon, this conjoined muscle more closely resembles that in *Lemur* than that in *Nycticebus* or *Loris*.

In *Tarsius*[1] it is said (no doubt by a misprint) to spring from the head and posterior surface of the *fibula*. In passing down it becomes slightly connected with the tendon of the flexor longus hallucis; it then splits into four separate tendons, supplying the four outer digits, but it takes no share in that of the hallux.

Its tendon, again, in Professor Owen's specimen of *Cheiromys*[2], took no part in forming that to the hallux, but its quadruple division for the outer digits united with three slips coming from the flexor longus hallucis. In our specimen its condition perfectly resembles that described as existing in *L. catta*.

Flexor longus hallucis[3].—This is a considerably larger muscle than the flexor longus digitorum. It arises from the whole posterior surface of the fibula to its summit, and from the whole of the interosseous membrane, also from the peroneal side of the tibia towards its distal end. Its strong tendon passes in an exceedingly deep groove between the astragalus and the inwardly inflected tuberosity of the os calcis, and is external to and quite separate from the tendon of the flexor longus digitorum. In the sole of the foot it gives off a large tendon to the hallux, and then blends with the tendon of the last-mentioned muscle, forming with it the perforating tendons of the four outer digits, and forming the main part of those of the second, third, and fourth digits.

Galago crassicaudatus (Pl. II. fig. 3, Pl. V. figs. 23 & 24, and Pl. VI. fig. 28, *F.l.h*), *G. garnettii*, and *G. allenii* have this muscle without any origin from the tibia; but its insertion is as in *L. catta*.

We found *Loris gracilis* to agree with what we shall presently state regarding *Nycticebus*. Its tendons, however, start in common, excepting that to the hallux. It also concurs in forming the tendon of the fifth digit.

In *Nycticebus tardigradus*[4] it has two heads of origin—one from the fibula, the other, smaller, from the tendon of the popliteus. Its insertion further agrees with *L. catta*; only in this last the slip of tendon of the flexor longus digitorum going to the hallux is not so strong in *Nycticebus*.

In *Perodicticus* it is not described as a separate muscle, but as part of the flexor digitorum communis[5].

In *Tarsius*[6] this muscle furnishes the flexor tendon of the hallux, and is only united partially along the outer margin of its tendon with that of the flexor longus digitorum. It is said (no doubt by a misprint) to arise from the tibia, instead of from the fibula.

In *Cheiromys* it is quite as in *Lemur catta*.

[1] *Loc. cit.* p. 78, tab. 3. fig. 1. no. 32, and tab. 4. fig. 5. 32, and tab. 5. figs. 8 & 9. 32.

[2] *Loc. cit.* p. 67, pls. xxiv. & xxv. figs. 1 & 2, no. 32. Professor Owen has misprinted tibia for fibula and fibula for tibia in the origin of this and the following muscles.

[3] Cuvier, in *L. varius*, pl. 70. fig. 3, ι^1.

[4] P. Z. S. 1865, p. 253, figs. 5 & 6.

[5] *Loc. cit.* p. 44, pl. iii. fig. 15, *c*.

[6] *Loc. cit.* p. 77, tab. 5. figs. 8 & 9. no. 31.

Tibialis posticus[1].—This is a very thin but a very long muscle, with a very long tendon; and this is so enclosed by the flexor longus digitorum and flexor longus hallucis as to be entirely hidden down almost to the internal malleolus. It arises from the tibial surface of the fibula, almost to its summit, and from the interosseous membrane. Its tendon is somewhat attached to the distal end of the naviculus, but is finally inserted into the proximal end of the plantar surface of the ento-cuneiform.

In *Galago crassicaudatus* (Pl. V. figs. 23 & 24, *T.p*), *G. garnettii*, and *G. allenii* there is a superficial median tendon upon the muscular fibre almost its entire length; but the tendon of insertion commences only above the ankle to the inner side of the malleolus, which it crosses, and is attached to the proximal end of the naviculare.

Popliteus.—This muscle arises from a pit outside the peroneal condyle by a strong tendon which runs beneath the external lateral ligament. The muscular fibres spread out as usual, and are inserted into the posterior surface of the tibia above the origin of the flexor longus digitorum.

Found in the same condition in all the Lemurs and Galagos, also in *Nycticebus*[2], *Loris*, *Perodicticus*[3], and *Tarsius*[4]—and in *Cheiromys*, although Owen does not mention it. Figured in *Galago crassicaudatus* (Pl. V. figs. 23 & 24, and Pl. VI. fig. 28, *Po*).

Rotator fibulæ (Pl. V. figs. 22 & 23, and Pl. VI. figs. 28 & 29, *R.fb*).—This small but very peculiar muscle is somewhat rhomboidal in shape, and extends from the summit of the posterior surface of the tibia to the anterior surface of the fibula, its insertion into the fibula being rather more vertically extended than is its origin from the tibia. Its fibres pass downwards and outwards, and therefore in an opposite direction to those of the interosseous membrane, the upper part of which membrane appears to be absent. The posterior surface of the rotator fibulæ is covered by the popliteus, the flexor longus hallucis, and the tibialis posticus, while its anterior surface is in contact with and covered by the peroneus longus, and by the very singularly situated upper end of the flexor longus digitorum.

The muscle described by Professor Owen[5] as existing in *Phalangista* has its fibres inclined in an opposite direction to those of our muscle; and Professor Huxley, in his recent Hunterian Course of Lectures, has announced the same fact with regard to the Wombat; and as we believe this Lemurine muscle is as yet altogether undescribed, we propose to bestow on it the above appellation.

We have carefully verified the existence of this muscle in both legs of each of the species of *Lemur* and *Galago* dissected by us, but could find no trace of it in *Nycticebus* and *Loris*; and Burmeister and Owen are silent as to its existence in *Tarsius* and *Cheiromys*. Nevertheless in our specimen of *Cheiromys* we find this muscle fully as

[1] Cuvier, pl. 70. fig. 3, δ^1 (in *Lemur varius*).

[2] *Loc. cit.* p. 251, fig. 5, P.

[3] *Loc. cit.* p. 43, pl. iii. fig. 15, *a*.

[4] *Loc. cit.* p. 75, tab. 4. fig. 5, no. 23.

[5] Todd's Cyclop. of Anat. and Physiol. vol. iii. p. 291, fig. 113, *i*. In the text the fibres are spoken of as passing "outwards and downwards;" but the accompanying figure contradicts this statement.

well developed as in *Lemur*, and presenting the very same relations to all the surrounding parts.

e. *Region of the Foot (dorsal and plantar surfaces).*

EXTENSOR BREVIS DIGITORUM [1].—This muscle seems to be somewhat irregular, differing in the feet of the same individual. It arises from the upper surface of the cuboid, ectocuneiform, naviculare, and the anterior part of the os calcis, and may consist of two, three, or four portions, and may send tendons to the hallux and second, third, and fourth digits, as we found in the right foot of *Lemur catta*—or the second, third, and fourth digits only, as we found in the left foot of *Lemur catta* and *L. varius*. There is also a small deeper layer of muscular fibres attached to the cuboid and the fascia investing the interossei and metatarsals.

In the left foot of *L. catta* the extensor brevis digitorum consisted of two bellies, only one (the tibial one), with its superficial layers, sending a tendon to the fibular side of the proximal end of the first phalanx of the second digit; the second belly bifurcated in the middle of the foot, its two tendons going to the corresponding joints of the third and fourth digits. No tendon went to the hallux. A third layer of muscle arose by a tendon from the cuboid, and ended in a flat muscle attached by muscular fibres to the surface of the interossei between the third and fourth digits, nearly to their distal ends.

In the right foot of *L. varius* we observed it to consist of two bellies and of three tendons therefrom:—one tendon to the fibular side of the index, but not joining the extensor longus digitorum; two more to the third and fourth digits, these also on the fibular sides.

An extension of fibres to the styloid process of the fibula is found in *L. xanthomystax*.

In the right foot of *L. nigrifrons* it is composed of two main slips, and sends tendons to the second and fifth digits, which join the extensor communis digitorum, also a small one to the hallux. In the left foot of the same animal (Pl. VI. fig. 27, *E.b.d*) the muscular fibres were pretty well fused into a single mass, but three separate tendons were derived, supplying the second, third, and fourth digits respectively.

In *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. VI. fig. 25, *E.b.d*) and in *G. allenii* the right foot had four muscular slips and tendons, as in the right foot of *L. catta*.

In *Galago garnettii* this muscle is essentially divided into two slips, the large and innermost one arising from the anterior upper (dorsal) surface of the os calcis, and is inserted by a rather long and strong tendon into the proximal end of the second phalanx of the hallux. The second slip has a similar origin, but is inserted by a much more delicate tendon into the second digit, in union with the tendon of the extensor longus digitorum.

In *Nycticebus tardigradus* the extensor brevis digitorum consists of five muscular

[1] Cuvier, *l. c.* pl. 70. fig. 1, 9 (in *Lemur varius*), and pl. 67. fig. 1, 9 (in *Loris gracilis*).

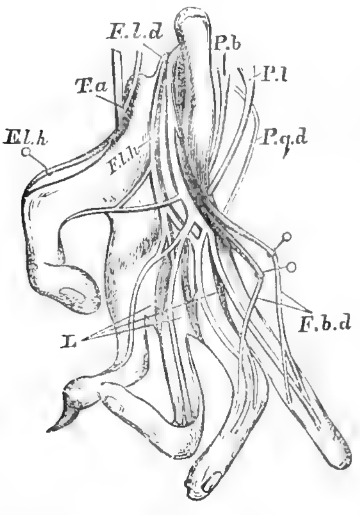
bellies and as many tendons. One, arising from the astragalus and calcaneum (their outer surfaces), is inserted into the hallux, and may be regarded as the extensor brevis hallucis. Another, the outermost and somewhat superficial layer, has a similar origin to the last; its tendon is inserted into the peroneal side of the fourth digit. The other three bellies cover more deeply the dorsum of the foot, and at their proximal end are united together, but distally divide and send tendons to the second, fourth, and fifth digits respectively, the third digit having no tendon derived from this muscle.

Perodicticus agrees with *Galago garnettii* in having two slips and as many tendons. That to the hallux Van Campen names the extensor brevis hallucis [1].

In *Tarsius* Burmeister [2] describes the short extensor as consisting of three parts—the extensor brevis hallucis (40), the extensor of the second digit (51), and the extensor brevis digiti tertii (52). The last muscle is very elongated, arising, as it does, high up on the outside of the extremely long os calcis.

In *Cheiromys* Professor Owen [3] found an extensor brevis of more or less separate parts, and going to the hallux and second and third digits. In our specimen, strange to say, no short extensor goes to the hallux in either foot, but in both feet there is a thin muscular layer arising from the tarsus (and but indistinctly divided into slips) and going by three tendons to the second, third, and fourth digits; that of the second digit gives off a small slip (on its peroneal side) uniting with that of the third digit.

Fig. 20.



Diagrammatical sketch.—Flexor tendons of the foot in the Slow Loris, from P. Z. S. 1865, p. 253.

F. l. d. Flexor longus digitorum.
F. l. h. Flexor longus hallucis.
F. b. d. Flexor brevis digitorum.
L. Lumbricales.
P. b. Peroneus brevis.
P. l. Peroneus longus.
P. q. d. Peroneus quinti digiti.
T. a. Tibialis anticus.
E. l. h. Extensor longus hallucis.

Flexor brevis digitorum.—This is represented by two more or less distinct muscles, one arising from the plantar fascia, and furnishing the perforated tendon of the index of the foot and half that of the third digit, the other springing from the plantar surface

[1] *Loc. cit.* pp. 44 & 45, pl. iii. fig. 14, *i.*

[2] *Loc. cit.* p. 83, tab. 4. fig. 5, and tab. 5. figs. 6 & 7.

[3] *Loc. cit.* p. 68.

of the deep flexor tendon, and forming the other half of the perforated tendon of the third digit and the whole of those of the fourth and fifth digits.

In Cuvier's figure of *Lemur varius*, pl. 70. fig. 3, this muscle also seems to consist of two portions similar to those above described by us; but the part springing from the plantar fascia and supplying the perforated tendon of the index is not represented as furnishing any tendon to the third digit, while its fleshy belly is not separated from those of the abductors of the hallux and fifth digits respectively, the whole being marked κ and named "court fléchisseur commun" (calcanéo-sous-onguien). The other part, which springs from the deep flexor tendons, supplies the perforated ones of the third, fourth, and fifth digits; it is distinguished by π and is the "lombricaux (*planti-sous-phalangiens*)."

The arrangement which we have found in the Thick-tailed and Garnett's Galago is a kind of modification between *G. allenii* and what Burmeister describes and figures in *Tarsius* (see *infra*). The deepest fleshy division corresponds to Burmeister's third portion (see *G. crassicaudatus*, Pl. V. fig. 24, *F.b.d*), moreover in *G. garnettii* supplying a perforated tendon to the second digit; his F. b. h. superficialis is but a few very delicate muscular fibres on the under surface of the hallucial plantar extension (Pl. V. fig. 24, *P.f.s**, and Pl. II. fig. 3, *P.f.s*); besides there are films of fleshy substance attached to the deep side of the plantar fascia where it goes to the fourth and fifth digits, Pl. V. fig. 24, *P.f.s***, forming, indeed, almost separate muscles. Burmeister's F. b. d. secundi, therefore, may either be represented by a palmar fascial slip or derived from the true flexor brevis. The tendency of the distribution on the whole seems to point to a superficial, a middle, and a deep set of flexor muscles, besides the lumbrical and interosseal sets.

In *G. allenii* fibres arose from the deep surface of the superficial plantar fascia (continuous with the plantaris); it was connected not only with the index but with the hallux. Also from the plantar surface of the deep tendon the second part arises, which furnishes a *distinct* perforated tendon to the third, fourth, and fifth digits.

According to Cuvier[1], in *Loris gracilis* there appear to be four fasciculi going to the four peroneal digits.

In *Nycticebus*[2] the flexor brevis is a small muscle, of which fasciculi arise from the deep flexor tendon and go to the fourth and fifth digits.

In *Tarsius*[3] this muscle is described as consisting of three portions: the first, his flexor brevis hallucis superficialis (36 *a*), arises from the superficial plantar fascia and goes to the hallux; the second, his flexor brevis digiti secundi, arises from the same fascia and goes to the second phalanx of the index; the third portion, his flexores breves digiti tertii, quarti, et quinti (36 *b*), springs from the plantar surface of the deep flexor tendon, and forms the perforated tendons of the third, fourth, and fifth digits.

[1] Pl. 67. fig. 2, κ.

[2] P. Z. S. 1865, p. 253, fig. 6, *F.b.d.*

[3] *Loc. cit.* pp. 80 & 81, tab. 5. figs. 8 & 9, nos. 36 *a* & 36 *b*.

In *Cheiromys* this double muscle is just as in *L. catta*, except that the part springing from the flexor tendon supplies the whole of the perforated tendon of the third digit.

LUMBRICALES [1].—These are four in number, and arise from the tibial side of the deep flexor tendons of the four peroneal digits, and are inserted into the tibial side of the same digits.

The so-called lumbricales figured in Cuvier's 'Recueil' are really part of the flexor brevis digitorum, as we have before said.

The lumbricales are figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. V. fig. 24, L^1, L^2, L^3, L^4).

In *Nycticebus tardigradus* these are only three in number, none going to the index.

FLEXOR BREVIS HALLUCIS.—Relatively it is a large muscle, which arises from the meso- and ectocuneiform bones. Embracing the long flexor tendon of the hallux, it is inserted as usual.

This is called in Cuvier's 'Myologie' "court abducteur du pouce," pl. 70. fig. 3, μ.

In *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 24, and Pl. VI. fig. 30, *F.b.h*) and both in *G. garnettii* and *G. allenii* it arises from the deep plantar fascia and plantar surface of the interossei. Insertion, the outer side and plantar surface of the proximal phalanx of the hallux.

Burmeister [2] describes this muscle in *Tarsius* under the names flexor brevis hallucis profundus, his flexor brevis hallucis superficialis being only a portion of our flexor brevis digitorum. It arises by two heads, one from the ectocuneiform and the proximal end of the first metatarsal, the other head from the meso- and ectocuneiform—and is inserted as in *L. catta*.

ABDUCTOR HALLUCIS.—Also a strong muscle, arising from the plantar fascia and inserted by a strong tendon into the proximal phalanx of the great toe.

This is confounded in Cuvier's 'Recueil' with the plantar part of the flexor brevis, as before said when speaking of that muscle, pl. 70. fig. 3 (*Lemur varius*).

In the genus *Galago* the origin is the sesamoid bone at the proximal end of the hallux and deep plantar fascia. Insertion, metatarso-phalangeal ligament and plantar surface of the proximal phalanx of the hallux. Figured in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 25, and Pl. VI. fig. 30, *Ab.h*).

In *Tarsius* [3] it goes from the naviculare to the hallux.

ADDUCTOR HALLUCIS AND TRANSVERSUS PEDIS [4].—In *Lemur catta* we found but a single broad slip representing these muscles. It arises from the third metatarsal bone, and is inserted into the proximal phalanx of the pollex.

[1] *Tarsius*, p. 78, tab. 5. fig. 9. no. 34.

[2] *Loc. cit.* p. 81, tab. 5. fig. 10. no. 44, and also fig. 9. no. 45, the dotted line leading to this last number having been by mistake carried on beyond the muscle it ought to indicate (namely, the transversus pedis inferior) to the flexor brevis hallucis.

[3] *Loc. cit.* p. 80, tab. 5. fig. 8. no. 41.

[4] Cuvier, *l. c.* pl. 70. figs. 1 & 3, ν & ν^1.

In *L. varius* we found two slips arising from the second and third metatarsals and from the fascia investing the interossei between those bones.

It is small in the Galagos as compared with the Lemurs. In *G. garnettii* the adductor hallucis is separable into two slips, both arising from the plantar fascia, covering the interossei at the distal end of the second metacarpal and proximal end of the first phalanx of the second digit. Insertion, the one into the proximal end of the first phalanx of the hallux, the other into its distal end. The adductor hallucis partially covers the insertion of the first.

There is but one triangular-shaped slip in *G. crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 24, and Pl. VI. fig. 30) and in *G. allenii*, which is strong. Origin, the surface of the interossei of the second digit and the sesamoid bone at the proximal end of the hallux. Insertion, the distal end of the proximal phalanx of the hallux.

In *Nycticebus tardigradus* (see fig. 7, p. 254, P. Z. S. 1865).

Burmeister[1] describes the adductor hallucis as distinct from both, a superior and an inferior transversis pedis; but their insertions and origin are essentially similar to the more single muscular mass of the Lemuroids.

In *Cheiromys*, according to our dissection, there is but a single muscular mass, if (as we have taken it) the muscular belly on the peroneal side of the long flexor tendon of the hallux be part of the flexor brevis hallucis. This single triangular mass may be more or less artificially divided into a smaller part arising from the proximal end of the plantar surface of the third metatarsal, and into another larger portion arising from the distal end of the same surface of the second and third metatarsals. They are inserted into the proximal end of the proximal phalanx of the hallux.

Flexor brevis minimi digiti.—A muscle of moderate size, which arises from the base of the metatarsal bone of the fifth digit, and is inserted into the base of the first phalanx of that digit.

The muscle named in Cuvier's 'Recueil' "adductor minimi digiti," pl. 70. fig. 3, ξ, is, in all probability, really the flexor brevis.

Figured in *Galago crassicaudatus* (Pl. II. fig. 3, and Pl. VI. fig. 25, *F.b.m.d*) and in *Nycticebus tardigradus* (woodcut, fig. 21).

It is the same in *Cheiromys* and *Tarsius* as in *Lemur catta*; but Burmeister calls it "m. adductor minimi digiti," p. 88, tab. 5. fig. 10. no. 48.

Abductor minimi digiti[2].—This is very large and fleshy, and arises from the under surface of the os calcis near its tuberosity, and from the tibial side of that tuberosity. It is inserted by a strong tendon into the peroneal side of the base of the proximal phalanx of the fifth digit.

[1] *Loc. cit.* p. 81, tab. 5. figs. 8 & 10.

[2] Confounded in the posthumous plates of Cuvier with that part of the flexor brevis which springs from the plantar fascia, as before said in speaking of that muscle, pl. 70. fig. 3 (*Lemur varius*).

Of great length in *Galago crassicaudatus* (Pl. V. fig. 24, and Pl. VI. fig. 30, *Ab.m.d*), also in *Nycticebus* (woodcut, fig. 21).

Fig. 21.

Enlarged view of the plantar surface of the foot of *Nycticebus tardigradus*, to show the small muscles of the hallux and fifth digits, the interossei, and the lumbricales attached to the outwardly dragged flexor tendons.—From P. Z. S. 1865, p. 254.

It is the same in *Tarsius* (p. 82, tab. 5. fig. 9, no. 47), where it is even larger than in *Galago*, because of the still larger tarsal bones.

Abductor ossis metacarpi quinti[1].—It arises from the peroneal side of the os calcis, and is inserted into the base of the fifth metatarsal towards its peroneal side. It is much smaller than the abductor minimi digiti.

The muscle represented in *L. varius* in Cuvier's 'Receuil,' pl. 70. fig. 1, *o*, is probably this muscle, although erroneously called the accessorius.

Very diminutive, and partly fused with the abductor minimi digiti in *L. nigrifrons.*

It is represented in *Galago crassicaudatus* (Pl. II. fig. 3, Pl. V. fig. 24, and Pl. VI. fig. 30, *Ab.o.m.q*) and *G. garnettii* by a fair amount of muscular fibre, which occupies the outer and plantar aspect of the os calcis. Its broadish tendon is inserted into the proximal end of the fifth metatarsal. We traced it in *G. allenii* beyond the cuboid, although it possibly may go to the fifth metatarsal.

The Accessorius is entirely absent in *Lemur catta*, the Galagos, *Nycticebus*, *Tarsius*, and *Cheiromys*, unless the deep fleshy belly of the flexor brevis digitorum be in part regarded as such. What is called in Cuvier's 'Receuil' the "accessorius," pl. 70. fig. 1, *o*, is, in all probability, really the extensor ossis metacarpi quinti.

Interossei of Foot.—In *Lemur catta* there are two to each digit, except the hallux, and counting the flexor brevis minimi digiti as one. Over and above these there is a more superficial slip or belly arising from the tarsal fascia, and going to the peroneal

[1] In *Tarsius*, Burmeister, *l. c.* p. 82, tab. 5. fig. 9. no. 46, that anatomist's abductor digiti minimi externus.

side of the flexor of the index, and another having origin from between the bones of the third and fourth metatarsal, and going to the tibial side of the fifth digit.

The Thick-tailed Galago agrees with our type in the distribution and number of the interossei (see enlarged view, Pl. VI. fig. 30, *I, I, I, I*, double interossei, and Is^1 & Is^2, superficial interosseal slips); some of these also appear on the dorsum of the foot; but we have preferred to regard them altogether as deep plantar flexors, although no doubt some of them are abductors of the digits to each other.

There are three distinct double interossei in *G. allenii*, which arise from the tarsus, and are inserted by tendons into sesamoid bones on either side of the distal end of the metatarsals. Besides the above, there is a single and more superficial muscle arising by tendon from the plantar surface of the internal side of the fourth metatarsal, and inserted into the outer (peroneal) side of the proximal end of the proximal phalanx of the same digit.

Nycticebus tardigradus and *Cheiromys* agree in having a superficial and deep layer of interossei.

In *Tarsius*[1], besides the ordinary four double interossei, there are two superficial fasciculi going to the second and fourth digits. Respecting the first of these it is called "abductor digiti secundi" (49), the second is represented in table 5. fig. 10, just internal to the insertion (48), but is not described in the text.

Opponens minimi digiti pedis.—In *Lemur catta* several fibres were observed distinctly inserted into the whole length of the fifth metatarsal. This little muscle appeared to arise between the fourth and fifth digits upon the plantar surface.

These are not mentioned by G. Burmeister in *Tarsius*.

RÉSUMÉ AND DEDUCTIONS.

In our introductory remarks we alluded to the intermediate position assigned to the Lemuroids by most naturalists, namely, below the higher Primates (Man and Apes), but above all other Mammals. We shall now consider how far this is justified by those external characters and by the Myology of the forms which have been the subjects of our study.

Some of the more exceptional structures presented by certain forms may be explicable by peculiarity of habit, or by special exigencies of existence; but others seem to be altogether destitute of any marked utility to their present possessors, and one or two are so bizarre as to render it very difficult, if not impossible, to conceive their ever having materially helped to preserve even the remote ancestors of existing species.

Besides considerable variation (and in spite of certain strongly marked family resem-

[1] *Loc. cit.* p. 82.

blances) in the nature of the hairy covering, the form of the body, and length of the limbs in genera of the group, the ear, as we have demonstrated, pertains to three types. If *Lemur* be taken as a standard, then *Cheiromys* much surpasses it in the relative size of the concha. *Tarsius*, *Galago*, and *Microcebus* diverge somewhat from *Cheiromys*, but agree pretty well together; they vary chiefly in the amount of excavation of the posterior helical pit. *Nycticebus*, *Perodicticus*, *Loris*, and *Arctocebus* are allied in the diminution of the pinna, in the depth of the posterior helical pit, and in the possession of the peculiar horizontal folds of the antihelix already adverted to.

The precise advantages gained or the developmental relation and value of the above differences are not so very easily discerned. Reasons, no doubt, might be conjectured, such as adaptation to nocturnal habits, or derivation from an ancient type. Thus the large and wonderful moveable ears of the Galagos &c. probably assist them in their nightly predatory excursions, either guiding them to their prey, or warning them of hostile approach. On the other hand, the short-eared *Nycticebinæ* are not, as far as we know, one whit less nocturnal in their habits than are the *Galagininæ* and *Chiromyidæ*, while their means of escape are much less effective.

Man and the Gorilla[1] are characterized by having a pendulous ear-lobule; while in the Chimpanzee and Orang it is sessile. In other quadrumana the lobule diminishes, or is so very small as to be considered absent. As we descend from Man and the *Simiinæ*, which possess a considerable incurved marginal helix, to the lower subfamilies of Monkeys, we find less inflexion of the helix, the upper or anterior portion only retaining a fold. In some Apes, e. g. *Cynocephalus* and *Macacus*, there is a faint depression or rudimentary posterior helical pit, while in others, as *Hylobates* and *Ateles*, no trace of this exists. Although the Primates have in many instances a transverse bifurcation of the antihelix, yet none have this forming a pouch. The flat pinna is oval or roundish, the *Cynopithecinæ* possessing a tendency to angularity.

The Lemuroids, while presenting a similitude to Man and Apes in the outer organ of hearing, do not conform in every particular. So far as size and shape are concerned, *Cynocephalus* might represent *Lemur*, and *Nyctipithecus* be equivalent to *Nycticebus*; but no Monkey whatsoever has the enlarged conch-like pinna matching that of *Cheiromys* and *Galago*.

On the other hand, the ears of some lower animals approximate considerably to the Lemurine peculiarities. Thus the Carnivora, the Cheiroptera[2], the Rodentia, nay, even the Marsupialia repeat characters manifested in them. For example, the Dog, Cat, and other well-known Carnivores have the posterior helical pit of remarkable size; and other genera among Bats have a most extensive pinna. The common Rat has the power

[1] Owen, Trans. Zool. Soc. vol. v. p. 246.

[2] Burmeister's 'Tarsius,' p. 8, where he remarks, "So merkwürdig diese Bildungen auch erscheinen, so sind sie doch keineswegs ausschliessliche Eigenthümlichkeiten des Tarsiers, sondern finden sich in ähnlicher Weise theils bei den *Fledermäusen*, theils bei *Nagern*. Die innere Klappe hat z. B. auch *Cavia*."

of contracting the auricle similar and equal to *Galago*; nay, further, the Short-eared Phalanger (*Belideus breviceps*) furls its large conch-like ear and has a posterior helical pit and pouch-folds of the antihelix. We have, moreover, observed in Mauge's Dasyure (*D. maugæi*) a curious modification of the upper ridge of the parallel bifurcation of the antihelix. In this animal it assumes the form of an epiglottis overhanging the hollow, and partially overlapping the opposite ridge.

This likeness to lower types manifested by the ear of Lemuroids is not carried out quite to the same extent in the development of the fatty cushions or pads of the palms and soles. In none of the Carnivora, not even in the arboreal Kinkajou and Binturong, nor in any of the Bears, does the disposition of the pads accord with those of the former group. This might naturally be expected from the want of opposable power in the pollex and hallux, and the consequent reciprocal relation of the adjoining parts. The palm and sole of *Cercoleptes*, for instance, has the same number of pads as *Lemur* and *Galago*; but the thenar and hypothenar ones, as well as the pollicial and hallucial ones, are differently sized and placed. Another very obvious difference is the absence of those peculiar-looking tactile balls at the ends of the digits. Among the Rodentia and Cheiroptera the modification of the manus and pes are such that the palmar and plantar surfaces bear no close correspondence with those of the Lemuroidea. Strange to say, however, a resemblance crops out among the further removed marsupials. In the genus *Belideus* the distribution of the pads, enlarged digital tips, and fine parallel striations are but slight modifications of the conditions found in the Galagos and Slow Loris. Furthermore in *Dasyurus maugæi* the same surfaces, or rather the interspaces between the cushions, present that remarkable papillary or pitted sculpture so well pronounced in *Lemur* and *Cheiromys*.

Compared with *Lemur* and its allies, Man and the Apes possess less separation of the palmar and plantar pads; but they have nearly all those figured by us in the genera of Lemuroidea, though less raised. Generally there are longer thenar and hypothenar cushions, and three, or sometimes four, broadish and equal-sized proximal phalangeal ones. In the thumbless genera the pad is still present, though the digit is wanting. In none of the Simian families nor in Man are the digital extremities furnished with such comparatively large tactile cushions as are universal in the Lemuroids. In Cuvier's 'Recueil' Laurillard has given some excellent sketches of the palm and sole of *Simia innuus* and *Ateles belzebuth*, natural size, pls. 26 & 62.

The peculiar modification of the nail of the pedal index[1] is another of those strange anomalous characters of the Lemuroids, the utility of which it is difficult to conjecture; but still more mysterious is the gradual atrophy of the index of the hand, reaching almost to the last degree of degradation in *Perodicticus* and *Arctocebus*.

How this mutilation can have aided in the struggle for life, we must confess, baffles

[1] The pedal index of *Hyrax* also has a peculiarly modified nail, as was noticed by Prof. Huxley in his Hunterian Lectures.

our conjectures on the subject; for that a very appreciable gain to the individual can have resulted from the slightly lessened degree of required nourishment thence resulting (*i. e.* from that suppression) seems to us to be an almost absurd supposition.

Of quite a contrary nature and stage of development is that wonderfully lengthened, attenuated, and probe-like middle digit of the Aye-Aye, in which Prof. Owen discerns a final purpose in its adaptability to the extraction of Wood-boring Grubs, Dr. Sandwith[1] having witnessed this action in a specimen kept by him for a short time in the Mauritius. But on this point Mr. Bartlett's[2] observations on the living animal in the Zoological Gardens lead him to a different conclusion. Whatever be the physiological import of this extraordinary digital structure, it certainly recalls to mind and much resembles the very elongated middle finger of some Bats.

Turning now to the 'Myology,' we find structures which are presented by none of the higher Primates, while at the same time a remarkable uniformity runs through the whole of the family Lemuridæ. It is only in *Nycticebus* and *Loris* that we have found a marked divergence—though we expect that the African genera *Arctocebus* and *Perodicticus* will be found on examination to differ similarly from the other Lemuroids, and to resemble in the main their oriental allies the Slow and the Slender Loris.

Besides general similarity to a human type in the disposition of the groups of muscles, we may observe that *the following points equally obtain throughout the group*:—

1. There is a tendency to duplicity in the sterno-mastoid; that is, the cleidal portion presents more or less of separation without actually being distinct from its fellow sternal portion. 2. There is no median tendon in the omohyoid, excepting, it may be, in *Tarsius*, where it is said by Burmeister to be double-bellied. 3. The longus colli is divisible into three portions, which, however, is best seen in *Cheiromys*, the Potto, and the Galagos. 4. The deltoid is composed of three parts, less separable in the small than the larger specimens. 5. A teres minor exists, but is diminutive in size. 6. The triceps is four-headed. 7. Both a dorso-epitrochlear and anconeus are present; but the latter is said to be wanting in the Potto. 8. The coraco-brachialis is double-bellied. 9. There is no extensor primi internodii pollicis. 10. No pyramidalis is developed. 11. There is a rhomboideus capitis muscle; but no usual division into rhomboideus major and minor, a slight approach to this being only found in *Tarsius* and Allen's *Galago*. 12. A levator claviculæ is alone (doubtfully?) said to be absent (?) in *Potto*, all the others certainly have it. 13. The levator anguli scapuli is almost inseparable from the serratus magnus, and has attachment to all the cervical vertebræ. 14. All possess a thin serratus posticus anterior, though it is assumed to be absent in the Potto. 15. The gluteus maximus is double, or has two separate planes of fibres. 16. A scansorius does not exist. 17. The quadratus lumborum muscle arises by a series of tendons from the last dorsal and

[1] See his letter to Prof. Owen, Trans. Zool. Soc. vol. v. p. 37.

[2] P. Z. S. 1862, p. 223.

anterior lumbar vertebral. 18. A double tendon of origin is possessed by the rectus femoris. 19. The tensor vaginæ femoris is absent, or only rudimentary fibres are extant, in *Cheiromys*, *Nycticebus*, and *Galago crassicaudatus.* 20. The biceps femoris is simple, or only slightly modified in attachment and muscularity. 21. There is no peroneus tertius. 22. Those species examined possess an extra and superficial layer of palmar and plantar interosseous slips. 23. All the genera have a short tendon which unites the flexor sublimis and the flexor profundus digitorum muscles previously to their usual digital divisions.

There is nothing of a very singular nature in the muscles distinguishing any one genus from its fellows. As regards characters of a positive or negative kind that have been observed by us or by others, they may indeed be inconstant; nevertheless we place the undermentioned on record.

I. *Lemur.*—1. The temporalis assumes a partly double layer, in this respect exhibiting structure pointing towards Rodents and Carnivora. 2. In *L. xanthomystax* the stylo-hyoid is pierced by the digastric muscle. (Meckel distinguishes a muscle in Lemurs as the "masto-styloïdien.")

II. *Galago.*—No myological structure is peculiar to this genus, unless the absence of a pectoralis minor is a normal condition in *G. allenii.*

III. *Loris and Nycticebus.*—These are alike, except that the former in one instance examined by us had no psoas parvus.

IV. *Tarsius.*—1. The psoas magnus is said to be double. 2. The vastus externus has also two bellies. 3. There are, according to Burmeister, but two adductors of the thighs.

V. *Perodicticus.*—Van Campen has asserted that in the Potto the following muscles are wanting:—1. The anconeus. 2. The levator claviculæ. 3. The serratus posticus.

VI. *Cheiromys.*—The curiously constructed Aye-Aye differs muscularly from its kindred, in alone having 1, a double semitendinosus, and, 2, in the trapezius overlapping and hiding the insertion of the levator claviculæ.

We shall now place together the several genera which exhibit alliances or similarities with reference to the development of muscles or the distribution of tendons. At the same time we do not attach equal weight to all these seeming affinities, as some may but represent irregularities of tendinous distribution such as happen in Man; others, again, are more suggestive and better to be relied on as balancing characters of family relationship.

Group I. *Lemur*, *Galago*, *Cheiromys*, *and Tarsius.*

1. In the first three genera that anomalous muscle the rotator fibulæ is undoubtedly found: it may possibly be also extant in *Tarsius* (?), though the accurate Burmeister has not described such a structure.

2. A plantaris muscle exists in the genera under consideration.

3. The peroneus quinti digiti is well developed; it is likewise present in *Nycticebus.*

4. The biceps flexor cubiti consists of two bellies in the above group, and also in *Perodicticus.*

5. The extensor indicis has a single belly in *Lemur* (with one exception), *Cheiromys*, *Tarsius*, and besides in *Nycticebus* and *Perodicticus*, but not in *Galago.* Tendons go to the second and third digits in *Lemur*, *Galago*, and *Tarsius.* In *Cheiromys* and *Tarsius* (and once in *Lemur*) an extra tendon supplies the fourth digit, and in *Perodicticus* the fifth digit.

6. The extensor communis digitorum (manus) in *Lemur*, *Galago*, and *Tarsius* splits into four tendons (an exceptional example of *L. varius* having on one side but three, and a *Galago* possessing two subsidiary uniting transverse slips). Our specimen of *Cheiromys* presented a double-bellied muscle, subdividing into seven tendons, the second, third, and fourth digits receiving two tendons each.

7. In all the genera comprising Group I. the extensor minimi digiti of the hand has fourth and fifth digital tendons. Over and above, *L. catta* has an extra indicial derivative tendon,

8. The flexor sublimis digitorum has usually four perforated tendons.

9. At the wrist the flexor profundus digitorum and flexor longus pollicis have a single broad and strong common tendon.

10. In the above group, and also in the genus *Perodicticus*, the flexor longus pollicis is double-headed (once in *Cheiromys* it occurred three-headed); but in all no special tendons go to any digit but the pollex.

Group II. *Lemur, Cheiromys, and Tarsius.*

1. The three genera which we have here brought together are equally distinguished by the soleus muscle having, as in higher Primates, a long fleshy belly.

2. They each have a peroneus quarti digiti muscle.

3. *Lemur* and *Cheiromys*, but not *Tarsius*, have the flexor longus hallucis arising from both the tibia and fibula.

4. The masseter is double in *Cheiromys* and *Tarsius*, but not in *Lemur* or the other forms.

Group III. *Lemur and Tarsius.*

1. A subcrureus has been found by us only in *Lemur nigrifrons*, and by Burmeister in *Tarsius.*

2. In this division, partly including the genus *Galago*, the insertion of the rectus anticus major does not pass beyond the cervical region.

Group IV. *Lemur and Cheiromys.*

With the exception of *L. catta*, the species of the genus *Lemur* and the single one of *Cheiromys* have each a double-bellied and tendinous tibialis anticus muscle. In all other Lemuroids it is single.

Group V. *Lemur and Galago.*

We have found the palmar lumbricales to be four in number in the genus *Lemur* and in *Galago crassicaudatus.*

Group VI. *Lemur and Perodicticus.*

These widely different forms approach each other in having each two supracostal muscular slips.

Group VII. *Galago, Cheiromys, Nycticebus, and Perodicticus.*

1. All the genera in this group, excepting *G. crassicaudatus*, have but three lumbrical muscles in the hand.
2. Excluding *Perodicticus*, they have but a single supracostal slip.

Group VIII. *Galago and Tarsius.*

1. These agree in the occipito-frontalis and the retractor muscles of the ear being unusually well developed. The retrahens aurem is indeed compound in them, where it may be assumed a certain correlation of structure and growth exists in connexion with the remarkable folding movements of their capacious concha.
2. They alone of all the Lemuroidea dissected show a depressor scapulæ muscle.
3. In them the flexor profundus digitorum has three muscular bellies, whereas in the other genera they are more or less united.
4. In the two genera of this group the flexor longus hallucis has origin from the fibula only.

Group IX. *Galago and Loris.*

1. The iliacus appears only to be double in them alone; but the difficulty of separating the fibres of this usually single muscle renders their singularity in this respect doubtful. *Galago* certainly has a vertebral besides its iliac origin.
2. They, as well as *Lemur xanthomystax*, have a clearly double extensor indicis.

Group X. *Galago and Perodicticus.*

The myological agreement between these two genera consists in the extensor longus digitorum being single-bellied and divisible into three main tendons going to the corresponding digits.

Group XI. *Loris and Nycticebus.*

1. The biceps of the arm is a single muscle in these two Indian genera, but double, as before noticed, in all kindred forms.
2. In *Loris* and *Nycticebus*, and in them only of all the Lemuroidea, the flexor

longus digitorum pedis has three heads of origin and three muscular bellies—the origin, as in *Pteropus*, being partly from the femur.

3. They also agree, and differ from the other forms, in having the origin of the flexor longus hallucis from the fibula and from the tendon of the popliteus.

4. Neither possesses the short but remarkable rotator of the fibula which we have described in another part of our memoir.

5. The flexor longus pollicis is single in them only, and supplies two or three more digits besides the thumb.

Group XII. *Loris*, *Nycticebus*, *Perodicticus*, *&c.*

1. No trace of a plantaris muscle is found in these genera, nor in *Galago peli* either, according to Kingma.

2. The muscle named peroneus quinti digiti, again, is decidedly absent in *Loris*, and probably is also wanting in *Perodicticus*, though its presence has been demonstrated by ourselves in *Nycticebus*.

3. In *Loris*, *Nycticebus*, and also in *Galago*, no peroneus quarti digiti is developed.

4. The flexor sublimis digitorum has but three perforated tendons in *Loris* and *Perodicticus*; in *Nycticebus* there is in addition an undivided indicial tendon.

5. The three genera (*Loris*, *Nycticebus*, and partly *Perodicticus*) have not, like the Lemurs and Galagos, such complete adhesion into a broad common tendon of the deep flexor and long pollicial tendons of the hand; nor do the two first supply the index tendon.

6. The extensor communis digitorum (manus) has in *Perodicticus* four, in *Nycticebus* five, and in *Loris* six tendons. In the first two genera the fourth, and in *Loris* the fifth digit receives a double tendon; in the *Potto* the second digit has none.

7. In contradistinction to what occurs in *Lemur*, *Tarsius*, and *Galago*, the rectus anticus major is continued into the thorax or on to the dorsal vertebræ in *Loris* and *Nycticebus*, as likewise is the case in the aberrant *Cheiromys*. *Galago crassicaudatus* has it in an intermediate condition between these.

8. Only one tendon is derived from the extensor minimi digiti and goes to the fifth digit in *Loris*, *Nycticebus*, and *Perodicticus*.

9. In *Nycticebus*, *Perodicticus*, and in *Galago* (but not to the same extent in *Loris*) the soleus is a remarkably short and broad muscle and fused below with the gastrocnemius.

Some muscles are so irregular in their distribution that they cannot well be classed with any of the above groups. Amongst these may be mentioned the extensor brevis digitorum of the foot, which has as many as two, three, four, or five muscular slips and tendons in different specimens, or even on the opposite feet of the same specimen. The scalene muscles, again, may possess two, three, or four divisions; and in the Grand Galago a pencil of fibres pierces the serratus magnus. The latter muscle is inconstant in its rib attachments. In like manner the caudal tendons and muscular bellies do not always present regularity of distribution, although, as a rule, they are pretty uniform.

We will now institute a few comparisons between the myology of the Lemuroidea and that of higher and lower forms.

The absence of an extensor primi internodii pollicis and of a peroneus tertius muscle, and the presence of levator claviculæ, dorsi epitrochlear, and abductor ossis metacarpi quinti muscles, show, as might of course be expected, that the Lemuroidea agree in muscular developments rather with the Apes than with the more common arrangement found in Man. The genera *Lemur*, *Galago*, *Cheiromys*, and possibly others possess the short deep leg-muscle which we have termed rotator fibulæ. *Tarsius* and some of the Galagos have likewise a distinct depressor scapulæ. So far as we know, neither of these muscles[1] has hitherto been described as occurring in the higher Primates or lower Mammals; and hence we may for the present consider them essentially Lemurine in character. In other respects myological distinction between the Lemuroidea and Anthropoidea is mainly confined to difference of attachments or tendinous distribution: and, furthermore, the muscular variations exhibited by the group are found in widely different lower families, though often resembling conditions extant in arboreal Rodents. Broadly speaking the muscles of the head approximate to a Rodent or Carnivorous type; whereas those of the extremities depart little from the higher Primates, excepting the long flexors of the palm and sole. As representative of what we here state, the complex condition of the ear-muscles and tendency to duplicity of the temporalis and masseter may be regarded as marks of degradation. In the hand the more or less complete separation and full development of the abductor, adductor, flexor brevis, and opponens pollicis, the flexor brevis, abductor, and opponens minimi digiti, and comparative absence of a flexor brevis manus, with diminutive size of palmaris brevis, are Simian in appearance and attachment. In the foot the flexor brevis digitorum and hallucis, the abductor and adductor hallucis, the transversus pedis, the flexor brevis, abductor and opponens minimi digiti, and the abductor ossis metacarpi quinti likewise are more truly Ape-like than fashioned after the lower Mammalian forms.

In the Lemurine suborder, as a whole, we witness Simian muscular organization with proclivities towards the structure of animals of lower grade.

Intermediate forms or gradations of myology are very numerous; among such are the following:—

The thoracic extension of the rectus capitis anticus major, which is met with in the Platyrrhine Ape *Ateles belzebuth*, and the Rodent *Castor fiber* The scalene muscles, in their length and in the frequency of an addition to their number, probably as much

[1] Unless the small "infraspinatus secundus" met with by Macalister (Nat. Hist. Soc. Dublin, April 5, 1866) in several species of Monkeys be equivalent or homologous with the depressor scapulæ of Burmeister and ourselves.

abide by the Primatial type as wander from it. A tendency to deviate towards a not uncommon condition in Rodents and Carnivora is seen in the extra divisions of the pectoralis major; but a double layer is also frequently met with in Apes.

The subclavius is tolerably human in character. The compound deltoid is a change from the higher and simpler condition to the constantly divided state in which it is found among Rodents, Carnivora, Ruminants, Marsupials, &c. A diminished teres minor, as in Lemurines, is met with in some Rodents. In almost all the lower Mammals, but only in some of the higher Primates, the rectus abdominis goes to the first rib, as is characteristic of the Lemuroids. In Man, Apes, and Lemurs, the serratus anticus and posticus are quite separate and but moderate-sized; in some Rodents, and notably in *Hyrax*, they are continuous. A supracostal is the rule in the lower Mammalia; it is constantly met with in Lemuroids, but in the higher Apes it is not always present. The trapezius, the rhomboideus capitis, the levator claviculæ, and the levator anguli scapulæ, each and all, in development, relation, and attachment, are Ape-like, but not more so than in their compeers of lower grade.

That the biceps humeri should be double in one portion of the group and single in the other is not readily to be explained; as regards affinities, conditions similar to both one and the other are found in higher and in lower groups. The lengthening of the brachialis anticus, and its non-embracement of the deltoid, are points indicating alteration in this muscle from the Simian, towards the purely rotating character which it bears in digging and swimming Mammals.

The following muscles of the forearm are met with almost unaltered from Man and Apes:—the supinator longus and brevis, the extensor carpi ulnaris, the extensor secundi internodii pollicis, the pronator radii teres, the flexor carpi radialis, the palmaris longus, and the flexor carpi ulnaris.

A divided or multiple extensor indicis, supplying tendons to the second and third, or even the fourth digit, occurs in higher Quadrumanous genera; Lemuroids repeat the character, which becomes less marked in lower Mammals, inasmuch as where the tendon is divided they chiefly go to the index and third digit. We meet with a numerous subdivision of the long extensors to the back of the hand in several Simian genera; and even in Man the extensor communis and minimi digiti often exhibit extra development of tendons, particularly the minimi digiti, which splits into branches going to the fourth and fifth digits. In the Lemuroids these characters are more constantly manifested, notably in the Aye-Aye, as we have shown. No part of the muscular system of Lemuroids exemplifies the gradual change of the Quadrumanous type into lower forms so markedly as do the long flexors of the palm and sole. In the manus the deep palmar tendons show much variety; but in all a short slip unites the flexor sublimis with the profundus: this has been demonstrated by Turner[1] and others to be not an unfrequent

[1] "On Variability in Human Structure, with Illustrations from the flexor Muscles of the Fingers and Toes" (Trans. Roy. Soc. Edinb. p. 180 *et seq.*, fig. 2).

abnormality in Man. Only in scattered genera of the lower Mammals is the union found; but where it does exist it is large, and powerfully aids the combined actions of the superficial and deep flexors.

The multiple origin of the three muscles in question (flex. sublimis, profundus, and longus pollicis) is curious and interesting homologically as regards family relationship, and also as regards the serial homology between flexors of palm and sole. In the higher Quadrumana the tendons of the flexor profundus and pollicis more commonly, but not always, pass in separate slips below the annular ligament, the former muscle usually supplying the second, third, fourth, and fifth digits, the latter the pollex. Variations take place wherein the pollicial tendon splits and partly goes to the index, or where union takes place between the common deep flexor and longus pollicis, the latter even appearing as but a slender tendon from the former. These so-called variations culminate in the Lemuroids, and even reverse the primordial relationship of the muscles and tendons, inasmuch as the flexor longus pollicis encroaches considerably on the domain of the profundus, becomes far the larger muscle of the two, and in *Nycticebus* sends on the main tendons to the first, second, third, and fourth digits. The palmar tendinous type of the group diverges into two, one wherein the flexor profundus and pollicis unite as a broad flat tendon, ending in five equal or subequal digital segments: the genera *Lemur*, *Galago*, *Perodicticus*, *Tarsius*, and *Cheiromys* fall under this; the second, as witnessed in the Slow and Slender Loris, has separate proximal palmar tendons, the flexor longus pollicis becoming functionally the more important, and, as already said, acting as the tendinous lever of three or four of the radial digits, whilst the flexor profundus digitorum lessens its tendons to the fifth and fourth or only fifth digit, branchlets merely uniting it with the enlarged flexor longus pollicis tendons. These examples of differentiation are highly important as affording proof of the identity of the muscular relations of the hand and foot; for the flexor longus hallucis supplants, in great part, the flexor longus digitorum both in size of fleshy belly and tendinous insertion. The increase of force resulting from the palmar union is shown prominently in those lower Mammals where the manus serves the office of a scratching or digging apparatus, notably so in *Talpa*. It may be a question whether this change of tendinous type is not as much due to the uses and modes of life of the animals thus identically distinguished as purely to family organization. As regards the interossei, these manifest higher character in a slight exhibition of dorsal ones, but on the whole they more closely exemplify lower forms in being true flexores breves of the palm and sole. The extra superficial layers are of common occurrence, and indeed almost the rule, in inferior families.

In the arrangement and relative size of the psoas parvus magnus and iliacus the Lemuroids more resemble the Squirrel, Kangaroo, Seal, &c. than most Apes; this may follow as a consequence from the great extent of the lumbar region and similarity of some of these in habits, and is certainly no evidence of any affinity.

The gluteus maximus in the higher Quadrumana is usually simple, often large, but inserted seldom further than the great trochanter; in the Lemuroids it partakes of a passage form from the Apes towards Carnivora, Rodents, Cheiroptera, and other groups, by having a caudal division and being inserted much lower upon the shaft of the femur. A scansorius presents itself as a distinct fleshy muscle in most of the higher anthropoid Apes, neither does it disappear in the lower Simians, though often fused with the gluteus medius; it is next to absent in the Lemuroids, but again appears in Rodents and other lower Mammals. There are few better climbers than the Lemurine family, where, as we see, this muscle is diminutive or aborted, so that the name scansorius is not the most happily chosen one as expressive of its true function. What has been said regarding the development and presence of the scansorius applies in most respects to the tensor vaginæ femoris. The double origin of the rectus femoris is a normal condition in Man and persists in the Lemurs. The adductors of the thigh, though only three in Man, are occasionally more numerous in Apes and inferior Mammalia, The Lemurs stand midway as respects number, and they are feebler than in Monkeys, as Meckel has already observed (*l. c.* p. 379).

The division of the tibialis-anticus tendon and muscle is a structure exhibited by some of the highest Quadrumana; so that its persistence in some Lemuroids affords no grounds of separation from the Primates, although a divided origin of the tibialis anticus is found in some Rodents. The muscle in the Rabbit and Hare which Professor Huxley has termed the tibialis secundi (Hunterian Lectures, 1865), has no analogue in the Lemuroids; they exhibit, on the contrary, a well-defined quadrumanous tibialis posticus.

Thus then, on the whole, the muscular structure of Lemuroids harmonizes with their osteological characters in justifying their union in one order with the Apes and Man, while aberrant and inferior characters point to a subordinal distinctness.

We cannot conclude this Memoir without offering our thanks to our artist Mr. Berjeau for his earnest endeavours faithfully to render the natural appearances of the parts, while not losing sight of the necessity of clearness of detail.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Female *Galago crassicaudatus*, Geoff. (the individual described as *G. monteiri* by Bartlett, P. Z. S. 1863, p. 231, pl. xxviii.), from a photograph by Dr. Murie. Taken two-thirds life-size. The figures of the dissections in the Plates following, unless where otherwise denoted, are from the same specimen.

Fig. 2. Applies collectively to four greatly reduced figures of *Galago garnettii* (Ogilby). These are from sketches of the living animal by Mr. Wolf. They represent the various attitudes assumed by this species when allowed to gambol about freely after nightfall. The climbing position of figure 1 (*G. crassicaudatus*) applies equally to all the species of *Galago* which we have had the opportunity of observing.

PLATE II.

Fig. 3. Dissection of *Galago crassicaudatus*, natural size, to show the superficial muscular layer of the entire animal, the dermal fibres of the panniculus carnosus alone being removed.

The muscles and other parts are specified by the following lettering:—

1. *Head and Neck.*

O.f. Occipito-frontalis.
At.a. Attrahens aurem.
Te. Temporal.
O.p. Orbicularis palpebrarum.
Na. Naso-labial muscle.
O.o. Orbicularis oris.
Bu. Buccinator.
Ma. Masseter.
St.m. Sterno-mastoid.
Tz. Trapezius (cervical portion).

L.cl. Levator claviculæ.
On the Ear the numbers indicate:—
No. 1. Helix, its posterior margin.
„ 1*. „ its anterior margin.
„ 2. Fossa of the helix.
„ 2*. Pit above the antitragus.
„ 3. Antihelix.
„ 4. Fossa of the antihelix.
„ 5. Antitragus.
„ 6. Tragus.

P.gl. Parotid gland. *St.d.* Stenon's duct. *Sm.gl.* Submaxillary gland.

2. *Pectoral Limbs.*

D^1. Deltoid, its first or clavicular portion.
D^2. „ its second or acromial portion.
D^3. „ its third or spinal portion.

T^1. Triceps (long or scapular head).
T^2. „ (outer head).
T^3. „ (upper part of inner head).

P.ma. Pectoralis major (its humeral insertion).

B^1. Biceps (long head or glenoidal division).

B^2. Biceps (short or coracoid portion). In the right arm its lower part has been removed; but the dotted line indicates its continuity and insertion.

D.ep. Dorso-epitrochlear.

Anc. Anconeus.

S.l. Supinator longus.

E.c.r.l, E.c.r.l.* Extensor carpi radialis longior.

E.c.r.b. Extensor carpi radialis brevior.

E.c.d. Extensor communis digitorum.

E.c.d. Extensor communis digitorum, tendon above digital divisions.

** 4 & 3. Extensor communis digitorum, extra slips to fourth and third digits.

E.c.u. Extensor carpi ulnaris.

E.i. ,, indicis.

E.o.m.p. ,, ossis metacarpi pollicis.

E.s.i.p. Extensor secundi internodii pollicis.

I,I,I,I. Interossei seen partly on dorsal and palmar surfaces of hand.

L^1. *L^2.* *L^3.* *L^4.* } Lumbricales.

B.a. Brachialis anticus.

$C.b^1$. Coraco-brachialis (long head).

F.c.r. Flexor carpi radialis.

P.r.t. Pronator radii teres.

Pa.l. Palmaris longus.

F.s.d. Flexor sublimis digitorum.

F.p.d. ,, profundus digitorum.

F.l.p. ,, longus pollicis (thumb-tendon).

F.c.u. ,, carpi ulnaris.

Ab.p. Abductor pollicis.

F.b.p. Flexor brevis pollicis.

Ad.p. Adductor pollicis.

F.b.m.d. Flexor brevis minimi digiti.

Ab.m.d. Abductor minimi digiti.

3. *Trunk and Tail.*

P.c. Panniculus carnosus. A small axillary piece is all that has been left of this subcutaneous muscle.

P.ma. Pectoralis major, and humeral insertion shown in right arm.

R.ab. Rectus abdominis (costal continuation).

Ex.o. External oblique.

Tz.* Trapezius (dorsal portion), the cervical is marked *Tz.*

La.d. Latissimus dorsi.

S.mg. Serratus magnus, digitations with external oblique.

S.p.p. Serratus posticus posterior, digitations with external oblique.

L.c.i. Levator caudæ internus.

L.c.e. ,, ,, externus.

It.cd. The fleshy portion of the intertransversarii caudæ, which passes up to

P. & I.c. Pubo- and Ilio-coccygeus.

S.c. Sacro-coccygeus.

4. *Pelvic Limbs.*

$G.mx^1$. Gluteus maximus (iliac portion).

$G.mx^2$. ,, ,, (caudal portion).

Sa. Sartorius.

R.f. Rectus femoris.

V.e. Vastus externus.
V.i. „ internus.
Il. Iliacus.
Pe. & Ad.l. Pectineus and Adductor longus.
Ad.m. Adductor magnus.
S.t. Semitendinosus.
S.mb. Semimembranosus.
B.f. Biceps femoris.
Ga, *Ga**. Gastrocnemius.
Pla. Plantaris.
T.a, *T.a**. Tibialis anticus.
P.l, *P.l**. Peroneus longus.
P.b, *P.b**. „ brevis.
P.5.d, *P.5.d**. „ quinti digiti.
E.l.d, *E.l.d**. Extensor longus digitorum.
E.b.d, *E.b.d**. Extensor brevis digitorum.
E.p.h. Extensor proprius hallucis.
I. Interossei, seen on dorsal surface.
*Ab.o.m.*5. Abductor ossis metacarpi quinti.
F.l.d, *F.l.d**. Flexor longus digitorum.
F.l.h, *F.l.h**. „ „ hallucis.
T.p. Tibialis posticus.
L^1., L^2., L^3., L^4. Lumbricales.
Ab.h. Abductor hallucis.
F.b.h. Flexor brevis hallucis.
Ad.h. Adductor hallucis.
F.b.d. Flexor brevis digitorum.

I.l.l[1]. Internal lateral ligament of the knee-joint. *E.l.l.* External lateral ligament of knee-joint. *I.l.l*[2]. Internal lateral ligament of the ankle-joint. *L.p.l.* Long plantar ligament. *L.d.l.* Long dorsal ligament.

Fig. 4. Sketch of the left ear of *Galago garnettii* (natural size, and from life), showing the manner in which it contracts.

P. Plications.

PLATE III.

Fig. 5. Thorax, ventral surface of neck, and inframandibular region in the Grand Galago. The dissection on the left side of the body displays the superincumbent muscular masses in position; while on the right side some of the muscles have been removed or cut short and thrown back, bringing the deeper-seated parts into view.

1. *Head and Neck.*

O.o. Orbicularis oris.
Bu. Buccinator.
Ma. Masseter.
My.h. Mylo-hyoid.
G.h. Genio-hyoid.
Ear 1. Posterior margin of helix.
„ 1*. Anterior margin of helix.
Ear 2. Fossa of helix (the glands are seen above the pointer).
„ 2*. Pit.
„ 3. Antihelix.
„ 4. Its fossa.
„ 7. Fossa of the concha.

Di, *Di**. Digastric. The pointer indicates the median tendon on the right side, part of the anterior belly being removed. On the left side the anterior belly is left entire, the posterior being hidden by the submaxillary gland.

St.m. Sterno-mastoid. Its mastoidal insertion on the right side is cut and thrown outwards.

Cl.m. Cleido-mastoid.

S.hy. Sterno-hyoid.

*S.hy**, *S.hy***. Portions, origin and insertion, of same muscle on right side, the middle being removed.

St.th. Sterno-thyroid (its attachments are hidden by the remaining portions of the sterno-hyoid).

Th.h. Thyro-hyoid.

O.h. Omo-hyoid.

L.cl. Levator claviculæ.

R.a.ma. Rectus capitis anticus major.

F.ar. Facial artery. *Smx.gl.* Submaxillary gland. *Th.gl.* Thyroid gland. *C.ar.* Common carotid artery. *P.n.* Pneumogastric nerve. *B.px.* Brachial plexus of nerves. The phrenic nerve is seen among these; and the inferior thyroid and transversalis cervicis arterial branches are seen crossing the plexus.

2. *Thorax and segments of Pectoral Limbs.*

P.ma. Pectoralis major.

*P.ma**. ,, ,, Its right humeral insertion cut through and thrown back.

P.mi. Pectoralis minor.

Sb. Subclavius.

S.sp. Supraspinatus.

S. Subscapularis.

T.ma. Teres major.

D^1. Deltoid (first or clavicular portion).

B^1. Biceps (first portion or long head).

B^2. ,, (second portion or short head).

$C.b^1$. Coraco-brachialis (long head).

R.ab. Rectus abdominis.

Ex.o. External oblique.

S.mg. Serratus magnus.

La.d. Latissimus dorsi.

*La.d**. Segment of same on right side, showing tendon of insertion conjoined with that of the panniculus carnosus.

P.c. Part of the panniculus carnosus as it passes to its humeral insertion.

D.ep. Dorso-epitrochlear.

$T^{1\,\&\,3}$. Triceps, first and third heads.

*B.px**. Continuation of Brachial plexus and axilla, here partially covering the axillary artery.

Fig. 6. A dorsal view of the trunk, neck, and head of the same animal, also natural size, showing the superficial layer of muscles on the left side, and a deeper layer on the right side of the median line. Both scapulæ and portions of arms are backwardly extended, the better to display their fleshy investments.

1. *Head and Neck.*

O.f. Occipito-frontalis.
Te. Temporal.
Re[1]., *Re*[2]., *Re*[3]. } Tripartite division of the retrahens aurem muscle.
St.m. Cranial attachment, Sterno-mastoid.
Ma. Masseter.
L.cl. Levator claviculæ.
Tz. Nuchal portion, Trapezius.
Sp.cp. Splenius capitis. The dotted line indicates its spinal attachment below.
Co. Complexus., *Bi.c.* Biventer cervicis. } Partially seen.
O.h. Omo-hyoid.
L.a.s.=*S.mg.* Levator anguli scapulæ, or cervical portion of Serratus magnus, dragged out. Its thoracic attachment is seen below (*S.mg**).
*Lo.d**. A small cervical portion of the Longissimus dorsi.
Smx.gl. Submaxillary gland.

2. *Trunk and Scapulo-humeral Regions.*

*Tz**. Dorsal portion of Trapezius.
Rh. Rhomboideus. Its outer border faintly shows a line of demarcation constituting an indefinite rhomboideus capitis.
La.d. Latissimus dorsi.
S.mg. Serratus magnus (interdigitating with obliquus externus).
Lo.d. Longissimus dorsi (a small portion carried into the neck is marked above *Lo.d**).
Ex.o. External oblique.
In.o. Internal oblique (portion of the external oblique being removed to show the internal muscle).
S.p.p. Serratus posticus posterior, the fine muscular digitations cut across, the dotted line indicating the aponeurotic continuation to the spine.
S.sp. Supraspinatus.
I.sp. Infraspinatus.
T.mi. Teres minor.
T.ma. ,, major.
B.a. Brachialis anticus.
D[2]. Deltoid (second portion).
D[3]. ,, (third portion).
T[1]. Triceps (first head).
T[2]. ,, (second head).
D.ep. Dorso-epitrochlear.
S.p.a, *S.p.a**. Serratus posticus anterior, partly seen below and above the rhomboideus.

Fig. 7. A partial dissection of the right side of the back at the scapular region in one specimen of *Galago crassicaudatus* (a female), showing a rudimentary depressor scapulæ and its relations to the other muscles.

Tz. Trapezius; the attachment to the vertebral border of the scapula, *Tz**, has been cut through and reflected. *Rh.* Rhomboideus. *D.sc.* The rudimentary depressor scapulæ muscle lying between. *La.d.* Latissimus dorsi, and *T.ma.* Teres major. It runs across a portion of the Serratus magnus (*S.m*). *I.sp.* Infraspinatus muscle. *D*[2], *D*[3]. Second and third bellies of the deltoid. *B*[1]. Biceps. *T*[1]. Triceps.

Fig. 8. Similar view to fig. 7, but on the left side of the Aye-Aye (*Cheiromys madagascariensis*). The muscles are designated by the same lettering. No trace of a depressor scapulæ is present. The fibres of the latissimus dorsi commingle with those of the rhomboideus.

PLATE IV.

Deeper layers of the dorsal muscles, and dissected views of the anterior limb in *Galago crassicaudatus*, also the thoracic segment of *Lemur catta* to demonstrate its multiple pectoral and supracostal muscles.

Fig. 9. Right lateral half of the neck and chest in the Grand Galago, displaying the third or middle muscular layer. The Splenius and Rhomboideus muscles, seen from behind in Pl. III. fig. 6, have here been removed, and the continuation of the long dorsal muscles into the neck thus brought out.

Co. Complexus.
Bi.c. Biventer cervicis.
Di. Digastric (mastoidal attachment).
L.cl. Levator claviculæ.
T.ms. Trachelo-mastoid.
C.as. Cervicalis ascendens.
Tr.c. Transversalis cervicis.
S.l. Sacro-lumbalis.
Lo.d. Longissimus dorsi.
L.a.s.=S.mg. Levator anguli scapulæ, or cervical continuation of the Serratus magnus.
S.p.a. Serratus posticus anterior cut through; the dotted lines carry it on to the spine.
S.p.p. Serratus posticus posterior.
Ex.o. External oblique (its costal digitations).
In. Marks some of the intercostal muscles.

Sca[1]. Dotted line expressing continuation of first or long scalenus muscles, which, attached to the fourth rib, passed through the serratus magnus previously to its ascent into the neck.

Fig. 10. The vertebral column, seen behind, from the skull to the ilia, in the same animal, showing the fourth muscular layer on the right side and part of the next or deepest layer on the left side. Just sufficient of the ribs have been left to guide the eye to the dorsal division of the vertebræ.

Co. Complexus.
Bi.c. Biventer cervicis.
T.ms. Trachelo-mastoid, thrown outwards to show the spinal attachment of the two former muscles.
S.l. Sacro-lumbalis.
Lo.d. Longissimus dorsi.
$\frac{1}{2}$*Sp.d.* $\frac{1}{2}$ spinalis dorsi.
$\frac{1}{2}$*Sp.c.* ,, cervicis.
Ml.s. Multifidus spinæ. The pointers include some of the lumbar portions of this complex muscle. The exposed dorsal parts are not lettered.

Fig. 11. Back view of the head and neck wherein the fifth or deepest layer of muscles alone remains; the five anterior dorsal vertebræ are present. On the right side the biventer cervicis has its occipital attachment cut away, and the cervical portion hooked back. On the same side the ½ spinalis colli is in position; but on the left side it is dragged outwards to show its spinal tendons.

Bi. Biventer cervicis. ½ *Sp.c.* Spinalis colli. *Ml.s.* Multifidus spinæ, anterior dorsal divisions.

R.p.ma. Rectus capitis posticus major.
R.p.mi. „ „ „ minor.
R.l. Rectus lateralis.
Te. Occipital portion of temporal muscle.
O.s. Obliquus superior.
O.i. „ inferior.

* Extra fibres of rectus capitis posticus major.
Di. Digastric cut through to the median tendon and turned back. The occipital insertion of the posterior belly is well seen.

M. Angle of Mandible.

Fig. 12. Semidiagrammatic view of the pectoral muscles in *Lemur catta.*

P.ma[1]. First portion of the pectoralis major. *P.ma*[2]. Its second portion. *P.ma*[3]. The third or long division of the same muscle. *D.* Deltoid. *R.ab.* The part of the Rectus abdominis which passes to the first rib. *S.mg.* Several digitations of the Serratus magnus. *Sp.co*[1]. First supracostal muscle, crossing the rectus. *Sp.co*[2]. The second supracostal slip. *Sca.* Scalenus.

Cl. Clavicle.

Fig. 13. The anterior limb separated from the trunk, and the extensor muscles exposed in such a way as to show the origin and insertion of each.

S.mg. Serratus magnus, cut short close to its scapular attachment.
O.h. Tendon of insertion of omo-hyoid.
S.sp. Supraspinatus.
I.sp. Infraspinatus.
T.ma. Teres major.
T.mi. Teres minor.
S. Portion of subscapularis seen beneath the teres minor.
L.c. Levator claviculæ (its acromial insertion).
P.mi. Pectoralis minor (cut short).
P.ma. „ major (cut short).

D[2]. Deltoid, second portion (cut short).
D[3]. „ third portion (cut short).
La.d. Latissimus dorsi.
D.ep. Dorso-epitrochlear.
T[1]., *T*[2]., *T*[3]., *T*[4]. Triceps. Its four separate fleshy bellies indicated respectively by the numerals.
Anc. Anconeus.
B.a. Brachialis anticus.
B[1]. Biceps (long glenoidal belly).
S.l. Supinator longus.
S.r.b. Supinator radii brevis.

E.c.r.l. Extensor carpii radialis longior.
E.c.r.b. „ „ „ brevior.
E.o.m.p. „ ossis metacarpi pollicis.
E.s.i.p and *E.s.i.p**. Extensor secundi internodi pollicis. Its belly and tendon.
E.c.u. Extensor carpi ulnaris.
E.i^{1,2} and *E.i*^{1,2*}. Extensor indicis. The two bellies and respective tendons.

E.c.d. Extensor communis digitorum (divided).
E.m.d. Extensor minimi digiti (double tendon).
F.b.p. Flexor brevis pollicis.
Ad.p. Adductor pollicis.
I.I.I. Interosseous muscles (dorsal aspect).

Fig. 14. The same anterior limb seen on its inner side, displaying chiefly the flexors. The lettering as low as the elbow-joint is nearly identical with that in fig. 13.

B^1. *B*^{2}. The first and second portions of the biceps; the latter joining the coraco-brachialis longus.

C.b^1. Coraco-brachialis (its long portion).
C.b^2. „ „ (its short portion).
B.a. Brachialis anticus.

Pa.l. Palmaris longus (origin and partial insertion), the belly removed.

F.c.u. Flexor carpi ulnaris (divided).
F.s.d. Flexor sublimis digitorum (divided).
** Tendinous union of superficial and deep flexor.
F.p.d^1. *F.p.d*^{2}. *F.p.d*^{3}. Flexor profundus digitorum; its three separate heads of origin.
P.q. Pronator quadratus.
S.l. Supinator longus, partly seen.
P.r.t. Pronator radii teres.
F.c.r. Flexor carpi radialis; portion of belly removed.
E.o.m.p. Insertion of extensor ossis metacarpi pollicis.

F.l.p. Flexor longus pollicis; tendon of insertion.
F.l.p^1. Flexor longus pollicis; first head.
F.l.p^2. Flexor longus pollicis; second head, divided into two.
Ab.p. Abductor pollicis.
Ad.p. Adductor pollicis.
Ab.m.d. Abductor minimi digiti.
F.b.m.d. Flexor brevis minimi digiti.
L^1. *L*^{2}. *L*^{3}. *L*^{4}. First, second, third, and fourth lumbrical muscles.

Fig. 15. Enlarged section of palm, a small part of the proximal phalanges and of the distal end of the radius and ulna being left. The superficial and deep interossei, and the small muscles of the pollex and of the fifth digit, are exhibited.

Ab.p. Abductor pollicis. *Ad.p.* Adductor pollicis; the pointer leads to the long and the short slips. *Ab.m.d.* Abductor minimi digiti. *F.b.m.d.* Flexor brevis minimi digiti. *I,I,I,I.* The first, second, third, and fourth double interossei. *Is, Is.* The two superficial interosseal slips. The numerals 1, 2, 3, 4, and 5 are appended to the several digits.

PLATE V.

Dissections of *Galago crassicaudatus*, being deep views of the head, neck, and lower (posterior) limb: all nearly natural size.

Fig. 16. Segment of the skull, the neck, and the thorax of the Thick-tailed Galago. prepared to show the deep ventral muscles of the neck and the supracostal slip. The sternal cartilages have been cut through on the left side, and the costal parts pushed outwards.

R.a.ma. Rectus capitis anticus major, in position on the right side, partially severed and pulled out on the left.
R.a.mi. Rectus capitis anticus minor.
R.l. Rectus lateralis.
L.c[1]. Longus colli, first portion (dragged outwards).
L.c[2]. Longus colli, second division (dragged outwards).
L.c[3]. Longus colli, third or deep part.
S.mg. Serratus magnus.
Sca[1]. Scalenus (the long thoracic division piercing the serratus).
Sca[2]. Scalenus (short portion).
S.c. Supracostal.
R.ab. Rectus abdominis.

Ms. Mastoidal inflation of periotic. *Ste.* Sternum.

Fig. 17. Portion of the inferior palatine surface of skull, with part of the mandible. The latter loosened at its articulation and twisted inwards, to show the pterygoid muscles.

E.pt. External pterygoid, cut through, part of the insertion being seen on the upturned coronoid portion of the mandible. *I.pt.* Internal pterygoid, crossed by the inferior dental nerve and artery.

M. The right mandible. *Ms.* Mastoidal eminence. *I.d.n.* Inferior dental nerve and artery passing into inferior dental foramen.

Fig. 18. A somewhat similar view of the under surface of portion of the skull, also on the left side, but the position reversed. The tongue, not entire, has been pushed to one side, allowing a moiety of the palate to be seen. Posteriorly some of the stylo-pharyngeal and deep muscles of the neck are traced. The mandible is inclined outwards, to display the pterygoids.

I.pt. Internal pterygoid.
E.pt. External pterygoid.
R.a.ma. Rectus anticus and part of longus colli.
R.l. Rectus lateralis.
S.c.ph. Portion of the superior constrictor of the pharynx.
Sy.g. Stylo-glossus.
Sy.h. Stylo-hyoid.
Sy.ph. Stylo-pharyngeus.

M. Mandible. *To.* Tongue. *Ms.* Mastoidal bulla.

Fig. 19. Deep sets of muscles of the under surface of the lumbar, pelvic, and caudal regions. The symphysis pubis has been divided and the ischio-pubic portion of the right side dragged outwards, to expose the origin of the sacro-coccygeus, &c. The quadriceps extensor, adductors, and inner hamstring-muscles remain on the left limb.

Dph. Diaphragm, cut through, leaving its lumbar attachment.

*Ql,Ql**. Quadratus lumborum. In position on left side, and pulled out on right side, to show its tendons of origin and insertion.

Ps.m. Psoas magnus. *In situ* on left side, and part of origin severed on right side.

Ps.p. Psoas parvus. Entire on left side and tendon of insertion shown on right.

Il. Iliacus. Partly hidden on left side and on right severed and dragged out so as to expose its double origin pierced by the lumbar plexus.

Py. Pyriformis. Partly shown as it passes from the sacrum to the femur.

Gr. Gracilis. Origin cut and thrown back on right side; and *Gr** the insertion, common with the sartorius and semitendinosus, on the left limb.

Ob.i. Obturator internus; its flat musculo-tendinous surface of origin.

P & Ic. Pubo- and ilio-coccygeus, with fleshy belly severed on right side.

Sc. Sacro-coccygeus. *In situ* on left side, and tendons dragged out on right.

Ic. Infracoccygeus.
It.cd. Intertransversarii caudæ.
Pe. Pectineus.
Ad.l. Adductor longus.
Ad.m. ,, magnus.
Ad.b. ,, brevis.
R.f. Rectus femoris.
Cr. Crureus.
*Vi,Vi**. Vastus internus; origin and insertion.
V.e. Vastus externus; insertion.
S.mb. Semimembranosus.
St. Semitendinosus.
Sa. Sartorius; common insertion with the above.

L.px. Lumbar plexus of nerves.

Fig. 20. Adductors, &c. of femur on left side, seen in front. The brim of pelvis, ilium, and part of sacral vertebræ form the upper segment of the figure.

Ad.m. Adductor magnus.
Ad.l. ,, longus.
Pe. Pectineus.
Sa. Sartorius (its origin).
Ps.p. Psoas parvus (tendon of insertion).
Ps.m. ,, magnus ,, ,,
Il. Iliacus ,, ,,
Gr. Gracilis; origin thrown out.
R.f. Double-headed origin of rectus femoris.
G.md. Gluteus medius (insertion).
G.mx[1*]. ,, maximus (insertion of its so-called first portion).
V.i. Vastus internus (origin).
Cr. Crureus.

Fig. 21. Posterior view of buttocks and ischio-femoral region of left side. This figure is from the same specimen as fig. 20, only seen behind, with the sacrum and left moiety of pelvis bent forwards at a right angle, and consequently hidden from view.

Ad.m. Adductor magnus.
Ad.b. „ brevis.
Ob.e. Obturator externus.
G.mx[2]. Gluteus maximus; insertion of second portion.
Q.f. Quadratus femoris; muscular portion and insertion, thrown outwards.
*Q.f**. Quadratus femoris; tendon of origin.
Ob.i. Obturator internus; cut tendon of insertion.
G.md. Gluteus medius (insertion).
Py. Pyriformis (insertion).
G.i. Gemellus inferior.
S.t. Semitendinosus (origin).
S.mb. Semimembranosus (origin).
Gr. Gracilis (origin).

Tro. Peroneal trochanter.

Fig. 22. Segments (femur, tibia, and fibula) of left lower limb, a front outer view showing the rotator fibulæ muscle and its relation to the origins of the leg-extensors.

R.fb. Rotator fibulæ.
E.l.d. Extensor longus digitorum.
T.a. Tibialis anticus.
E.p.h. Extensor proprius hallucis.
I.h. Conjoined insertion of the inner hamstring-muscles, thrown forwards.
Q.ex. Quadriceps extensor (the letter *P.* indicates the patella).
Ga. Gastrocnemius (origin).
B.f. Biceps femoris (insertion).
So. Soleus (origin).
Pl. Plantaris (origin).
P.b. Peroneus brevis.

Fig. 23. Same parts, seen from behind, some of the muscular origins being cut away. The posterior and crucial ligaments of knee-joint remain.

Po. Popliteus muscle severed, and the origin and insertion respectively thrown outwards and inwards.
R.fb. Rotator fibulæ; its fibres differing in direction from those of the popliteus, which lies completely above.
F.l.d. Flexor longus digitorum.
F.l.h. Flexor longus hallucis.
T.p. Tibialis posticus.

Fig. 24. Flexors of the lower leg and sole of foot. The superficial muscles of the calf have been removed, and those underneath pulled out on each side. The plantar tendons have in a similar manner been thrust out of position, to enable the eye to follow the course of each.

Po. Popliteus.
F.l.h. Flexor longus hallucis (fleshy belly).
*F.l.h**. ,, ,, ,, (plantar tendon).
F.l.d. Flexor longus digitorum (fleshy belly).
*Tp, Tp**. Tibialis posticus.
P.fs. Plantar fascia.
F.b.d. Flexor brevis digitorum.
*Ab.o.m.*5. Abductor ossis metacarpi quinti.
Ab.m.d. Abductor minimi digiti.
L^1, L^2, L^3, L^4. Lumbricales.
Ad.h. Adductor hallucis.
Ab.h. Abductor hallucis.
F.b.h. Flexor brevis hallucis.

L.p.l. Long plantar ligament.

PLATE VI.

Fig. 25. Hind extremity and tail of the Grand Galago, showing in an outside view the deep muscles and tendons pulled asunder. The caudal tendons are enlarged, but the other parts about their natural proportions.

G.mx[1]. Gluteus maximus, first portion, origin reflected.
G.mx[1*]. Its insertion, cut short.
G.mx[2]. Gluteus maximus, second portion, origin reflected.
G.mx[2*]. Its insertion, cut close to the femur.
G.md. Gluteus medius.
G.mi. Gluteus minimus.
Py. Pyriformis.
G.s. Gemellus superior.
G.i. ,, inferior.
Ob.i. Obturator internus.
B.f. Biceps femoris.
S.t. Semitendinosus.
Smb. Semimebranosus.
V.e. Vastus externus (origin).
R.f. Rectus femoris.
Cr. Crureus.
L.c.i. Levator caudæ internus.
L.c.e. Levator caudæ externus.
Is.c. Ischio-coccygeus.
P. & *I.c.* Pubo- and ilio-coccygeus.
S.c. Sacro-coccygeus.
I.t.cd. Intertransversariæ caudæ.
Ga. Gastrocnemius.
So. Soleus.
Pla. Plantaris.
F.l.h. Flexor longus hallucis.
*P.l, P.l**. Peroneus longus; posterior origin and plantar tendon.
*P.b, P.b**. Peroneus brevis; belly and tendon.
*P.5.d, P.5.d**. Peroneus quinti digiti; belly and tendon.
T.a. Tibialis anticus.
E.p.h. Extensor proprius hallucis.
E.l.d. Extensor longus digitorum.
E.b.d. Extensor brevis digitorum.

Tro. Great trochanter. *L.d.l.* Long dorsal ligament of tarsus.

Fig. 26. A few of the caudal vertebræ of the same animal, seen on their under surfaces, and with the short caudal muscles *in situ* on the one side and pulled out on the other.

It.cd. Intertransversarii caudæ muscles. *S.c.* Portions of some of the tendons of insertion of the sacro-coccygeus.

Fig. 27. Anterior view of lower left hind leg and foot of the Black-fronted Lemur (*L. nigrifrons*), showing the double tibialis anticus muscle, &c., and short tarsal bones.

T.a[1]. Tibialis anticus primus.
T.a[2]. „ „ secundus.
E.p.h. Extensor proprius hallucis.
E.l.d. „ longus digitorum.
E.b.d. „ brevis digitorum.
1,2,3,4,5. Digits (distal ends, metatarsals).
P.l. Peroneus longus.
P.b. Peroneus brevis.
P.4.d, *P.4.d**. Peroneus quarti digiti.
P.5.d. Peroneus quinti digiti (muscular belly).
*P.5.d**. Peroneus quinti digiti (tendon of same.

Fig. 28. Slightly enlarged semidiagrammatic representation of the head of the tibia and fibula of the Ring-tailed Lemur (*L. catta*), showing the rotator fibulæ and its muscular relations, seen behind and slightly outwards; from a sketch by Mr. Mivart.

R.fb. Rotator fibulæ. *Po.* Popliteus, transversely cut through. *F.l.d.* Flexor longus digitorum, passing from before backwards. *T.p.* Tibialis posticus. *F.l.h.* Flexor longus hallucis.

Fig. 29. Anterior and outer view of the same. *Ta.* Tibialis anticus. The other letters are as in Fig. 28. Here the origin of the flexor longus digitorum is seen to be in front of the rotator fibulæ.

Fig. 30. Enlarged plantar surface of left foot of *Galago crassicaudatus*—the elongated tarsus being thus well displayed, and the short muscles and interossei better defined.

Ab.m.d. Abductor minimi digiti (dragged out),
Ab.o.m.5. Adductor ossis metacarpi quinti (dragged out).
F.b.m.d. Flexor brevis minimi digiti.
1,2,3,4,5. Digits, four of them being shown only as far as the proximal phalanx.
Ab.h. Abductor hallucis.
F.b.h. Flexor brevis hallucis.
Ad.h. Adductor hallucis.
I,I,I,I. Four pairs of double interosei.
Is[1],*Is*[2]. First and second superficial single interosseous muscles.

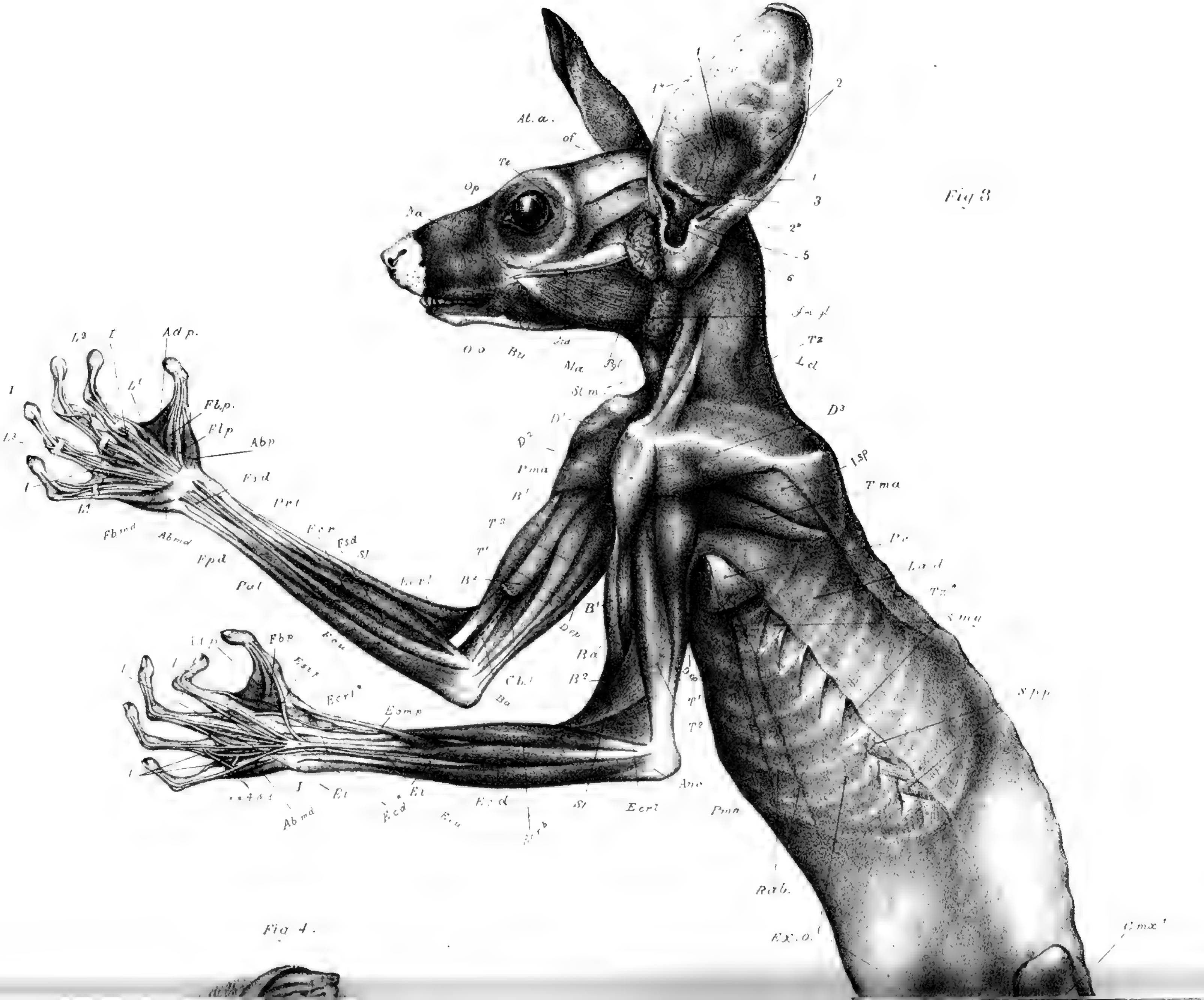
L.p.l. Long plantar ligament.

Fig. 31. Short deep muscles of the ventral surface of the neck in the Aye-Aye (*Cheiromys madagascariensis*), reduced in size.

R.a.ma. Rectus capitis anticus major. *R.a.mi.* Rectus capitis anticus minor. *R.l.* Rectus lateralis. *L.c*[1]. Longus colli; first portion. *L.c*[2]. Second portion of same muscle, dragged out by a hook. *L.c*[3]. Third portion of the longus colli.

Dr Murie, Photo. J. Wolf del.   C. Berjeau lith.   M & N. Hanhart imp.

I. GALAGO CRASSICAUDATUS ♀ ⅗ Nat. size. 2. G. GARNETTII.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C Berjeau & Dr Murie. del   C Berjeau lith   M & N Hanhart imp'

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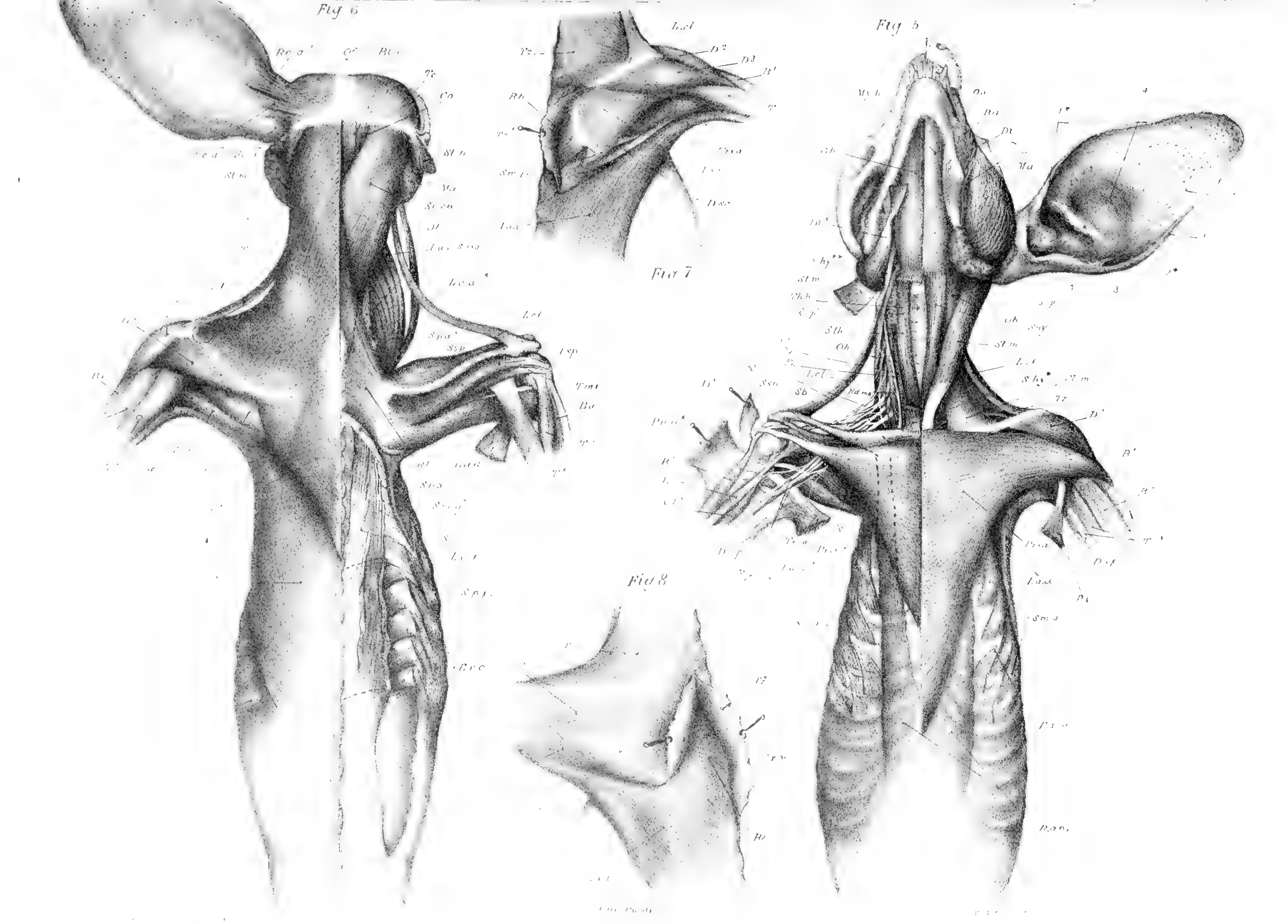

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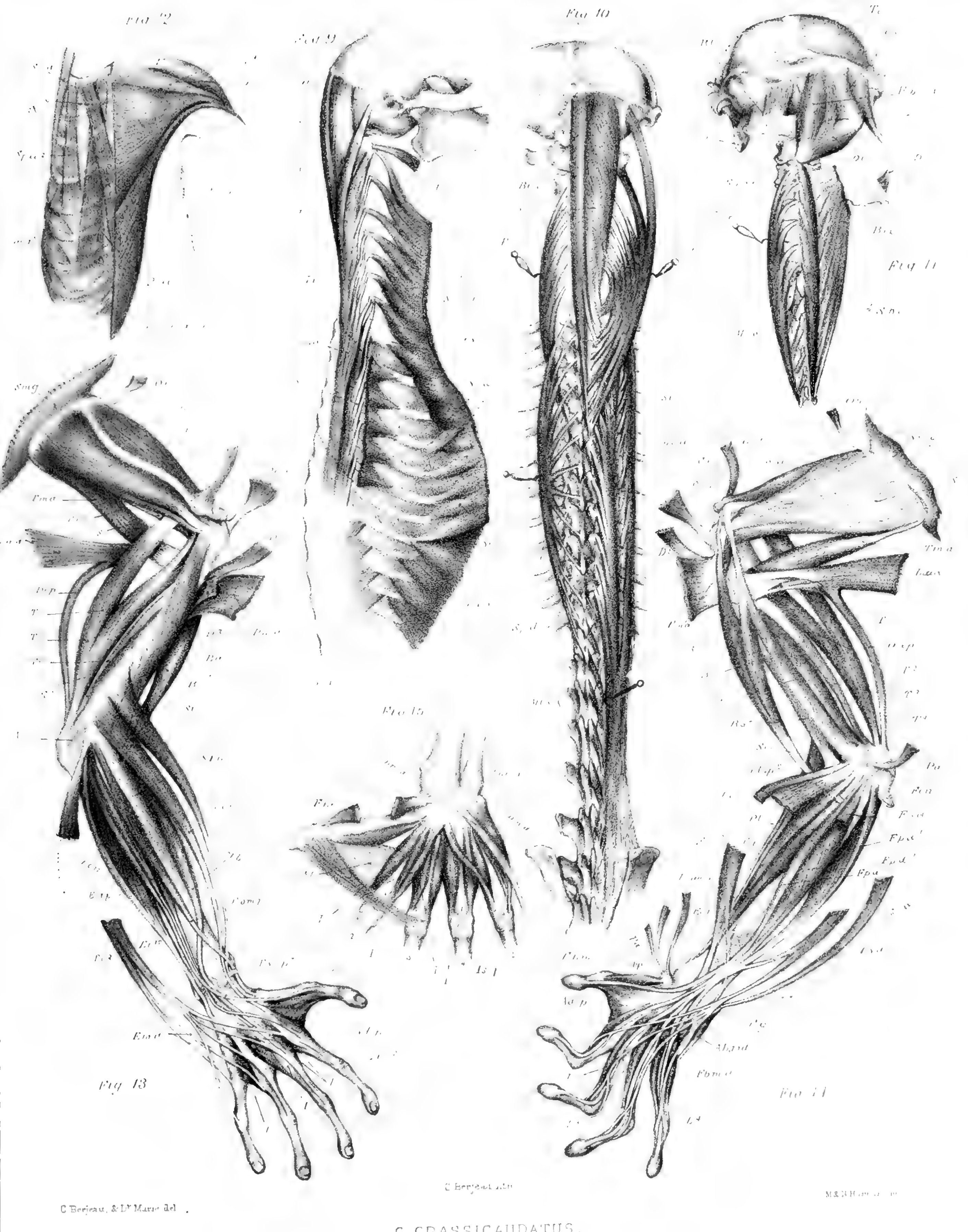

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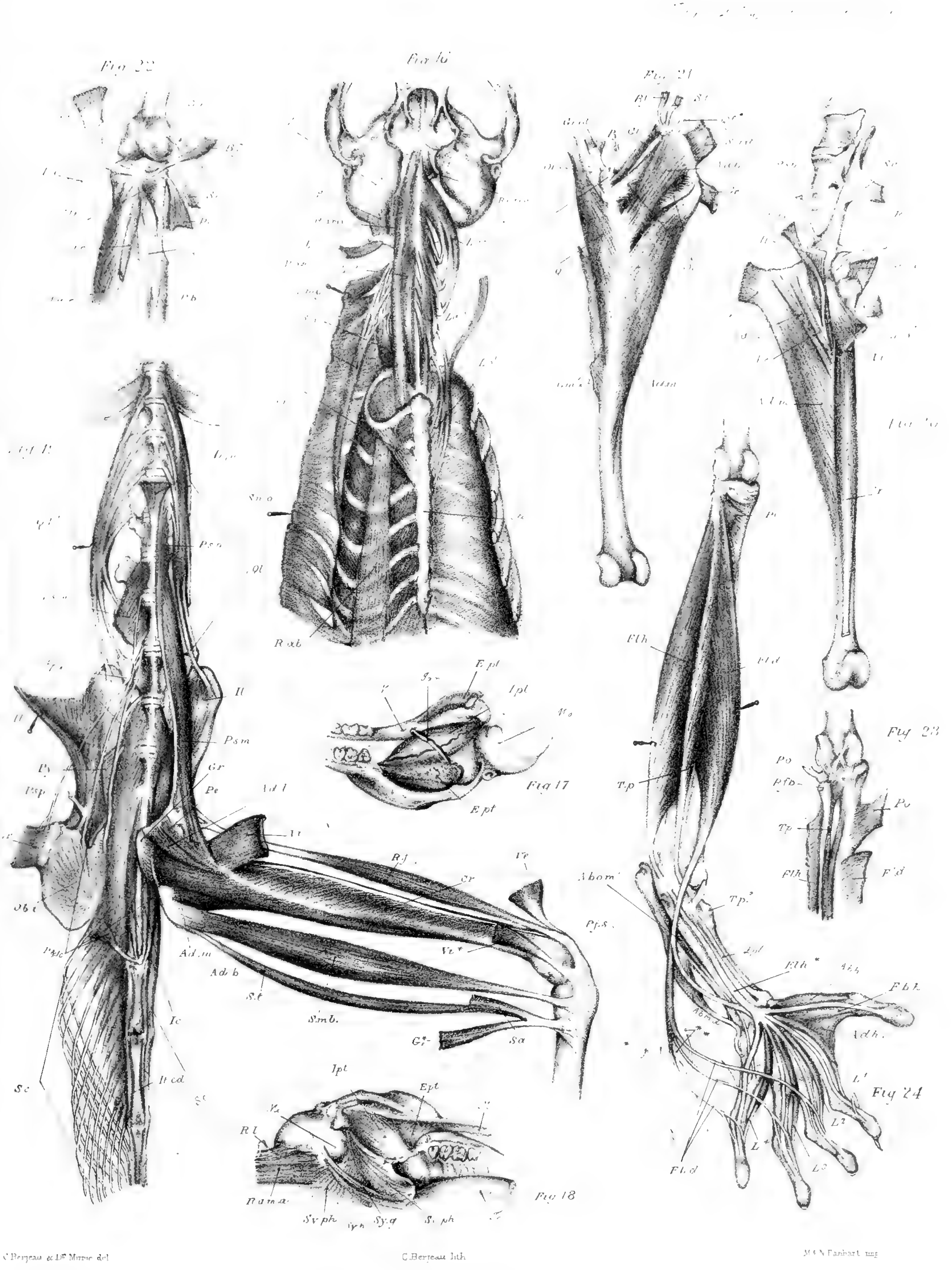

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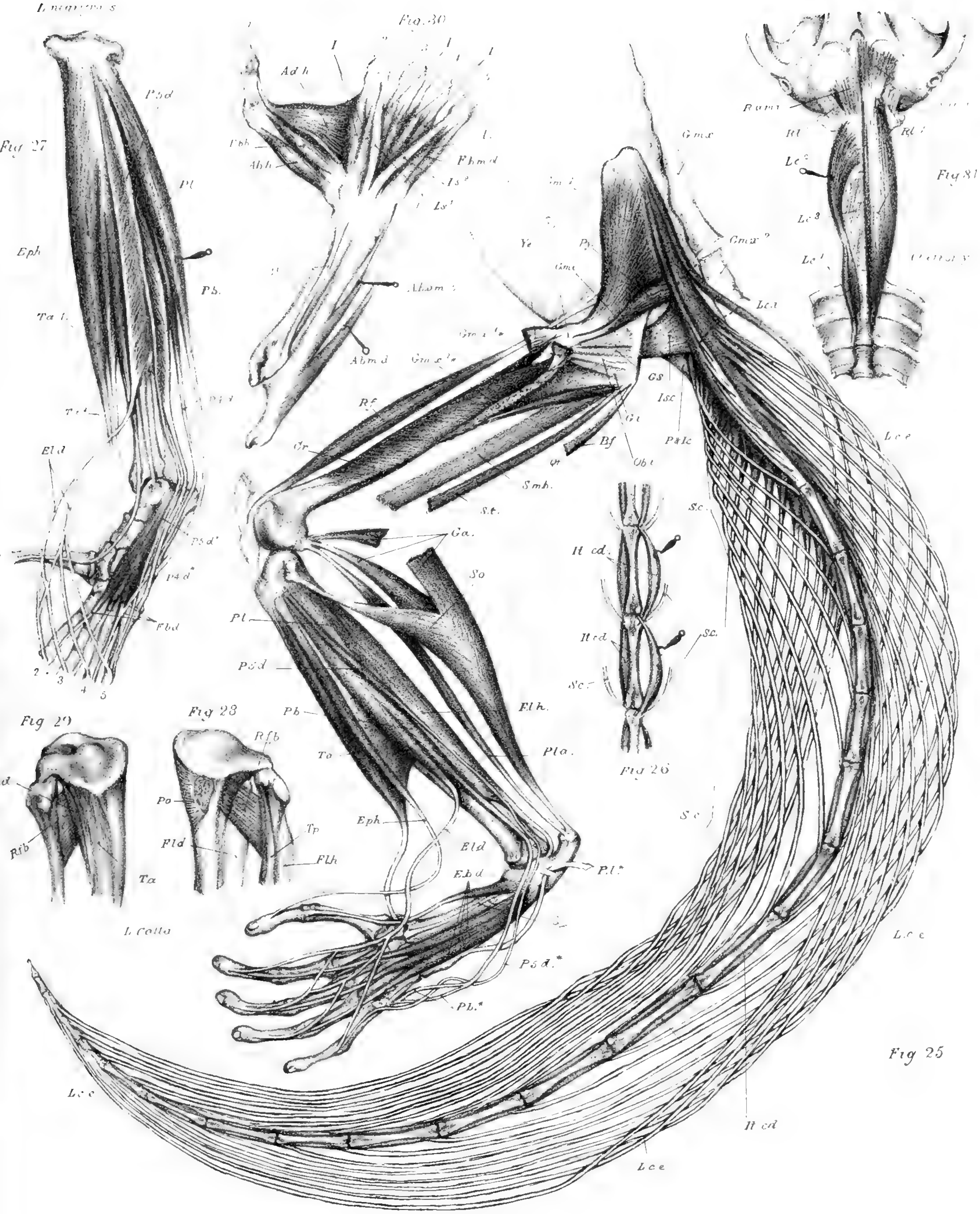

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C Berjeau lith

M & N Hanhart imp

G. CRASSICAUDATUS

II. *On* Dinornis (Part XIII.): *containing a Description of the Sternum in* Dinornis elephantopus and D. rheïdes, *with Notes on that Bone in* D. crassus *and* D. casuarinus. *By* Professor Owen, *F.R.S., F.Z.S., &c.*

Read June 25th, 1868.

[Plates VII. to IX.]

In November 1867 I was favoured by a note from Henry Sumpter, Esq., requesting me to inspect a collection of bones which he had received from a correspondent at Christchurch, Canterbury Settlement, in the South (or Middle) Island of New Zealand, and which were to be seen at Mr. Sumpter's place of business at No. 1 Church Court, St. Clement's Lane, Lombard Street, whither I forthwith proceeded.

It appeared that the bones had been obtained from the extensive swamp or bog at Glenmark, about forty miles from Christchurch; they consisted of a considerable proportion of the skeleton of the *Dinornis elephantopus*, of a less complete series of the bones of *D. rheïdes*, including bones of the foot, corresponding with those figured in pl. 3, Vol. IV.[1] There were also a few bones of *D. crassus*. In this collection I saw, for the first time, specimens of sterna, entire, of the large wingless birds of New Zealand.

Sternum of Dinornis elephantopus, *Ow.* (Plate VII.)

The collection of bones of *Dinornis elephantopus* includes a sternum (Pl. VII.), wanting only the margin of the anterior border with the costal processes: the costal tracts (d, *c*, c, fig. 2, *m*, *n*, *o*) are nearly entire; and a great part of the lateral processes (fig. 1, *h h*) are preserved, showing that these diverged from the sternal body at a more open angle than was given in the restoration of the bone from the fragments accompanying the skeleton figured in pl. 47, Vol. IV. of these 'Transactions,' such restoration being guided by the analogy of the more perfect sternums referable to the genus *Dinornis* (pl. 43, Vol. III.) or *Palapteryx* (pl. 4, Vol. IV.).

In the transverse extent and straightness of the anterior border (fig. 1, *b b*), the small and feebly marked coracoid depressions limited to the outer angles of that border (*d d*), and in the pair of wide and deep posterior vacuities (*f f*), this sternum exhibits the general Dinornithic modifications of the type of the bone presented by the *Apteryx*, and noted at p. 163, Vol. IV.

The body of the sternum in *Dinornis elephantopus* is unusually flattened; the upper or

[1] Described in Memoir, Part iv. (Feb. 1850), in Vol. IV. of these Transactions, pp. 8–20.

inner[1] concavity (fig. 1) is limited to the fore part of the disk, and is due chiefly to the upward or backward bending of the anterior border, slightly deepened by the ill-defined pneumatic fossæ (ib. *pn pn*) near the costal border (*c c*). As the sternum recedes backward the inner concavity changes to a convexity, both lengthwise and transversely, the broad mesial process (ib. *g*) rising into a low obtuse ridge (ib. *r*) along the mid-line of the inner surface.

The outer surface of the bone offers a corresponding convexity at the fore part, and concavity both lengthwise and across in the rest of its extent; and this concavity is continued along part of the origins of the lateral processes. The thickness, or rather thinness, of this flattened sternum varies from $\frac{1}{4}$ to $\frac{1}{8}$ and $\frac{1}{16}$ of an inch.

The costal border is traversed by two oblique parallel articular ridges (fig. 2, *m n*), with shallow intervening and contiguous depressions (ib. *o o o*). The lateral process (*h*) retains, anteriorly or externally, the thickness of the lower part of the costal tract, diminishing in thickness towards the posterior border, which there has a breadth of 6 lines; the inner or posterior surface of the process is impressed by a shallow groove lengthwise, and, after an extent of about 3 inches from the sternal body, the process appears to be twisted upon itself from before backwards, the inner border of the outer surface becoming the inner ridge-like border of the process itself, which is then compressed from without inwards, instead of from before backwards as at its basal half. This twist is more notable in the right process (*h*) than in the left one (*h'*), a greater proportion of which is preserved. Dimensions of different parts of this sternum are given in the Table of Admeasurements, p. 122.

Sternum of Dinornis rheïdes. (Plates VIII. & IX.)

The sternum of *Dinornis rheïdes* is of the long and slender type, with the minor degree of divergence of the lateral processes. The body of the sternum is cleft for more than half its extent by a pair of posterior notches (*f f*) of a narrow angular form with the apex rounded off, leaving a long and narrow mesial process (*g*), which, in the specimen described, is notched at its rounded extremity, and has a small unossified vacuity about an inch anterior thereto. The entire part of the sternal body is moderately convex in every direction externally (Pl. VIII.), and correspondingly concave within (Pl. IX.). On the inner surface it is impressed by two special deeper hollows (Pl. IX. *n n*) just behind the anterior border and near the base of the costal processes (*d d*): these pneumatic depressions are perforated by several small foramina conveying air from the air-cells which occupied them into the cancellous texture of the thicker parts of the sternum. Neither the Ostrich nor Cassowary shows such pneumatic

[1] In the following descriptions I term the surface of the sternum which, in its natural position, is upward, or toward the cavity of the body, internal or "inner" surface; the opposite one, which looks downward and is toward the pectoral muscles, I call the external or "outer" surface.

depressions and foramina, their sternum receiving air exclusively from the intercostal fossæ, whilst these in *Dinornis* are imperforate (Pl. VIII. fig. 2, *o o o*).

The anterior border of the sternum of *D. rheïdes* (Pl. IX. fig. 4) is straight, no part projecting forward as "manubrium" or receding; it is slightly and equably curved transversely toward the chest (as shown at *a*, fig. 4); it is strongly bent from without inward, or from below upward, where it terminates by a narrow subobtuse margin, overhanging, in the vertical position of the bone, the pneumatic depressions and the general concavity of the inner surface. This margin is continued on into each costal process (figs. 3 & 4, *d d*), which extends upward and outward in the same slight transverse curve for rather more than an inch beyond the costal border, with an antero-posterior thickness, at the middle, of 9 lines, and with an obtuse and apparently slightly expanded termination, which, however, is not quite entire in the specimen.

The coracoid depressions (fig. 4, *b b*) are feebly defined by a transverse concavity occupying the fore part of the costal process, not extending mesially much beyond the line of the outer or lower border of the costal tract (fig. 4, *c c*). This tract (Pl. VIII. fig. 2) shows ridges for the articulation of two sternal ribs, the anterior one (*m*) being bituberculate, as in the Ostrich; the posterior and shorter ridge (*n*) is simple: three intercostal fossæ (*o o o*) are defined by these ridges; the anterior and largest has a somewhat irregular surface, the two following are smoothly concave.

The sternum, which is 1 inch across the first fossa, contracts to a thickness of 4 lines at the end of the third fossa. The length of the costal tract is $2\frac{1}{2}$ inches. The outer border of the lateral process (*h*) continues obtuse but decreasing in thickness to about one-third from the lower end, where it becomes a ridge: the inner border is a sharper ridge through the whole extent. The length of each lateral process is 6 inches, the average breadth 6 lines, being very little more at its commencement.

The length of the sternum in a straight line along the middle is 9 inches: the lateral processes (*h h*) extend about an inch beyond the middle one (*g*); this, halfway from its commencement, measures 2 inches across.

The breadth of the sternum at the ends of the lateral notches (*f f*), or origins of the lateral processes, is 5 inches 6 lines; the breadth of its fore part, including the costal processes (*d d*), in a straight line is 7 inches.

The middle of the entire part of the sternum is reduced to the thinness of cartridge-paper; it gains a little in thickness at the median process; but this thins off again to the end.

The outer surface is marked by fine lines, indicative of aponeurotic insertions; the inner surface is for the most part smooth and polished.

Longitudinally both median and lateral processes have a slight outward or downward flexure, giving a gentle sigmoid contour to the bone in that direction, as in fig. 2, Pl. VIII.

The second sternum of *Dinornis rheïdes* in the collection examined at Mr. Sumpter's shows the same general specific characters as the one above described, with individual differences due to degrees of ossification of the posterior half of the sternum.

The lateral notch, measured along the border formed by the lateral process, is 5 inches 3 lines; the length of the mesial process along the median line is 3 inches 3 lines, the breadth of that process across its middle part 2 inches 3 lines; it is thus shorter and broader than in the first described specimen (Pls. VIII. & IX.). The lateral processes, about 5½ inches in length, are rather broader than in figs. 1 & 3, but diverge at a corresponding angle. The more essential characters afforded by the costal tracts and processes, the coracoid depressions, and pneumatic fossæ, with the general outward convexity and inward concavity of the entire part of the sternal body, exemplify the specific identity of these bones.

Thus the specimens of sternum in Mr. Sumpter's collection show two well-marked modifications of the Dinornithic or Apterygian type of sternum, which type may be characterized as "subquadrate, keelless, more or less flattened, with a pair of deep and wide posterior notches, and with small and remote coracoid pits." The characteristic which differentiates *Apteryx* is the anterior emargination: in *Dinornis* the different degrees of divergence of the lateral processes, involving corresponding differences in the breadth of the sternum, appear to be the best-marked modifications, though not the only ones; but before referring to these I may note the concurrence of the broad modification with the peculiar robustness of the legs and breadth of pelvis in *Dinornis elephantopus*. The chief minor modification, after the difference of divergence and breadth, is that shown by the costal tract in a fragmentary sternum obtained by Mr. Percy Earl from the turbary at Waikawaite, and referred by me to "one of the larger, if not of the largest, species of *Dinornis*."[1] The costal tract occupies a relatively greater extent of the lateral border of the sternum between the coracoid and lateral processes, and shows in that extent three articular transverse ridges (pl. 43. fig. 3, *r′ r″ rrr‴*). The anterior border (ib. fig. 2) exceeds in extent that in *Dinornis elephantopus*, but is less thick; the lateral processes are more slender, with a narrower base and minor degree of divergence, so far as can be judged from the proportion of the process preserved and figured in pl. 43. fig. 1, *p*.

The more perfect sternum of the smaller species of *Dinornis* described and figured in Vol. IV. pp. 16–18, pl. 4. figs. 1–⁴, is of the same type as that of *Dinornis rheïdes*. Its somewhat smaller size, with the more acute termination of the posterior notches, and greater prominence of the mid part of the outer surface of the sternum anteriorly, as shown in fig. 4 of the plate above cited, induced me to regard it as having come from a different species, which is very probably the *Dinornis casuarinus*, leg-bones of which have also been obtained from deposits south of Otago, Middle Island, where the sternum (pl. 4. figs. 1–4, Vol. IV.) was found.

At the beginning of the work of determination of the remains of wingless birds from

[1] Trans. Zool. Soc. vol. iii. p. 316.

New Zealand I found two generic types of skull, and referred in 1848 one of these (Vol. III. pl. 52. figs. 1–6) to *Dinornis*, the other (ib. pl. 54) to *Palapteryx*. I subsequently discovered a type of leg and foot generically distinct from those which had been referred respectively to *Dinornis* and *Palapteryx*; and for that type I proposed the genus *Aptornis*, to which genus I was then led to refer the very remarkable skull figured in pl. 52, *tom. cit.*[1]

Successive evidences of cranial characters of different species of *Dinornis*, from the largest downwards, were far from showing the distinctions which, in the skull of *Aptornis*, had originally led to a generic division of the larger extinct wingless birds of New Zealand; and accordingly, retaining the name *Dinornis* for the *D. giganteus* and allied species to which, as originally known by vertebræ, pelvis, and limb-bones, that generic name had been applied, I was driven, after ascertaining their true cranial characters, to rest the distinction of *Palapteryx* on the presence of the small back toe, determined in the large robust species of the Middle Island (*Palapteryx robustus*[2]), and its seeming absence in the more slender *Dinornis giganteus* of the North Island. Subsequently I was led to doubt the generic value which had been assigned to that reduced, not to say abortive, digit, probably variable as to its existence; and I gave up the application of the character, from the consideration that the ligamentous attachment might fail to leave sufficient indication on the metatarsal bone in some cases. The range of variation in the cranial characters of species unequivocally of either *Dinornis* or *Palapteryx* did not appear to me to support a continuance of those generic sections; and of late years I have, therefore, practically dropped "*Palapteryx*," and described additional facts and evidences of these extinct birds under the old generic term *Dinornis*.

No doubt, apart from the Apterygian character of the back toe (*i*, fig. 1, pl. 1, Vol. IV.), if even it had been determined without question to be constantly present in certain species and absent in others, the singularly massive proportions of the limb-bones in such species as *D. elephantopus* and *D. crassus* might lead one, prone to generic sections, to found a genus for such strong-limbed birds. But *D. robustus* and *D. maximus*, with the series of Moas dwindling to a form smaller than any which I have yet described, but equally worthy of being named, illustrate the transitional steps in the derivation of such species, due to inherent tendencies operating independently of individual volitions, and under circumstances affording no obvious or intelligible selective influences. Guided, however, by the Linnean methods of making known these animated forms, and accepting genera as they stand in natural families of modern ornithological systems, the two well-marked modifications of sternum which I have now been enabled to describe might justify the restitution of the term *Palapteryx* to such thick-limbed kinds as *Pal. elephantopus*, *Pal. crassus*, and *Pal. robustus*.

[1] "On Dinornis (part v.): containing a description of the Skull of *D. giganteus* &c.," read Nov. 1850, Trans. Zool. Soc. vol. iv. pp. 59, 62.

[2] Trans. Zool. Soc. vol. iv. p. 2, pl. 1 (Memoir, part iv. read Feb. 1850).

EXPLANATION OF THE PLATES.

PLATE VII.

Fig. 1. Sternum, inner or back view, of *Palapteryx elephantopus*: nat. size.
Fig. 2. Costal border and lateral process of the same: nat. size.

PLATE VIII.

Fig. 1. Sternum, outer or front view, of *Dinornis rheïdes*: nat. size.
Fig. 2. Profile view, right side, of the same sternum.

PLATE IX.

Fig. 3. Sternum, inner or back view, nat. size, of *Dinornis rheïdes*.
Fig. 4. Anterior or upper border of *Dinornis rheïdes*: nat. size.

Supplementary remarks on the Sternum in Dinornis.

In a collection of bones transmitted by Dr. Haast to the Royal College of Surgeons, and which have been recently submitted, by his request, to my examination, there was a lot marked "no. 16, fragments of sternum of *Dinornis crassus*," and associated with a portion of the skeleton ascribed to the same species. This lot contained portions of sternums of three or more species of *Dinornis*, and probably included all the parts of that rare bone which had been obtained in this collection from the swamp at Glenmark.

One of the fragments (no. 1), including the left anterior angle wanting the costal process, affords the means of comparing the anterior and costal borders with the sternum of *Dinornis rheïdes*. The costal border shows a proportion of extent from without inward double that in *D. rheïdes*; it is of a more definite triangular form, with the base forming the inner or upper border of the tract, and the apex obtuse; it is traversed by two oblique continuous ridges for the attachment of the sternal ribs, the second of nearly equal extent with the first, which is not divided as in *D. rheïdes* and the Ostrich. The anterior border is bent upward or inward like that in *D. rheïdes*, but terminates in a much thicker margin than in *D. rheïdes*; the convex bend inclines towards the costal border, is not so abruptly continued into it as in *D. rheïdes*: there is no definite pneumatic depression; the pneumatic foramina extend over a greater proportion of the fore part of the upper or inner concavity. The whole bone, so far as preserved in this fragment, is thicker than the corresponding part of *D. rheïdes*, and may well, therefore, have formed part of the sternum of the more robust species of *Dinornis* to which it is ascribed by Dr. Haast.

A second corresponding fragment of a sternum (no. 2), in which the costal process is preserved, has a costal border resembling in shape that in *D. rheïdes*; but both articular surfaces are undivided, the lower one being more extensive and broader than in *D. rheïdes*, not projecting as a ridge. The depression between the surfaces is much less extensive and less deep than in *D. rheïdes*; the costal process is broader but thinner, directed more outwardly than in *D. rheïdes*, from which it shows the more important difference of a deeper and much better-defined coracoid depression, of which the anterior boundary is partially produced as a ridge, and the posterior or upper one is plainly defined. The articular surface, broadest externally, is concave from before backward, slightly convex transversely, but with a small special depression at the narrower median end; there is also a pneumatic hole near the front ridge. The costal process has an obtuse, convex termination. The pneumatic depression on the anterior inner surface of the sternal body is more definite than in *D. crassus*, but is wider and less deep than in *D. rheïdes*. This portion of sternum shows characters specifically distinct from those in the two species named.

A third fragment of sternum in the lot, no. 16, includes the costal process and border of the right side of that bone. The process is entire, of a different shape from that in either *D. rheïdes* or *D. crassus*, the anterior margin being obliquely truncate toward the narrower but obtuse apex. There is a well-marked distinction from no. 1 in the absence of any defined coracoid depression; and sufficient of the body of the bone is preserved to show the absence of a pneumatic depression, such as exists in *D. rheïdes*. The external convexity leading to the anterior border is less abruptly defined than in *D. rheïdes*. The two articular tracts on the costal border are narrow, oblique, and continuous as in *D. crassus*; but the shape of the tract is like that in no. 1 and in *D. rheïdes*.

A portion of the right side of a sternum, which appears to be part of the same bone as no. 1, shows a continuation of the lateral process in the same direction relative to the contour of the costal border as in *D. rheïdes*. A corresponding portion of another sternum, no. 6 in lot 16, shows a divergence of the lateral process from the line of the costal border like that in the sternum of *D. robustus*, *D. elephantopus*, and probably also *D. crassus*, to which nos. 2 & 5 may have belonged. Assuming that nos. 1 & 3 are parts of the same sternum, it is certainly of another species, which probably may be *D. casuarinus*; the portion no. 4 belongs to a different species, and the portion no. 6 to a different individual of, perhaps, *D. crassus*; but four distinct birds, at least, must have contributed the fragments of sternum ascribed to the skeleton of *D. crassus* in Dr. Haast's list.

A more important contribution to the reconstruction of the extinct wingless birds of New Zealand has been made by the eminent State Geologist of Canterbury Settlement, by a series of photographs of skeletons obtained from the Glenmark Marsh, and preserved articulated in the Museum at Christchurch. From the front view of that of the *Palapteryx robustus* I infer that the remark, that "the attempted restoration of the sternum of a large species referred to *Dinornis* (Vol. III. p. 316, pl. 43. figs. 1, 2, 3) may, however, belong to *Palapteryx robustus*" (Vol. IV. p. 16), is correct. The divergence of the lateral processes, though less than in *Palapteryx elephantopus* and *Pal. crassus*, is greater than in *Dinornis giganteus* and *D. rheïdes*. To this series of photographs I propose to return in a subsequent Memoir, after completing the comparison of the collection of Dinornithic remains transmitted by Dr. Haast.

Admeasurements of Sternum.

	Dinornis elephantopus.		*D. crassus?*		*D. rheïdes.*	
	in.	lines.	in.	lines.	in.	lines.
Length, along mid line, from the anterior border to the end of the median process	10	0 [1]	9	0	9	0
Extreme breadth, across the lateral processes in a straight line	16	0	13	0	8	0
Breadth of body from fore part of the costal tracts	8	0	7	0	5	6
Length of costal tract	2	3	1	7	2	4
Antero-posterior breadth of ditto	1	5	1	2	0	10
Antero-posterior extent from anterior border to apex of posterior notch	5	6 [2]	4	6	4	5
Breadth between apices of posterior notches	8	6	6	0	4	0
Length of median process	5	0 [3]	4	0	5	0
Breadth of mid part of ditto	4	6	3	6	2	0
Length of lateral process, following the curve of anterior border	7	0	6	0	7	6
Breadth of base of lateral process	2	9	2	0	0	10
Breadth of middle of ditto	1	2	1	0	0	6

[1] The end of the median process is not entire; one, or even two inches may be wanting.

[2] This is on the left side; the extent is less on the right side, where the notch is deeper and is terminated by a narrower curve.

[3] Subject to addition from the part wanting.

DIIJORN

.EPHANTOPUS

Printed by M & N Hanhart

Trans Zool Soc Vol 7 Pl 8.

Drawn on stone by J. Erxleben

M & N Hanhart imp.

DINORNIS RHEIDES

From nature on stone by J. Erxleben

M. & N. Hanhart imp.

III. *On* Dinornis (Part XIV.): *containing Contributions to the Craniology of the Genus, with a Description of the Fossil Cranium of* Dasornis londinensis, *Ow., from the London Clay of Sheppey. By* Professor Owen, *F.R.S., F.Z.S., &c.*

Read January 28th, 1869.

[Plates X. to XVI.]

In the Memoir on the skeleton of *Dinornis elephantopus*, the skull is briefly noticed[1]. Subsequent acquisitions of specimens of that part, in some respects more complete, enable me to better appreciate its specific characters and to bring them out by comparisons with those of the skull of *Dinornis robustus*, described in Memoir, Part IX.[2] I also avail myself of these grounds to determine and elucidate the cranial characters of some other species of *Dinornis*, as well as those of a seemingly dinornithoid gigantic bird which, like *Gastornis parisiensis*, existed in our own part of Europe at a remote tertiary period.

Skull of Dinornis elephantopus. (Plate X.)

The cranium of *Dinornis elephantopus* equals in length that of *D. robustus*[3], but is inferior in breadth and more convex both longitudinally and transversely, especially the latter, at the interorbital region (fig. 1, 11). The entire skull of *D. elephantopus* is shorter than that of *D. robustus*, by reason of the relatively shorter premaxillary and mandibular bones.

The occipital condyle (Pl. X. figs. 2, 4, 1) is a hemispheroid with a small proportion truncate above, from the middle of which surface a groove extends to the centre; its breadth is $4\frac{1}{2}$ lines, its vertical diameter 4 lines.

The occipital foramen is in one skull subcircular, in others shield-shaped, as in the second specimen of *D. robustus* (*tom. cit.* pl. 56. fig. 2). The lower transverse superoccipital ridge (Pl. X. fig. 2, 2), which overhangs the foramen, subsides upon the exoccipitals sooner than in *D. robustus*. The basioccipital descends proportionally lower to its bimammillate union (ib. figs. 2, 4, 1′) with the basisphenoid. There is one small precondyloid foramen on each side the base of the peduncle of the condyle. The vagal (ib. *v*), carotid (ib. *c*), and sympathetic canals have the same relative position as in *D. robustus*. The superoccipital is much less broad and is more arched than in *D. robustus*; its median vertical ridge (ib. fig. 2, 3) is less prominent in the present specimen, subsiding

[1] (Part VIII.) Trans. Zool. Soc. vol. iv. (1856) pp. 161, 163.
[2] Trans. Zool. Soc. vol. v. p. 337.
[3] Measured from the superoccipital protuberance to the premaxillary depression on the nasals; comp. Pl. X. fig. 3 with pl. 53. fig. 1, vol. v. Trans. Zool. Soc.

halfway down towards the foramen magnum. The paroccipital ridge takes the same course, but is not bent backward as in *D. robustus*; its lower angle (ib. fig. 2, 4) is divided by a notch from the carotid fossa. The paroccipital process is more contracted toward its lower end. The basisphenoid resembles in shape that in *D. robustus*, but the pterapophyses[1] (ib. fig. 4, 5′) are relatively shorter; the oblique eustachian grooves (ib. *e*) are well marked. There is a median venous foramen, in two skulls, between the origins of the pterapophyses, in one skull accompanied by a groove (ib. fig. 4, 5).

The crenate transverse occipital ridge, answering to that marked *d d*, pl. 38. fig. 3, vol. iii. (Trans. Zool. Soc.), instead of two, shows three curves on each side of the median vertical ridge (Pl. X. fig. 2, 3), answering to as many insertions of nuchal muscles. In advance of this ridge, upon the upper surface of the cranium (Pl. X. fig. 3), is a second transverse ridge (ib. 7), not parallel with the former, but with a greater bend convex forward; it is formed in the same way, viz. by the rise of the outer surface in advance of the depression for muscular insertion. This second ridge is from 5 to 7 or 8 lines in advance of the first; it seems to correspond with the place of the lambdoidal suture in the young bird, here and in other adult skulls quite obliterated.

The mastoid process (fig. 1, 8) is as long as in *Dinornis robustus*. The premastoid (ib. 8′) is a ridge produced into a short point; the intervening concavity gives attachment to the postcrotaphyte fascicule or muscle. A longitudinal ridge extends from above the base of the mastoid, backward, overhanging somewhat the tympanic fossa, and joining the outer margin of the paroccipital at a right angle; to a ridge within this border, part of the ear-drum was attached, and the ridge, before it subsides, indicates the ecto- and entotympanic surfaces of the paroccipital (ib. 4). The tympanic cavity is formed as described in *D. robustus*, as is also the articular cavity for the tympanic bone. The characters of the "foramen ovale" and "prelacerate fissure," with its divisions into the optic foramen and those for the fourth nerve, the anterior division of the fifth, and the sixth nerve, are as in *D. robustus*. The right and left optic foramina are 7 lines apart; at the intervening space are the deep fossæ impressing the upper part of the sides of the beginning of the presphenoid (fig. 4, 9) and confluent orbitosphenoids (ib. 10).

The temporal fossæ are well defined, are similar in shape to and quite as large as those in *Dinornis robustus*: the least interspace between their upper ridges is 2 inches; but this varies a little in different specimens. The posterior division of the temporal fossa (Pl. X. fig. 1, 8 8′) is smaller relatively to the anterior division (ib. 7) and to the entire cranium than in *D. robustus*.

On the upper part of the cranium (Pl. X. fig. 3) a rough surface extends forward from the upper normal transverse occipital ridge for about half an inch at the mid line; it is

[1] Trans. Zool. Soc. vol. iii. p. 351 (January 1848), and Osteol. Catal. Mus. Coll. of Surgeons, p. 303, no 1601: my "pterapophysis" is the "éminence particulière qui provient du sphénoide" of the Leçons d'Anat. Comp., ed. 1835, tom. iv. prem. partie, p. 111.

defined by a slight elevation of the anterior, smoother upper intertemporal surface of the cranium, simulating a second upper transverse ridge (7) as before described.

The postfrontal or postorbital processes (Pl. X. figs. 1–4, 12) are as broad as in *D. robustus*, consequently are relatively broader in proportion to the orbits and skull in *D. elephantopus* than in *D. robustus*: they are bent in their descent less obliquely backward. Upon the under surface of the roof of the orbits there is a well-marked oval depression, 3 lines in long diameter, posteriorly (ib. fig. 4, *l*), and a number of smaller more irregular depressions and foramina anterior thereto.

The presphenoid (ib. fig. 4, 9) is compressed and is angular at the interorbital extent of its under surface, instead of being convex as in *Dinornis robustus*. The depression above the base of the presphenoid and below the optic foramen is narrower than in *D. robustus*. The posterior part of the "girdle" is not transverse to the axis of the skull but is inclined from the mid line outward and forward; and the presphenoid is deeper as well as narrower below the "girdle."

The prefrontals (ib. figs. 1 & 4, 14), anterior to the orbitosphenoids (ib. 10), and continuous therewith, diverge from their basal confluence with the presphenoid (ib. 9), upward and outward; the part of their primitive blastema, interposed between the olfactory capsules, retains its unossified state at the hinder part of those cavities, save to the extent of one or two lines at the upper part, where a thin septal crest projects to the same extent from the expanded layer of the prefrontal, coalesced with the anterior wall of the cranium formed by the frontals and nasals. The posterior wall of the rhinal cavity is perforated by numerous olfactory nerve-filaments so as to form a "cribriform plate"[1]. At the fore part of the orbit the outer plate of the prefrontal bends downward, outward, and forward toward the lacrymal (Pl. X. figs. 1 & 5, 73), with which it forms the anterior wall of the orbit, chiefly convex thereto; the inferior border of this antorbital wall is continuous with the semicircular frame or "girdle" of bone[2] supporting a thin subreticulate ossified part of the olfactory capsule, forming a concavity looking or opening forward, and leaving a passage to the interorbital part of the olfactory cavity between its convex surface and the median part of the prefrontal. This median part, answering to the "lamina perpendicularis ethmoidei" of anthropotomy, the partial ossification of which at the upper and back part of the olfactory chamber has already been noticed, has undergone the ossifying process about half an inch in advance of the cribriform plate, for about an inch and a half along the base, which expands upon the fore part of the presphenoid; contracting as it rises to form the thin bony septum, it expands superiorly, especially at the hinder part, forming the platform supporting the nasals (ib. fig. 5, 15), and decreases vertically as it extends forward. The "girdle" divides the part of the olfactory cavity, partially partitioned by the bony septum, from the hinder expansion, where that septum is wanting. The undivided olfactory cavity

[1] "This cribriform plate is a peculiarity in which *Dinornis* participates with *Apteryx*."—*Trans. Zool. Soc.* vol. v. p. 350.

[2] "Cingulum olfactorium," ib. p. 349, pl. 56. fig. 1, *g*.

extends backward beneath the fore part of the cranial cavity as far as the back part of the orbits. The outer layer of the prefrontal projects from beneath the angle between the nasal and frontal, or lachrymal, very much in the ordinary position of the external part of the prefrontal in Reptiles and Fishes.

The nasals (ib. figs. 1, 3, 5, 15) are confluent posteriorly with the frontals (ib. 11), below with the upper expanded plates of the prefrontals (ib. fig. 5, 14), externally with the lachrymals (ib. 73), and internally or mesially with each other as far as the prefrontal confluence, in advance of which their median suture persists. The maxillary process (ib. fig. 5, 15′) appears to be shorter, and the premaxillary part (ib. 15) longer and more pointed than in *Dinornis robustus*. The smooth shallow depression (ib. fig. 3, 15) on which the premaxillary glides is narrower than in *D. robustus*; the raised, usually rough, surface external thereto contracts in breadth to near the pointed fore end of the bone, the upper part of which is smooth.

The cranium is longer in proportion to its breadth than in *D. robustus*. The occipital region is relatively of less extent vertically and transversely, and its middle part more completely overhangs the basioccipital condyle. The transverse extent of the cranium between the descending antorbital processes is markedly inferior in *D. elephantopus*, the vertical extent at the mid line being somewhat greater than in *D. robustus*.

The tympanic (ib. fig. 1, 28) differs from that of *Dinornis robustus* (Vol. V. pl. 53. fig. 2, 28) in the less-concave upper border of the orbital process (*k*) and in the smaller cavity (*h*) for the squamosal.

The posterior articular surface of the squamosal presents a convexity at the back part of the inner surface of the bone, fitting into the depression of the tympanic, and a concavity in advance adapted to the convexity on the tympanic process in front of the depression. The low obtuse ascending malar process to meet the postfrontal is better defined than in *D. robustus*.

Perhaps the best and most recognizable distinction between *Dinornis robustus* and *D. elephantopus* is in the not only absolutely but relatively smaller size of the mandibular parts of both upper and lower jaws in the latter species. The beak was shorter, more slender, and less obtusely terminated. The premaxillary with the most entire nasal process in my present series gives a total length of 3 inches 3 lines (ib. fig. 1, 22, 22′); that process expands posteriorly to a breadth of 6 lines (ib. fig. 6); but in the largest skull (belonging to the skeleton described in vol. iv.) the nasal articular surface indicates a rather broader process. As it advances the nasal branch loses breadth as it gains in depth, and is impressed at its narrowest part by a longitudinal groove. The lateral margins, as the branch contracts, bend downward and inward and meet to form the prenarial septum (ib. fig. 1, *s*), from the free margin of which to the tip of the beak measures 1 inch 7 lines.

The rough punctate surface sheathed by the horny bill passes rather gradually behind into the smooth septal plate. The maxillary branches (ib. figs. 1, 6, 22″) diverge backward at a more acute angle than in *Dinornis robustus.* The alveolar channel (ib. fig. 7) is much narrower; the intervening palatal tract is slightly concave without the median ridge. From the tip to the palatal fissure measures, in one specimen, 1 inch 5 lines; from the tip to the end of the maxillary process is 2 inches 5 lines; the breadth of the palate there is 1 inch 7½ lines.

The symphysial or rostral end of the lower jaw (ib. figs. 8 & 9) agrees with its homotype above in its smaller size, more slender and pointed proportions, as compared with that in *D. robustus.* The outer median tract defined by the parallel grooves (fig. 8) is 10 lines in length by 3 or 3½ lines in breadth. The upper or inner smooth surface of the symphysis (fig. 9) is deeper as well as narrower than in *D. robustus.*

Of the constituent elements of the mandible, the fore part of the splenial and the hind branches of the dentary retain their distinctness; the rest are welded together with the usual indications of the longitudinal fissure and foramina of the primitive separation.

The articular expansion of the mandible presents a narrow outer articular tract rising longitudinally into an open angle, and a broader inner and anterior surface, deeply concave transversely, almost level from before backwards, forming the anterior half of the digital cavity or depression, the posterior half of which is non-articular, and, in one specimen, is perforated by a small pneumatic foramen. The angle of the jaw is obtusely rounded, and from it arise, diverging upon the back part of the ramus, two obtuse ridges bounding a shallow transverse concavity; the outer ridge is most produced, especially at its termination.

The mandible, in proportion to the cranium, is relatively shorter, and of less vertical thickness than in *D. robustus.*

Skull of Dinornis crassus. (Plate XI.)

In the extensive collection of dinornithic remains from Ruamoa, Middle Island, purchased of Mr. Walter Mantell[1] in 1846 by the Trustees of the British Museum, were many skulls which could only be approximatively referred to their respective species according to characters of size and proportion; and it was not until my reconstruction of the skeleton of *D. elephantopus*, described in vol. iv. of Trans. Zool. Soc. p. 159, that, besides the skull fitting the atlantal cup of the vertebral column of that skeleton, and apparently of the same individual, I could refer three other specimens[2] of more or less mutilated crania, giving materials for the foregoing description, to the same species.

Other skulls, next in inferiority of size, seemed probably from their number to belong to the species, *D. crassus*, of which many individuals were indicated by limb-bones obtained from the same locality and deposit. Finally, in the collection recently transmitted from Christchurch, Canterbury Settlement, Zew Zealand, by Dr. Haast, are

[1] See Trans. Zool. Soc. vol. iv. p. 156.

[2] Nos. 32200, 32202, 32205 of the 'Register,' Geological Department, British Museum.

two skulls of corresponding dimensions and characters, one of which is referred by that accomplished geologist (and, I believe, rightly) to *Dinornis crassus*, of which species series of limb-bones form part of the same collection, obtained from the swamp at Glenmark, which has proved so prolific in evidences of these extinct gigantic birds.

With this confirmation I proceed to add to the subjoined figures of the skull of *Dinornis crassus* (Pl. XI.) notes of the principal differences which it presents in comparison with the skull of *D. elephantopus.*

The skull of *Dinornis crassus*, besides its proportional difference of size, chiefly shown in minor length, is distinguished from that of *Dinornis elephantopus* by a less-convex calvarium, relatively narrower and deeper temporal fossæ, and above all by shorter and terminally broader and more obtusely rounded upper and lower mandibles.

In breadth of superoccipital surface (Pl. XI. fig. 4, *d d*) *Dinornis crassus* almost equals *D. elephantopus* (Pl. X. fig. 2); but it has a sharper, more deeply defined supplementary upper transverse superoccipital ridge (ib. fig. 2, 7), and this is nearer to the normal (more or less wavy) upper transverse ridge (that, viz., which is marked *d d* in fig. 4, and in pl. 38. fig. 3, Vol. III., *Dinornis struthioïdes*).

The occipital condyle and foramen (Pl. XI. fig. 4, *m*) differ from those of *Dinornis elephantopus* both in size and shape; a larger proportion of the tubercle is truncate above. The basioccipital descends more abruptly and relatively lower to the "platform," the tuberosities forming the hinder angles of which are well produced but more ridged, less mammilloid, than in *Dinornis elephantopus* or *D. robustus.* The sphenoidal platform (ib. fig. 3, 5) is less deeply impressed, less constricted laterally, by the eustachian grooves; and its under surface is flatter, less irregular. The thick paroccipital border of the tympanic fossa is subangular, with a superincumbent prominence connecting the paroccipital (ib. fig. 1, 4) with the mastoid (ib. 8), rather more marked than in *Dinornis elephantopus.* The mastoid and the premastoid ridge and fossa retain the type of *D. elephantopus*; but the temporal fossa (ib. 7) has less than half the antero-posterior breadth, with equal depth: a tract of from 2 to 3 lines intervenes between the superoccipital and temporal depressions (ib. fig. 2). The hind part of the postfrontal (ib. fig. 1, 12) is more deeply excavated by the temporal fossa, and thereby has a sharp margin from the origin of the process, that margin being thick and obtusely rounded as in *Dinornis elephantopus.* The antero-inferior boundary-ridge of the temporal fossa is continued from the underside, not the hinder part, of the base of the postfrontal. There is every sign of the vigorous action of the temporal muscles, although they were relatively smaller, and absolutely much smaller, than in *Dinornis elephantopus.* The orbit is not much less than in that larger species. In one skull of *Dinornis crassus* the presphenoid is more carinate than in another.

The premaxillary (Pl. XI. figs. 1, 2, 3, 22), with the best-preserved nasal process (22′), gives a total length therealong, in a straight line, of 2 inches 7 lines, the length of the process from the point of trifurcation (or the back part of the prenarial septum) being

1 inch 6 lines. The rostral part of the bone contracts behind, rather gradually, to form that septum (ib. fig. 1, *s*), which is much narrower, or less produced backward, than in *Dinornis elephantopus.* The mid tract of the rostral part (ib. fig. 2, 22), defined by the pair of grooves, is broader and flatter than in *Dinornis elephantopus.* The sides slope from the grooves less vertically to the alveolar margin; and the end of the beak is more obtusely rounded: it is broader, flatter, and shorter than in *Dinornis elephantopus.* The palatal surface of the premaxillary (ib. fig. 3, 22) presents a gentle concavity, without median ridge or groove; and the bony roof of that part of the mouth is continued entire further back in relation to the prenarial septum.

The palatal part of the maxillary (ib. 21′) is gently convex from side to side, and sends back a short three-sided process for the articulation or attachment of the fore end of the palatine (ib. 20).

Two of the skulls of *Dinornis crassus*, from the morass at Ruamoa, in the Walter-Mantellian series, had fortunately been packed up with the fine dark mud dried and hardened about them. On carefully picking this matrix away from the palatal surface I exposed a pair of long, rather narrow, and slightly bent plates of bone (ib. fig. 3, 13), with their concave side applied to the presphenoidal rostrum (ib. 9), which they underlapped by their anterior third part, where their median edges come into contact. On being freed from the matrix, these laminæ fell apart: and I do not think that any confluence here of the pair of plates was ruptured in their exposure; but the delicacy and extreme fragility of the plates may leave this an open question at present I doubt whether the entire length of either plate is shown, as, in the skull presenting them, the upper mandible and the fore part of the presphenoidal rostrum has been broken off. Of that on the right side a length of 1 inch 9 lines is preserved, of the left lamina 1 inch 6 lines. Both begin, behind, by an obtuse narrow end, and, converging, quickly expand to a breadth of 4 lines, which is retained for the course of an inch, when the lamella gradually narrows, and at their anterior divergence more quickly, to a point. The inner concavity and the outer convexity, which are moderate, rule in the transverse direction of the plate. Lengthwise the plate posteriorly is slightly concave, and then more slightly convex, where the plates converge anteriorly. The lower margin is straight, the upper and outer one convex in the degree of the expansion of the plate. These lamellæ (Pl. XI. fig. 3, 13) are homologous with the pair, confluent anteriorly, and underlapping the rostrum in the Emu (*Dromaius ater*), determined (in my Second Memoir on *Dinornis*, 1846) as the vomer, and figured, with its symbolic number (13) in pl. 39. fig. 2 of that Memoir[1].

On the right side of the palate in the skull of *Dinornis crassus* with the divided vomer I found a more sinuously bent plate of bone in contact at its fore and inner surface with the hind end of the vomerine plate, extending some way forward parallel therewith, and continued backward, beyond the vomer, diverging, with gain of thick-

[1] Trans. Zool. Soc. vol. iii.

ness and loss of breadth, to abut against the pterygoid facet of the tympanic. This bone (ib. fig. 3, 24) is the "pterygoid." External and superior to it was the hind end of the palatine (ib. 20), which there has a breadth of $5\frac{1}{2}$ lines, the inner angle of which is rather thickened where it touched the vomer. From the outer, thinner and sharper angle the margin of the plate, which is the lower and outer one, is straight, slightly thickened, and, after advancing for one inch, expands, becoming again lamelliform. This end, however, is not entire, and seems to have been broken away from some attachment. The hind plate, which, after a slight transverse convexity from the hinder and outer angle, bends upward and inward, expands to a breadth of 7 lines at a distance of 9 lines from the hinder and inner angle; it then contracts with a thin wavy border to the fore end of the outer thicker border, which is there as it were twisted inward upon or beneath it. The entire plate then shows a twofold sinuous disposition with the concavity of the major part turned downward and inward. It bounds the inner, posterior or palatal nostril, and is homologous with the palatine (20, fig. 2, Emu, *loc. cit.*).

In the second skull of *Dinornis crassus*, yielding evidence of palatal structure, the palatals were found with the anterior, expanded, inwardly twisted end of the straight outer tract in contact with the palatal plate of the maxillary. This plate (ib. fig. 3, 21′), in form and proportion resembling that in *Dinornis robustus* (Trans. Zool. Soc. vol. v. pl. 56. fig. 1, 21′), together with the attached portion of the body of the maxillary, had been slightly displaced on both sides by a superincumbent pressure of matrix, the skull seeming to have rested on the calvarium, palate upwards. No trace of the delicate vomerine plates had been preserved in this skull. But, together with the tympanic, pressed forward to the horizontal position, with the mastoid condyle slightly dislocated, there was exposed in the space between the orbital process of the tympanic and the pterapophysis of the basisphenoid, extending obliquely inward between the hind part of the palatine and the base of the presphenoid, the pterygoid bone, corresponding in shape with that above described. This bone had its thick, narrow, subtrihedral end directed toward the pterygoid articular facet of the tympanic, and its lamellate fore end joining both vomer and palatine. Retaining its attachment to the tympanic on the left side, where that bone has been pressed more outward than on the right, the pterygoid has been dragged away from its anterior connexions, and lies above and to the outside of the left palatine.

In the general proportions and connexions of the above-described bones, readjusted as nearly as their condition permitted in their natural places, as in Pl. XI. fig. 3, they defined the posterior nostrils (palato-nares) and the pterapophysial vacuities (those between the rostrum and pterygoids bounded behind by the pterapophyses), in form and extent most nearly corresponding with that part of the skull in the *Apteryx*[1]. The two moieties of the vomer are in contact beneath the rostrum for nearly the same relative extent in *Apteryx* as in *Dinornis*; and the confluent anterior part of the vomerine

[1] Trans. Zool. Soc. vol. ii. pl. 53. fig. 2.

lamellæ in *Apteryx* probably indicates the true condition of the vomer in *Dinornis*. In *Dromaius* the non-united halves of the vomer diverge posteriorly in a greater degree than in *Apteryx* or *Dinornis*, exposing a greater proportion of the rostrum. The obliquely and mesially concave palatal plates converge anteriorly, not so much or so soon in *Dinornis* as in *Apteryx*, but more quickly than in *Dromaius*, defining more completely a smaller pair of bony palato-nares. It is most probable that the detached representatives of "palatines" worked out of the matrix, in the first specimen, were the parts broken away from the anchylosed union of those bones with the palatal plates of the maxillary anteriorly, and with the pterygoids behind.

In *Struthio*, *Rhea*, and *Casuarius* the pterygoid coalesces with the palatine earlier than it does in *Dromaius*. A greater proportion of the vomer is cleft posteriorly in *Dromaius* than in *Rhea*. Upon the whole *Dromaius*, among the larger existing *Struthionidæ*, makes the nearest approach in palatal structure to *Dinornis* and *Apteryx*. This closer affinity is shown in the form of the basioccipito-sphenoidal tract and its relation to the pterapophyses. In *Rhea*, which, after *Dromaius*, comes next in palatal conformity, the tract in question sinks abruptly below the level of the pterapophyses, which seem to diverge at almost a right angle from the base itself of the rostrum. In *Dromaius* the pterapophyses diverge from the fore part of the tract itself, which is on the same level with the back part of the tract, and, as in *Dinornis*, only distinguished therefrom by the lateral constrictions or grooves due to the pressure of the Eustachian tubes.

The appreciation of the near affinities, among *Struthionidæ*, of *Dromaius* to *Dinornis* and *Apteryx* led me to select the skull of the Emu to illustrate that of the Moa in my first attempts to restore that complex and instructive part of the skeleton of the huge extinct New-Zealand apterous birds[1].

The results of the above exposition of palatal structure in the skulls of *Dinornis crassus* have enabled me to restore, from cranial fragments in the Walter-Mantellian series, not only the pterygoids and portions of the palatines of *Dinornis crassus*, but also those of the *Dinornis ingens* as figured in Pl. XV. fig. 3.

In *Dinornis crassus* the malar process of the maxillary (Pl. XI. fig. 1, 21), the malar (ib. 26), and squamosal (ib. 27) have coalesced into a styliform zygoma 2 inches 2 lines in length. The malar rises as a low, obtuse ridge toward the postfrontal; the squamosal has a rough elliptic surface at the inner side of its hinder end, which projects inward to an obtuse point effecting the "gomphosis" with the tympanic (28). This bone (Pl. XI. figs. 5 & 6), in relation to the shorter mandible, is relatively as well as absolutely smaller than in *Dinornis elephantopus*; the orbital process (*k*) is more triangular, has a broader base than in *Dinornis elephantopus*: this process is more produced, with

[1] Most of the notable modifications of the palate and pterygo-palatine arches have since been figured by Eyton in the rich storehouse of the bony structures of birds, entitled 'Osteologia Avium,' 4to, London, 1864–67.

a narrower base, in *D. robustus* (Trans. Zool. Soc. vol. v. pl. 54. fig. 2, *k*). The pterygoid and pterapophysial (*pt*) articular surfaces are well marked.

The mandible (Pl. XI. fig. 1, 29, and figs. 7, 8, 9), nearly 5 inches in length, has a more irregular upper border than in most Moas, owing to the deeper emargination between the coronoid process of the surangular (29') and the alveolar border of the dentary (32'). The posterior triangular fossa is deeper and better-defined than in *Dinornis elephantopus*; its upper and outer angle is more produced; the expanded articular part is longer in proportion to its breadth. But the chief and most recognizable modification is at the rostral or symphysial end (figs. 8, 9), which is more expanded, more obtuse, and shallower above (fig. 9) than in *D. elephantopus*—conforming in shape to that of the premaxillary.

Skull of Dinornis rheïdes, *Ow.* (Plate XII.)

With the sternum and limb-bones of *Dinornis rheïdes*, in the collection of H. Sumpter, Esq., of which the former bone was described in Memoir No. XIII., there was a cranium and mandible proportionate in size. In the collection of Moa-remains brought by Mr. Walter Mantell from Ruamoa there were, with limb-bone evidences of *Dinornis rheïdes*, two skulls, more or less entire, which so clearly agree with that above-mentioned that I refer them to the same species; and this species I believe, on this evidence, to be *D. rheïdes*.

The cranium is narrower in proportion to its length than in *D. crassus*. The superoccipital so projects at its midpart as to conceal the condyle from view, looking directly upon the calvarium: comp. Pl. XII. fig. 3, with pl. 53. fig. 1 (Vol. V.), *D. robustus*. From this structure the plane of the occipital foramen (Pl. XII. fig. 2, *m*) is less vertical, inclining from above downward and a little forward to the condyle. From the prominent upper border of the foramen the superoccipital plane inclines from below, upward and forward, at an angle of 50° with the basi-presphenoidal axis. If the occipital plane be understood as the hind wall or face of the skull from the basioccipital mammillæ (ib. 1') to the superoccipital crest (ib. 3), such plane lies nearly at a right angle with the basi-presphenoidal axis. But in the present and some other dinornithine skulls it describes a convex curve vertically, of which the upper border of the foramen magnum is the most prominent part (ib. fig. 1, 437). The basicranial axis is usually understood to traverse the lower border of the occipital foramen, and it would then be out of the parallel of that of the basi-presphenoidal tract or axis[1].

The occipital condyle forms rather more than half a hemisphere, truncate above, from the mid part of which a slight depression or dimple extends toward the middle of the condyle. The crenate ridge (3) and the more advanced upper transverse superoccipital

[1] What Mr. Parker may mean by the "occipital plane," which he says "lies nearly at a right angle with the basicranial axis in the typical bird" (Zool. Trans. vol. v. part 3, p. 156), is as uncertain and as conjectural as that bird itself.

ridge (fig. 3, 7) are approximate; both the mid vertical and transverse ridges of the superoccipital are less strongly marked than in *D. crassus*, *D. elephantopus*, and *D. robustus*. With other smaller kinds of Moa, *D. rheïdes* exemplifies the less-mature age of the larger kinds in the minor indications of muscular force. The paroccipital part of the occipital surface bulges rather more abruptly outward and backward than in the larger crania above described, leaving a correspondingly deeper depression between that part (Pl. XII. figs. 2, 3, & 4, 4) and the superoccipital tract (ib. 3). The masto-paroccipital wall of the tympanic chamber (ib. figs. 1 & 4, 4, 8) has a less angular, more arched, border than in *D. crassus*. The basioccipital mammilloid tuberosities (Pl. XII. figs. 2 & 4, 1′ 1′) are less prominent. The posterior walls of the Eustachian canals (fig. 4, *e*) in one skull of *Dinornis rheïdes* are continuous, appearing to define the basioccipital from the basisphenoid, with a median emargination; but this is less marked in the two other crania of the same species. All show, more or less strongly, the remnant of the basisphenoidal mid vertical canal between the bases of the pterapophyses (5′).

The alisphenoid (fig. 4, 6) swells out into an oblong tuberosity below the "oval hole"; a deep notch, with a small venous perforation, divides the swelling from the pterapophyses (5′). The tuberosities are more prominent in *Dinornis rheïdes* than in *D. elephantopus* or *D. crassus*[1]; they correspond with the mesencephalic fossæ, but are pneumatic, and due exclusively to the outer table and subjacent diploë.

The orbitosphenoids (ib. 10) are as unmistakably indicated (in birds) by their essential characters as transmitters of the optic nerves, as are the alisphenoids by the oval foramina; no separate ossification of the descending orbital plate of the frontal in a young Grouse, or Goose, or other bird could be mistaken for an orbitosphenoid by any anatomist, save one constitutionally incompetent to appreciate or comprehend the grounds upon which true homology is determinable.

The presphenoid (fig. 4, 9) rostral in shape, as in all birds and most mammals, is of great length, as in other *Dinornithes* and the *Struthionidæ* generally; it is compressed behind its mid part, and again expands to a breadth equalling that of its hind part in *D. rheïdes*: the under surface is subcarinate where compressed, transversely convex where expanded; it terminates as usual, in a point. At its base it is confluent, above, with the orbito-sphenoids, and in advance of these with the prefrontals; the line of confluence with the latter extends outward in the form of a shelf, or transversely horizontal plate, with an obtuse terminal angle on each side (9″); on this plate rests the olfactory hoop (*cingulum olfactorium*).

The prefrontals retain the characters of those in the previously described species, making no show (as they do in *Struthionidæ*[2]) upon the upper surface of the cranium. The confluence of the nasals with the frontals, prefrontals, and lachrymals is very complete; the cleft between the nasals (fig. 3, 15) persists anteriorly.

[1] They are still more prominent in *D. gravis*, to be afterwards described.

[2] Trans. Zool. Soc. vol. iii. pl. 39. fig. 1, 14 (*Dromaius*).

Both nasals and frontals were unfortunately wanting in that instructive portion of the cranium of the young Gigantic Dinornis figured in the 'Zoological Transactions,' vol. iv. 1850, pl. 24. figs. 1, 2, 3. I have found the nasal confluent with the frontals in all other specimens of skulls of more or less adult birds; they are planed off, as it were, above, to let in the nasal process of the premaxillary. Such depressed articular surface (Pl. XII. fig. 3, 15) does not reach further back than the transverse parallel of the lachrymal part of the orbits.

The prosencephalic part of the cranial cavity makes a prominence above the general level of the calvarium. The postfrontal (ib. fig. 1, 12) is nearly vertical. The temporal fossa is narrow antero-posteriorly compared with that in *Dinornis elephantopus*, but is relatively wider than in *D. crassus*: a posterotaphyte fossa is defined by a short, pre-mastoid, pointed process[1]. The mastoid process (fig. 1, 8) is long, subcompressed from before backward, and pointed.

The rostral part of the premaxillary (ib. 22) is relatively longer than in *D. crassus* or *D. elephantopus*, shorter than in *D. robustus*; it is minutely perforated, showing a cork-like surface; that of the nasal process (22′) resumes the usual smoothness, as does the premaxillary part of the internarial septum (*s*). The premaxillary is more suddenly pinched in, as it were, laterally, to form this septum, than in any of the above species; its fore-and-aft extent is two-fifths that of the premaxillary prior to its trifurcation. The entire portion of the bone forming the end of the upper mandible is slightly deflected, and terminates subacutely. The upper median tract is defined by a well-marked, though shallow and narrow, groove on each side, ending about four lines from the apex. The palatal surface shows a low, narrow or linear median ridge, and two wider marginal or alveolar grooves; between these grooves the surface is transversely concave at the middle, and convex on each side. At about an inch from the apex the mid ridge subsides, and the bifurcation of the palato-maxillary processes begins; the fissure is relatively longer and narrower than in *Dinornis robustus*. The narrow base, or beginning, of the nasal process (fig. 1, 22′) shows a linear mid furrow on its upper surface, which disappears as the process flattens and expands; the under surface of the process shows a low mid ridge, against which the margins seem to be bent or folded inward to form the front part of the internarial septum. The hind free concave margin of this septum shows the fissure left between the inflected laminæ, which diverge below to form the upper surface or layer of the palatal part of the premaxillary. At the place of divergence, above the lower palatal layer, are the mid fossa and two lateral nervo-vascular canals conveying the trunks of the many ramifications which emerge at the perforations of the cork-like outer surface to constitute (or help thereto) the periosteal formative bed of the upper horny mandible.

The maxillary is broadest anteriorly, where it sends inward from its lower part the

[1] The homologue of the ridge bisecting the temporal fossa, and produced beyond the ordinary mastoid in *Aptornis* (Trans. Zool. Soc. vol. iii. pl. 52. figs. 1, 8′).

contribution to the roof of the mouth called "palatal plate or process of the maxillary," answering to the same processes in the Crocodile and in Mammals. The upper plate of this fore part of the bone swells into an oblong convex dome, roofing a sinus answering to the "maxillary" one or "antrum"[1] in Mammals, with a small subtriangular aperture posteriorly, which looks backward and downward: the longest diameter of this aperture is 4 lines; the sinus is elsewhere closed: its length is 1 inch 2 lines, its height 8 lines, and its breadth the same. The inner wall developes a slightly arched ridge, which abuts upon the presphenoid below the rhinal plate or "shelf" (fig. 4, 9′). The outer side or wall of the antrum is impressed lengthwise by the termination of the alveolar branch of the premaxillary (fig. 1, 22″): the palatal plate of the maxillary, forming the floor of the antrum, is underlapped anteriorly by the palatal plate of the premaxillary, and abuts by its median margin upon the fore part of the vomer. The maxillary or descending branch of the nasal, with the contiguous part of the rhinal capsule, articulates with the outer and back part of the antrum. Below this, and external to the antral orifice, the maxillary contracts to the slender subbihedral bar passing backward and outward to coalesce with the slender malar (fig. 1, 26). The under facet of the maxillary is impressed with the backward prolongation of the alveolar channel.

Thus the maxillary manifests its true nature and homology with the bone so called in the Mammal, in the clearest and most unmistakable manner in *Dinornis*. In all birds it retains the more essential and constant characters of 21 in Mammals and Reptiles. It continues backward the roof of the mouth from the premaxillary palatal process; it continues backward the alveolar process or border, from that grooved border of the premaxillary; it sends off the zygomatic process, to which the malar articulates, such part of this malar, prior to anchylosis, being overlapped, as is usual, by the maxillary, as the malar itself is overlapped by the zygomatic part of the squamosal.

Accordingly our great masters in Comparative Osteology (CUVIER[2], MECKEL, GEOFFROY ST.-HILAIRE) have unhesitatingly recognized the nature of this bone, which only one prone to mystify what is clear, and to complicate what is simple and plain, could have persuaded himself to contradict by "vicarious" fancies[3]. The usual extreme ornithic

[1] The corresponding part of the maxillary is described in *Dinornis robustus* as "an oblong, bony, pneumatic capsule, 2 inches in length and 1 inch 3 lines in breadth, flattened below," &c. (Trans. Zool. Soc. vol. v. p. 352).

[2] "*L'os jugal* réunit, comme dans les mammifères, les parties latérales du crâne à la face, par le temporo-articulaire [my "squamosal"], et le sus-maxillaire se joint à ces deux os par une articulation serrée, qui les force de suivre ses mouvements en avant et en arrière. Les os *palatins* ont une articulation à peu près fixe ou très-mobile avec les os sus-maxillaires," &c. (Leçons d'Anat. Comp. ed. 1835, tom. iv. p. 112). Cuvier's "sus-maxillaire" is my "maxillary"; his "sous-maxillaire" I call "mandible."

[3] The "maxillary" is, or rather was, the "prevomer" of Parker, who calls it "the splint-bone which is vicarious of the maxillary in the Bird-class" (Trans. Zool. Soc. vol. v. p. 233). His rectification of opinion (Trans. Zool. Soc. vol. vi. p. 502) is based on a distinct ground for the acceptance of homology, viz. "authority." It is in his case a praiseworthy ground, and needs only a choice of the proper one to lead him to a true view of other particulars of the osteology of birds in which he has gone astray.

modification of the bone is manifested in *D. rheïdes* as in *D. robustus* (*loc. cit.* pl. 56. fig. 1, 21 21′). The malar (26), with which it has coalesced, is remarkable in *D. rheïdes* (at least I have not found the character in the larger dinornithic crania with the zygomatic arch) by the extent of the process sent upward to meet the descending post-frontal (12).

The tympanic bone (figs. 9, 10) shows the single mastoid condyle (*e*) as in *D. robustus*, *D. crassus*, and probably all *Dinornithes*: it is here divided by a low mid-linear ridge at the fore part; and the divisions very slightly project behind, on each side a shallow mid depression. The stem is subcompressed obliquely from before backward, the hind surface inclining rather outward; both outer and inner sides converge to a sharp concave posterior margin, the stem becoming thus three-sided with the anterior surface narrower than the outer and inner ones. The latter shows a subcircular pneumatic foramen (fig. 10) ½ inch below the condyle, and not situated in so large and definite a depression as in *D. robustus* (*loc. cit.* pl. 54. fig. 2, *g*). The posterior margin shows part of the groove and ridge for the attachment of the tympanic membrane. The orbital process (*k*) shows the facet (*ps*) for the pterapophysis, but not supported on so well-marked a prominence as in the larger species of *Dinornis*. The surface for the pterygoid is at the fore part of the inner convex condyle (*i*) for the mandible. The two mandibular surfaces, postconcave and preconvex, are similar to those shown in pl. 54. fig. 3, *h i*, *tom. cit.* External to the mandibular process is the usual subhemispherical cavity (fig. 9, *h*) for the squamosal (fig. 8, 27).

The mandibular rami coalesce, as in other *Dinornithes*, by a short symphysis sloping from above downward and backward (Pl. XII. fig. 5). Each ramus describes a gentle sigmoid curve, best marked at the lower border, which is convex at the hinder, concave at the fore half of the mandible (ib. fig. 1, 29–32).

The back part of each ramus forms an expanded triangular surface (Pl. XII. fig. 6, 29), deeply concave from the outer to near the inner side, which is formed by a narrow, vertical, convex tract; the vertical ridge or plate of bone extending forward from this tract divides the concavity (fig. 7, 29) for the insertion of the pterygoid muscles from the interarticular depression (fig. 5, *i*). At the fore part of this depression is the transversely concave facet for the convex lower condyle of the tympanic. The plate of bone extending forward from the outer side of the mandibular base expands and forms along its upper part the oblong articular surface (fig. 5, *i*) adapted to the outer and lower condyle of the tympanic. The inner plate, which is sharp above, subsides at the fore part of the fossa (*b*); the surangular part of the ramus (fig. 7, 29) is continued from the outer articular surface. The angular piece (fig. 1, 30), smooth and broadly convex posteriorly, rapidly contracts to a vertical lamella, which is excavated at the outer part of its anterior half for reception of the lower division of the dentary (32), along which it is continued internally as a flat thin lamella, below and parallel with the splenial (figs. 1 & 7, 31), and terminating in a point about an inch from the fore end of the mandible. The surangular (29), coalescing or connate posteriorly, like the angular (30), with the articular element, bounds the outer ramal depression above and terminates forward by penetrating the upper division (32′) of the dentary, with which it thus unites as by a species of gomphosis. The splenial (fig. 7, 31), conversely with its condition in *Alca impennis* and many other birds, has coalesced posteriorly with the angular and surangular, and terminates in a free point anteriorly, being lodged, behind, between the angular and surangular, where it closes internally their interspace, and anteriorly between the two divisions of the dentary. Of these the lower (figs. 1 & 7, 32″), as in *D. robustus* and *D. crassus*, is longer than the upper one.

The outer surface of the unbranched part of the dentary and the symphysial part determining the contour of the lower mandible repeat pretty closely the characters described and figured in *D. robustus*. The alveolar groove (fig. 5, *b*) is narrow and multiperforate.

The length of the cranial cavity is 2 inches, its extreme breadth (across the hind third of the prosencephalon) is 1 inch 8 lines, its extreme height (behind the sella near the fore part of the epencephalon) is 1 inch 2 lines; and these admeasurements give almost accurately the dimensions of the brain in a bird which, weight for weight, equalled or surpassed the *Rhea americana*. The cavity is nearly equally divided lengthwise between the ep- and pros-encephala. A low tentorial ridge forms the boundary, arching from above, vertically, along the side walls of the cavity, interrupted at the fore part of the petrosal sinus, and subsiding on the floor of the cavity, after bounding anteriorly the triangular depression for the optic lobe. From the lower and back part of this depression is continued the canal for the main part of the trigeminal nerve (foramen ovale) traversing and determining the alisphenoid neurapophysis. The upper semicircular canal bounds below and gives the arched curve to the petrosal sinus. The roof of the epencephalic chamber is less arched from before backward than in most birds, owing to the hinder position and almost verticality of the foramen magnum and to the degree in which the superoccipital inclines forward to join the parietals. The tentorial ridge shows no trace of the tumid swelling which characterizes it in the *Didus ineptus*[1]. At the lower lateral part of the epencephalic wall is the multiperforate shallow depression receiving the acoustic nerve. Behind this is the canal for the vagal nerve and entojugular vein: below this opens the small precondyloid foramen. The prosencephalic chamber has its side and upper walls divided by a long, low, smooth, broad rising, which arches, from the tentorial ridge above the fore part of the petrosal sinus, obliquely forward and a little downward, subdividing at the rhinencephalic chamber: it indicates a corresponding longitudinal furrow of the cerebral hemisphere.

In all *Dinornithes*, and in the ratio of their size, the walls of the cranial cavity are thick, mainly through the abundance of largely cellular diploë interposed between the thin and compact outer "table" and the thicker compact inner table of such walls.

[1] Memoir on the Dodo, Zool. Trans. vol. vi. p. 71, pl. 23. fig. 1, *o*.

This is shown in the section of the cranium figured in Memoir V. (Trans. Zool. Soc. vol. iv.) pl. 24. fig. 4, also in the specimen with the outer table of the calvarium removed, in Memoir III. (*op. cit.* vol. iii.) pl. 53. fig. 6, and in the specimen with the outer table removed from the basis cranii, ib. fig. 5. The thickness of the cranial walls is strikingly shown at the lines of suture, or rather "harmonia," of the cranial bones in the skull of a young individual of *Dinornis giganteus*, Memoir V. (*op. cit.* vol. iv.) pl. 24. fig. 3, *r*, in which the extension of the compact table from the outer to the inner surface of the cranial bone is shown along the harmonial surface: such continuous plate becomes absorbed after the confluence of the cranial bones is completed; and the diploë then gives free and uninterrupted passage to the air through the thick walls of the skull. Consequently the inner table alone is moulded upon the brain, the most prominent upper parts of which (at the prosencephalon), though sometimes obliterating the diploë, as is partially the case in *Dinornis rheïdes*, rarely (as in that species) pushes the outer table above its level so as to indicate the whereabouts of the cerebral hemispheres. The breadth as well as length of the fronto-nasal roof of the skull (fig. 3, 11) anterior to the prosencephalic risings (if these happen to be marked) are characteristic features of *Dinornis*; and I may add that, among other distinctive characters noted in former Memoirs, *Dinornis* differs from the *Struthionidæ* in the upper expansion of the coalesced prefrontals being covered by the nasals and not appearing at the upper surface of the skull, in the absence of an expanded outer plate of the lachrymal, and in the almost equality of breadth of the occiput with the postorbital part of the skull.

Of the Cranial Cavity of Dinornis giganteus. (Plate XIII. fig. 9.)

With some parts of the skeleton of a *Dinornis giganteus* presented to the British Museum by Mr. Luxmore, including most of the vertebræ and pelvis, was the cranium, with some other fragments of the skull, all much abraded or fractured. The locality of these remains is unknown. The thick and coarse-celled diploë of the cranial walls was extensively exposed; and it seemed to me that the best use to make of the specimen was to expose in it by a vertical longitudinal section the extent, shape, and other characters of the cranial cavity in that species.

These, therefore, I propose to compare with those detailed in the foregoing account of *D. rheïdes*.

The length of the cranial cavity is 2 inches 8 lines, the breadth 2 inches 5 lines, the height 1 inch 4 lines, the measurements being taken at the same points as in the cranium of *D. rheïdes*. The cavity is unequally divided by the vertical tentorial ridge, the prosencephalon being longer in proportion to the cerebellum than in *D. rheïdes* or the species figured in pl. 24. fig. 4, Vol. IV. The tentorial ridge is interrupted, as in those species, by the passage of the longitudinal into the lateral or petrosal sinus. Beneath this the petrosal wall of the labyrinth makes a greater prominence than in the smaller Moas above cited. The mesencephalic fossa (Pl. XIII. fig. 9, *m*) is not larger than in them, is consequently relatively smaller, especially to the prosencephalic one (*p*) in *D. gigas*. The foramen ovale is more oblong, and at the upper part of the side of the cavity. The prelacerate and optic foramina present the same size and position as in *D. rheïdes*, indicating, together with the size of the mesencephalon, relatively smaller eye-balls in *D. gigas*. The sella (*s*) is somewhat deeper, but not larger in other dimensions; it is perforated behind by the entocarotid canal. The prosencephalic wall has the same configuration (indicative of the longitudinal indent of the cerebral hemisphere) as in *Dinornis rheïdes*. The rhinencephalic fossæ (*r*) are a pair divided by an obtuse longitudinal ridge representing a "crista galli" $2\frac{1}{2}$ lines thick; each fossa is elliptic, 5 lines by 4 lines in long and short diameters, with from eight to ten perforations, the largest leading from the outer side of the cavity. The cribriform plate is extremely thin[1].

Skull of Dinornis casuarinus, *Ow.* (Plate XIII. figs. 1–8.)

The relations of locality affecting the sternum and limb-bones of *D. rheïdes*, and the sole cranium therewith collected and transmitted to Mr. Sumpter, without a trace of any determinant bone of *Dinornis casuarinus*, solved the doubt which had long troubled me in regard to the skull, which, in respect to general size, might seem to belong to either of two such nearly matched species. It was with lively satisfaction, therefore, that I saw in a series of bones belonging to one and the same skeleton of a *Dinornis casuarinus* from the famous Glenmark swamp, submitted for sale to the Geological Department of the British Museum, in the course of the present year, by William Reeves, Esq., that the skull presented, with a general correspondence of size in the cranial part (Pl. XIII. figs. 2, 3), unquestionable specific differences throughout from that of *Dinornis rheïdes*, and more especially in the forms and proportions of the mandibular parts of both upper and lower jaws (ib. figs. 4–8).

The occipital surface (ib. fig. 3) almost exactly repeats the dimensions of the same in *Dinornis rheïdes*, but with the following differences:—

The basioccipital descends more abruptly and vertically, the vagal and carotico-sympathetic foramina are larger, the tuberosities (ib. fig. 3, 1′) are less prominent or defined at the back part of the basioccipito-sphenoidal quadrate surface or "platform." The upper border of the foramen magnum is much thicker, and is channelled, as if for a venous sinus. The superoccipital rises above the foramen, as a triangular tuberosity (ib. fig. 2), to the level of the calvarium. The superoccipital depressions, having this tuberosity intervening instead of a vertical crista, are wider apart. The ridges descending from above the foramen magnum, and diverging to the paroccipitals, are broader and more pronounced; they define, with the back part of the basioccipito-sphenoidal surface, a triangular area, from near the centre of which projects the occipital condyle. There

[1] This plate being broken away at its middle led me into the error of supposing the olfactory nerve to have escaped, as in birds generally, by one large foramen, in the first description of the cranial cavity, Memoir V. (Trans. Zool. Soc. vol. iv. p. 64).

is a similar depression to that in *D. rheïdes* on each side of the superoccipital surface, below and external to which bulge out the paroccipitals; the ends of both processes are broken away. I hesitate on this account to express the belief that the paroccipital part of the tympanic fossa has less antero-posterior extent than in *D. rheïdes.* The articular cavity for the tympanic extends further inward from the base of the mastoid process. The premastoid ridge is less produced than in *D. rheïdes*; the temporal fossa is encroached upon by a vertical longitudinal rising midway between the premastoid ridge and the postfrontal. The antero-posterior extent of the temporal fossæ and the calvarian interval between them are alike in both species. But it is in advance of this part of the skull that the greater differences begin. The orbits are smaller; the breadth of the cranium across the postorbitals is less; the fore part of the cranium is modified for the support and attachment of a much weaker and shorter mandible.

The premaxillary part (Pl. XIII. figs. 4, 5, fig. 1, 22) of this mandible is fortunately nearly entire. The anterior undivided mandibular part of the base is much smaller and shorter in proportion to the nasal process. The perforated irregular surface in relation to the bill-sheath contracts posteriorly more gradually between the nasal and maxillary branches to form the smoother prenarial septum; and this is relatively of much less extent than in *D. rheïdes.*

The palatal surface of the premaxillary in *D. casuarinus* (ib. fig. 5) is flatter and less bent; the marginal alveolar grooves are shallower. The mid furrow upon the narrower beginning of the nasal process is long and deep; it disappears upon the hinder flattened part of that process.

The tympanic (Pl. XIII. figs. 1, 28 & 13), like the mandible it supports, is markedly less than in *D. rheïdes.* There is less indication of a division of the single condyle that crowns the antero-posteriorly compressed mastoid branch (*e*); the orbital or pterygoid branch (*k*) is broader and shorter, more convex outwardly, more concave at the inner side, with a better-marked and more prominent pterapophysial facet (*p*). The pneumatic depression, though smaller, is better defined, extending from the foramen upward to the inner side of the mastoid condyle.

The rami of the lower jaw (fig. 6) are more delicate and slender in proportion to their length than in *D. rheïdes.* The back part of the ramus is less expanded, the outer border of its concavity is thicker and more obtuse, the inner one is less thick, the two borders, which meet at the lower angle, being more alike in character. The articular surfaces and intervening vacuity offer no notable modification. The outer depression between the angular and surangular retains posteriorly a small vacuity leading obliquely upward to a foramen on the inner side of the ramus, grooving the base of the low obtuse coronoid process. The splenial element (31) has coalesced behind, not anteriorly; the dentary has coalesced with both the angular and surangular. The outer mid tract of the symphysis (fig. 7) is defined, as in other species, by a pair of parallel grooves.

The more characteristic leg-bones of the specimen to which the above-described skull belongs, agree pretty closely in size with the type specimens[1], but are rather more slender as in the smaller variety of *Dinornis casuarinus* in Dr. Haast's admeasurements, the following being the length of—

	in.	lines.
Metatarse	8	5
Tibia	18	3

The difference between Dr. Haast's larger and smaller sizes is only such as might be explicable, as Dr. Haast suggests, as a sexual character; the specimen noted as yielding "the smallest size" is, as Dr. Haast remarks, of a bird not quite full-grown.

The difference in the proportions of the leg-bones between *Dinornis rheïdes* and *D. casuarinus* is greater in respect of robustness than of length, yet not in such a degree as to make the decision come to as to their specific distinction one lightly arrived at, or without well weighing many particulars. In the memoirs defining these species I troubled the Society mainly with the results, omitting particulars of the processes leading thereto. But I could not have ventured to anticipate that a certain comparative slenderness of the hind limbs would have been associated with a beak shorter and weaker in the degree demonstrated by the skull of *D. casuarinus* above described.

Skull of Dinornis gravis, *Ow.* (Plate XIV.)

Many characteristic parts of the skeleton of the same individual bird were obtained by William Fenwick, Esq., at the Kahamin River, Middle Island, New Zealand, and were presented by that gentleman to Miss A. Burdett Coutts. They were confided to me by that lady for determination in 1867; and the grounds on which I came to the conclusion that they represented a species not previously recognized may be communicated at a future period to the Zoological Society. *Dinornis gravis* was of about the same stature as *D. rheïdes*, and as the characteristics of cranial structure will be better appreciated in both birds by contrast and comparison, I give a description of the skull of the new species in the present Memoir.

Dinornis gravis presents the shortest mandible in proportion to the breadth of the skull that I have yet observed. The breadth of the occiput being equal to that of *Dinornis crassus*, the occipital condyle and foramen magnum are less, especially the latter (comp. fig. 4, Pl. XIV., with fig. 3, Pl. XI.). The superoccipital tract slopes more forward, is more continuous with the general longitudinal upper convexity of the cranium. The basisphenoidal platform is longer in proportion to its breadth; it shows a large central orifice of a canal extending upward and backward. The alisphenoidal tuberosity (fig. 4, 6) is more prominent and divided from the pterapophysis by a deeper and narrower fissure. The foramen ovale is divided by a better-marked bar into an upper smaller and lower larger division. The paroccipital bends down from the mastoid more abruptly, at a right angle to the connecting ridge, in order to form the back part of the tympanic fossa. The temporal depression is relatively smaller, especially in antero-

[1] Femur, Trans. Zool. Soc. vol. iii. pl. 46. figs. 1–3; tibia, ib. pl. 47. fig. 2; metatarse, ib. pl. 48. fig. 3.

posterior diameter; an extent of 1 inch 9 lines intervenes at the upper part of the cranium between these fossæ (fig. 3). The postorbital process is triangular, more rapidly decreasing in breadth as it descends, and its outer plane is directed more backward, less outward, than usual. The presphenoidal rostrum, 2 inches 8 lines in length, is compressed at its middle part below, expanded and convex before and behind this ridge, pointed anteriorly and confluent throughout its upper extent with the prefrontals and orbito-sphenoids. The "shelf" (Pl. XIV. fig. 4, 9″) extends further outward than in *Dinornis crassus* or *D. rheïdes*. A broad vertical lamina, continued from the lachrymal and the olfactory girdle, descends external to the posterior olfactory orifice almost to the level of the presphenoid, forming the anterior wall of the orbit. The fronto-nasal articular tract for the median process of the premaxillary is 1 inch 7 lines in length and 6 lines in breadth (fig. 3); there is no distinct orbital process of the nasal.

The mandible of *D. gravis*, 4 inches 4 lines in length, is 2 inches 9 lines across the condyles, 1 inch 3 lines in breadth opposite the back part of the symphysis, which is only 7 lines in length (fig. 6). The splenial bends inward anteriorly toward the symphysis, its pointed end terminating in the groove at the back part of the symphysis: it has coalesced throughout its length with the other elements of the lower jaw. The form of the symphysial or rostral part of this lower jaw (Pl. XIV. fig. 6) indicates a corresponding breadth and obtuse termination of the short rostral part of the premaxillary. The type of beak of *D. crassus* is that which is exemplified in *D. gravis*. In size of head *D. gravis* most resembled *D. rheïdes*; but the degree in which specific characters are exemplified may be satisfactorily appreciated by contrasting their respective mandibles in the figures 5 and 6 of Pl. XIV.

Skull of Dinornis ingens, *Ow.* (Plate XV.)

To pl. 23, vol. iv. of the Transactions of the Zoological Society, representing the most perfect skull of a *Dinornis* which had come to my hands at the date of my fifth Memoir (Nov. 12, 1850, p. 59), I added a note of interrogation to the name of the species to which such skull was, with that expression of doubt, referred.

This skull and many other bones, including limb-bones of *Dinornis ingens*, were discovered in 1849 in a cave in the district which lies between the river Waikata and Mount Tongariro, in the North Island of New Zealand; they were obtained and liberally transmitted to me by Governor Sir George Grey in 1850.

Successive receptions of Moa-remains, especially those with which the British Museum has been enriched by the laborious collectings of Mr. Walter Mantell, have added evidence of the general fixity of the characters of the above-described skull as belonging to an adult individual of a large and well-defined species; and the recent additional confirmation of its appertaining to the *Dinornis ingens*, published in the Palæontological part of the Circumnavigatory Expedition of the 'Novara,' induces me no longer to defer the publication of the description and figures of the more perfect materials at my command for the restoration of this instructive part of the skeleton of that species.

The portion of skull referred by Dr. Gustav Jaeger to *Dinornis* (*Palapteryx*) *ingens*, in the above-cited work (4to, p. 307, Taf. 25, 26), consists of the cranial part only, wanting both upper and lower mandibles. The locality where the specimen was discovered is not noted; it is stated to have formed part of the rich collection of remains of *Dinornis* obtained by Dr. v. Hochstetter during the stay of the Expedition of the Imperial Austrian frigate 'Novara' at New Zealand[1].

Dr. Hochstetter, however, was so fortunate as to have presented to him the parts of the skeleton of one individual Moa, determined by proportions of the leg-bones to be *Dinornis ingens*, which had been discovered in a limestone cavern on the right bank of the Aorere River, in the Province of Nelson, New Zealand, in which, with the cranium, were the two tympanic bones ("Quadratknochen") and both upper and lower jaws. Unfortunately no other figure of this skull is given, save that (much reduced in size, as seen obliquely from below) in the plate of the restored skeleton. It shows, however, as may be seen in the copy added to Pl. XV. (fig. 4) of the present Memoir, the main characteristic distinctions of the skull of *Dinornis ingens* given in Trans. Zool. Soc. vol. iv. pl. 23, viz. the wide temporal fossæ, the long rostral portion of the premaxillary, and the extent of the prenarial septum. Further conformity is shown by the following admeasurements:—

	Dinornis ingens[2].		*'Novara' specimen*[3].	
	in.	lines.	in.	lines.
Breadth of the cranium across the mastoid	3	8	3	8
Breadth of the lower end of paroccipitals	2	10	3	0
Breadth of the lower end of postorbitals	4	0	4	2
Antero-posterior diameter of temporal fossa	1	6	1	6
Antero-posterior diameter of posttemporal division of temporal fossa	0	5½	0	6
Breadth of intertemporal tract	1	8	1	9

I have found no such degree of conformity between skulls of distinct species of *Dinornis* as is here exemplified.

The length, of "about eight inches," assigned to the entire skull of *Dinornis ingens* (p. 61, Zool. Trans. vol. iv.) was estimated on the supposition that the nasal process of the premaxillary (pl. 23, 22') had lost more from its free end than I now know to have been the case; that described skull would not be more than from two to four lines longer than the more perfect specimen figured in Pl. XV. The superoccipital transverse ridge (ib. fig. 2, *d*, *d*) shows two curves on each side the vertical ridge (3), the outer one

[1] "Unter der reichen Sammlung von Moa-Resten, welche Professor Dr. v. Hochstetter bei Gelegenheit der Expedition der k. k. österreichischen Fregatte Novara aus Neu-Seeland nach Wien brachte, befindet sich ein Schädel," &c., p. 307.

[2] Trans. Zool. Soc. vol. iv. pl. 23, and vol. vii. p. 142, pl. 15.

[3] 'Novara' Expedition, Abth. Palæontologie, Taf. xxv. xxvi. (Dr. G. Jaeger's specimen).

being the widest, as in *Dinornis struthoïdes* (Trans. Zool. Soc. vol. iii. pl. 38. figs. 1, 3); the occipital condyle (1) is less pedunculate; the temporal fossæ (fig. 1, 7) are wider, with a different contour; and the prosencephalic chamber is more prominent on the upper surface of the cranium; the smooth tract between the temporal and occipital muscular fossæ is also narrower in *Dinornis ingens* than in *D. struthoïdes*. The mastoid (Pl. XV. fig. 1, 8) is produced as a slender process about five lines below the mastotympanic articulation; the premastoid ridge (ib. 8') seems more definite than in *D. struthoïdes*. The postfrontal process (12) is relatively longer than in *Dinornis robustus*[1]; the zygomatic arch (26 27) sends upward a more definite process toward the postfrontal. The rostrum (22 32) accords with the type of that in *Dinornis robustus* (Zool. Trans. vol. v. pl. 4. fig. 1), but is rather narrower and less obtuse.

The figures, of the natural size, in Pl. XV., in which each bone bears its symbolic number, with similar figures in the present and former Memoirs of other species of *Dinornis*, give grounds of comparison which preclude the necessity of further verbal notice of details. One notes with interest that a species with comparatively long and slender limbs in the present wingless genus has a more lengthened beak (e. g. *Dinornis ingens*) than *Dinornis crassus*, and that the diploë of the cranial walls is less thick, showing the more than usually domed character of the cranium[2] in this broad and flat-headed group of extinct birds. The range in the length of the rostral part of the premaxillary exemplified by *Dinornis crassus* and *Dinornis ingens*, indicates a ground of derivative variety in which the existing *Apteryx* exemplifies a maximized degree. But, unless this gain was sudden in the dwarf species, the intermediate steps should be numerous, and have not yet been observed.

In the 'Bericht über einen fast vollständigen Schädel von Palapteryx,' Dr. Gustav Jaeger compares his specimen with the several figures of the skulls of New-Zealand extinct wingless birds given in the 3rd volume of the 'Transactions' of the London Zoological Society, pls. 38, 39, 52, 53, 55, but appears not to have been cognizant of the Memoir in the 4th volume (p. 205), in which not only is the most complete skull of a Moa described and figured which had, at that date (1850), been obtained, but also one belonging to the same species as that to which Dr. Jaeger is finally led to refer the subject of his description. (See "Erklärung der Tafel xxv., Schädel von *Palapteryx ingens*, Ow.," at the close of the Memoir.)

The chief aim of the comparisons of the accomplished Director der Wiener Thiergartens is to show that his specimen exemplifies the generic characters of *Palapteryx* by contrast with those of the skull referred, erroneously, by me to *Dinornis casuarinus*, in my third Memoir (1848), p. 445, pl. 52. vol. iii. Trans. Zool. Soc. That

[1] In the specimen figured in Vol. IV. (1850) the postfrontals were broken and their abrupt down-bending not sufficiently allowed for (p. 60).

[2] This character of the skull of *Dinornis ingens* is somewhat exaggerated in Dr. Gustav Jaeger's figure (Taf. xxv. *op. cit.*), through the view in fig. 1 not being a direct profile but looking obliquely on the calvarium.

skull I now believe to have belonged to the *Dinornis otidiformis* of the first Memoir (1843), vol. iii. p. 247, pls. 25, 26. fig. 5, founded on a *tibia*, but recognized by the subsequent acquisition of the metatarsal as a distinct genus, *Aptornis*, belonging to a distinct family, perhaps order, of birds from that to which *Dinornis* belongs. The rectification was made in my fourth and fifth Memoirs (1850), vol. iv. Trans. Zool. Soc. pp. 10 and 62. Upon that rectification I lost the best ground on which I had previously based the generic distinction of *Dinornis* from *Palapteryx*; and now there remain the degree of development of the abortive and functionless back toe, which I cannot regard of generic importance, and the proportions of sternum, limb-bones, and rostral part of the beak-bones, all more or less gradational. With the breadth of trunk concomitant with limbs so robust and divergent as in *D. robustus*, *D. elephantopus*, and *D. crassus*, the sternum is broad in proportion to its length, and the side processes more divergent[1]; yet the dinornithic type of that bone is closely kept.

The robuster-limbed and broader-bodied Moas, however, do not all show the short, broad, obtuse form of beak; and I confess that the general conformity of cranial structure under the modifications illustrated in the present Memoir do not promise an advantage, by drawing a line which must be more or less arbitrary in whatever direction, equivalent to the imposition of two names for such divisions of a group of species so natural and closely allied as I would at present indicate by the sole generic name *Dinornis*.

On the Cranium of a Gigantic Bird (Dasornis[2] londinensis, *Ow.*) *from the London Clay of Sheppey, Kent.* (Plate XVI.)

The study and foregoing illustrations of the cranial structure of the recently extinct species of large terrestrial birds, induce me no longer to defer communicating similar evidence of one which passed away at a much more remote period of geological time. This evidence is the cranial part of the skull, which has been reduced by rough usage of the elements to a similar state with that of the cranium of *Dinornis giganteus* above described (p. 138). Very little of the outer table of the walls of that cavity is preserved; and much of the thick pneumatic diploë is exposed, not only along the upper (parieto-frontal) walls, but at the back and base of the cranium.

To this state it appears to have been brought, probably in its transport seaward by the mighty eocene river, prior to petrifaction in the mud with which it finally became enveloped. In the mass of such matrix, converted into petrified "London clay," of which geological formation the Isle of Sheppey now mainly consists, this cranium was gathered with other eocene fossils, and was obtained from a local collector by the Earl of Enniskillen, F.R.S., to whom I am indebted for the opportunity of describing

[1] Memoir XIII., vol. vii. Trans. Zool. Soc.

[2] *δάσος*, a thicket (in reference to the abundance of fossil fruits and other arboreal evidences associated with the remains of the large bird).

it, and to Mr. Davies, of the Department of Geology, for first calling my attention to the specimen in a collection of Sheppey fossils which Lord Enniskillen had sent (for determination) to the British Museum.

In size this cranium equals that of the *Dinornis giganteus*; its proportions are also dinornithic, exemplified in the great breadth, small height, and forward slope of the occiput, in the flatness of the calvarium—with all the indications, in short, of low cerebral development. But there are well-marked differences as compared with *Dinornis*. The occipital condyle (Pl. XVI. fig. 3, 1) exceeds in size by 1 line that of *Dinornis robustus* (Trans. Zool. Soc. vol. v. pl. 56. figs. 1, 2, 1) in both vertical and transverse diameters; its shape is almost the same; and it is similarly impressed along the middle of its upper half by a vertical groove deepening, and in the fossil slightly expanding, to the end. This latter character is more marked in *Dinornis elephantopus* than in *D. robustus*; but the groove goes lower, and the hemisphere is more truncate above in *D. elephantopus*.

The condyle in the fossil shows, under the pocket-lens, the same fine punctate diploë, or cellular structure, as does the condyle in *Dinornis*, when the thin, smooth outer coat has been rubbed off. The foramen magnum (ib. *o*) is rather smaller, especially across, than in *Dinornis giganteus* or *D. robustus*; it resembles in shape that of the specimen of the latter species from the limestone fissure at Timaru, figured in Trans. Zool. Soc. vol. v. pl. 53. fig. 2, *o*. The foramen has been overtopped, not by so sharp or narrow a penthouse as in *Dinornis robustus* (ib.), but by a thicker prominence of the combined ex- and super-occipitals, like that in *Casuarinus*, in *Dromaius*, and in *Dinornis gravis*. The abrasion of this part, and of the arc thence curving down to each paroccipital, exposes the diploë at many parts; where the outer table remains it shows the arched ridge (ib. 3, *d*) to be broader and more smoothly rounded than in *Dinornis robustus*, more like that in *Dinornis elephantopus*; but the descending curve is less, the arch is wider, spanning more transversely to the paroccipitals (ib. 4): in the degree of transverse and vertical concavity of the area below the exoccipital arch (2, 2, fig. 3. Pl. XVI.) *Dasornis* resembles *Dinornis robustus* rather than *Dinornis elephantopus*, in which the area is more depressed. The vagal foramina in this area, of which the right is plainly recognizable, open rather nearer the condyle than in *Dinornis*. In a direct upper view (fig. 1) the condyle is visible, as in *Dinornis struthoïdes* (Trans. Zool. Soc. vol. iii. pl. 38. fig. 3) and in *D. dromioïdes* (ib. pl. 39. fig. 5). It is plain from what remains of the basioccipital tuberosities (Pl. XVI. fig. 3, 1′ 1′) that they were developed from a tract not descending below the condyle in a degree beyond that in *Dromaius*; otherwise they resemble those protuberances in *Dinornis* in size and position. The superoccipital surface (ib. 3) inclines from below forward in a degree as great as in *D. struthoïdes* and *D. dromioïdes* (Trans. Zool. Soc. vol. iii. pl. 39. figs. 4 & 5)—consequently more so than in the larger Moas, much more so than in any of the existing *Struthionidæ*, or in any aquatic or other known living bird.

Notwithstanding the degree of abrasion of the transverse superoccipital ridge, there is evidence of the two outer and larger curves (3, *d*, fig. 3), convex forward, continued as in *Dinornis struthoïdes* (*op. & tab. cit.*) to the paroccipital ridges. These were inclined backward, as in *Rhea* and *Dinornis*; but to what degree, or how far the ridges descended, the broken specimen gives no information.

Against an indication of a short pterapophysis, on the right side, part of what is plainly a pterygoid abuts by its hinder end; this lamelliform bone extends forward and, as in *Rhea*, slightly outward, and joins a similar fragment of a lamelliform palatine which has been pressed upward into the orbit, above the level of the presphenoidal rostrum (fig. 2, 9). Of this rostrum, a length of nearly two inches is continued forward from the basisphenoid (ib. 5); its wide-celled pneumatic structure is exposed, as one sees in similarly abraded *Dinornis*-skulls. To the left of the anterior broken end of the rostrum, in the same relative position as in *Dinornis robustus*, is a portion of the hind part of a broad palatal plate of the premaxillary (fig. 2, 22); and suturally connected therewith is the palatal process of the maxillary (ib. 21), fractured across where it was contracting and thickening to join the palatine bone (compare Pl. XVI. fig. 2, 22″ 21″, with Pl. XV. and Trans. Zool. Soc. vol. v. pl. 56. fig. 1, 22″ 21″).

On the left side of the cranium, part of the smooth upper surface is continued upon a process arching downward (Pl. XVI. fig. 4, 12), which I regard as homologous with the postfrontal in *Dinornis*; the broken termination shows a fore-and-aft breadth of 5 lines, a transverse thickness of 2 lines; and the fracture exposes the same open pneumatic diploë as in *Dinornis*. This process is distant from the back part of what remains of the paroccipital process 1 inch 3 lines. It is consequently nearer that process, being more backwardly situated, than in *Dinornis robustus* or *D. elephantopus*. But the Moas differ among themselves in this respect, according to, or with concomitant differences in, the antero-posterior extent of the temporal fossæ. Thus *Dinornis rheïdes* more resembles *Dasornis* in this respect. But in the proximity of the postfrontals to the occiput *Dasornis* still more nearly resembles *Struthio*; and the resemblance extends to a concomitant large expanse of the superorbital arch.

Again, we find in what is preserved of the fore part of the cranium a marked departure from the dinornithic type, and an adhesion as well marked to that of existing *Struthionidæ*. The fore half of the interorbital part of the frontals (fig. 1, 11) is contracted, as in *Rhea* and *Dromaius*, and is concave transversely, as in *Rhea*. To its sides articulate the broad hind parts of a pair of bones (ib. 15, 15) which I regard as homologous with the two distinct nasals in *Rhea* and *Struthio*. These parts of the nasals, beginning narrow, or by a point, behind, rapidly expand and meet as they advance, so as to give a pointed form to the included part of the calvarium. Whether this part be the frontal (11), or an exposed surface of the connate prefrontals (æthmoid, 14), the abraded surface of the bone does not permit to be defined with certainty.

The structure of this interesting fossil, as far as it can be defined, shows it to be of a bird; its configuration and proportions exemplify combinations of dinornithic and modern struthious characters. What the mandibles may further prove, time, we will hope, may discover. But this I anticipate with confidence, that further acquaintance with the osseous structure of *Dasornis* will show it to be no exception to the flightless and terrestrial nature of all other known birds of like hugeness.

The present evidence of such a bird in so old a tertiary deposit as the London Clay at once recalled the discovery of the limb-bones of an equally gigantic bird by M. Gaston-Planté (tibia) and by Professor Hébert (femur) in the lower conglomerate of the eocene plastic clay at Meudon, near Paris. For the conclusions to which the study and comparison of these bones led me, I would refer the palæontologist to the Memoir quoted below[1], to which M. Alphonse Milne-Edwards has done me the honour to refer[2]. I will only add that the main part of the shaft of the fibula of *Gastornis* has been more recently discovered in the same formation at Passy, near Paris[3], which exhibits as extensive a connexion with the tibia, and proportions almost as massive and robust as the fibula of *Dinornis*, like which genus, *Gastornis* will probably prove to be tridactyle and terrestrial. It is possible (one cannot venture to say more) that the cranial fragment here described may belong to the same genus as the Parisian eocene large bird[4].

[1] "On the Affinities of the large Extinct Bird (*Gastornis parisiensis*, Hébert), indicated by a fossil femur and tibia discovered in the lowest eocene formation near Paris."—Quarterly Journal of the Geological Society of London, vol. xii. p. 204, pl. 3 (1856). I am glad to find, carefully reperusing this Memoir, that it affords no ground for the difference alleged to exist between myself and the accomplished writer of the following remarks:—" Je ne puis partager l'opinion de M. Owen relativement aux rapports qui existent entre le *Gastornis* et les oiseaux du groupe des Rallides."—Alphonse M.-Edwards, Recherches Anatomiques and Paléontologiques pour servir à l'Histoire des Oiseaux Fossiles de la France, 4to, p. 172.

[2] *Op. cit.* p. 167.

[3] *Op. cit.* pl. 29. figs. 3 & 4.

[4] In the Memoir quoted by M. Alphonse Milne-Edwards, the following 'Rapports' between *Gastornis* and *Dinornis* are thus indicated:—" Interesting, unquestionably, is the median position of the supratendinal bridge in *Gastornis*; and it would indicate affinities to the Swan and Goose, were not the same bridge equally medianly situated in the Gallinule, the *Notornis*, the Raven, some Accipitrine birds," &c. " The inclination of the canal to the inner side, and the position of the lower outlet to the left of the median plane, in *Gastornis*, while it is a departure from the Anserine type, is an approximation to the Gallinaceous and Dinornithic structures."—*Quarterly Journal of the Geological Society*, vol. xii. p. 215. And, again, " In the aspect of the lower outlet of the tendinous canal the *Gastornis* more resembles the known larger wading and land birds and the *Dinornithidæ* than it does any aquatic bird."—*Ib.* p. 216. " The proportions of the tibia, its thickness *e. g.* in proportion to its length, would plainly show that the Parisian eocene bird had more robust and shorter legs than the typical waders, and probably was, as other birds of like dimensions, better adapted for terrestrial life."—*Ib.* p. 216.

DESCRIPTION OF THE PLATES.

PLATE X.

Dinornis elephantopus.

Fig. 1. Side view of skull (wanting zygoma).
Fig. 2. Back view of cranium.
Fig. 3. Upper view of cranium.
Fig. 4. Under view of cranium.
Fig. 5. Front view of cranium.
Fig. 6. Upper view of premaxillary.
Fig. 7. Under view of premaxillary.
Fig. 8. Under view of symphysial end of mandible.
Fig. 9. Upper view of symphysial end of mandible.

PLATE XI.

Dinornis crassus.

Fig. 1. Side view of skull.
Fig. 2. Upper view of skull.
Fig. 3. Under view of skull.
Fig. 4. Back view of cranium.
Fig. 5. Inner surface of tympanic.
Fig. 6. Outer surface of tympanic.
Fig. 7. Inner surface of mandibular ramus.
Fig. 8. Under view of mandibular ramus and symphysis.
Fig. 9. Upper view of mandibular ramus and symphysis.

PLATE XII.

Dinornis rheïdes.

Fig. 1. Side view of skull.
Fig. 2. Back view of cranium.
Fig. 3. Top view of cranium.
Fig. 4. Base view of cranium.
Fig. 5. Top view of mandible.
Fig. 6. Back view of left ramus of mandible.
Fig. 7. Inner view of left ramus of mandible.
Fig. 8. Inner view of right zygomatic arch.
Fig. 9. Outer view of right tympanic.
Fig. 10. Inner view of right tympanic.

PLATE XIII.

Dinornis casuarinus.

Fig. 1. Side view of skull (wanting zygomatic and palato-pterygoid arches).
Fig. 2. Upper view of cranium.
Fig. 3. Under view of cranium.
Fig. 4. Upper view of premaxillary.
Fig. 5. Under view of premaxillary.
Fig. 6. Inner side of left mandibular ramus.
Fig. 7. Under view of symphysial end of mandible.
Fig. 8. Upper view of symphysial end of mandible.

Dinornis giganteus.

Fig. 9. Vertical longitudinal section of cranium.
Fig. 10. Inner side of right mandibular ramus, mutilated.
Fig. 11. Under surface of symphysial end of mandible.
Fig. 12. Upper surface of symphysial end of mandible.
Fig. 13. Inner side of left tympanic of *Din. casuarinus.*

PLATE XIV.

Dinornis gravis.

Fig. 1. Side view of skull.
Fig. 2. Back view of cranium.
Fig. 3. Top view of cranium.
Fig. 4. Base view of cranium.
Fig. 5. Top view of symphysis mandibulæ.
Fig. 6. Top view of symphysis mandibulæ of *Dinornis crassus.*

PLATE XV.

Dinornis ingens.

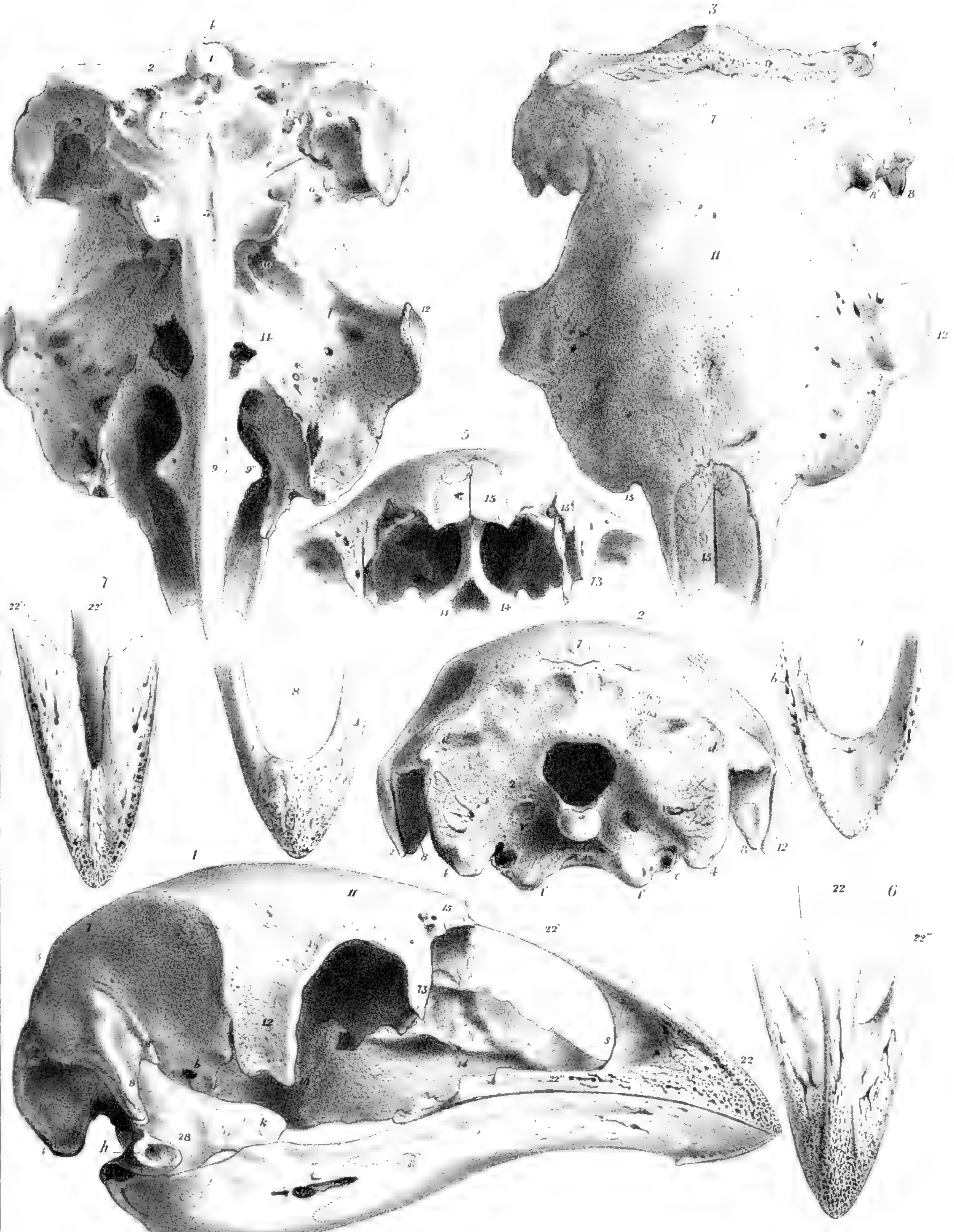
Fig. 1. Side view of skull.
Fig. 2. Back view of cranium.
Fig. 3. Base view of skull (minus mandible).
Fig. 4. Reduced side view of skull (*ex* Jaeger, *loc. cit.*).

PLATE XVI.

Dasornis londinensis.

Fig. 1. Upper view of cranium.
Fig. 2. Under view of cranium.
Fig. 3. Back view of cranium.
Fig. 4. Side view of cranium.

All the figures are of the natural size; the numerals and letters are explained in the text.



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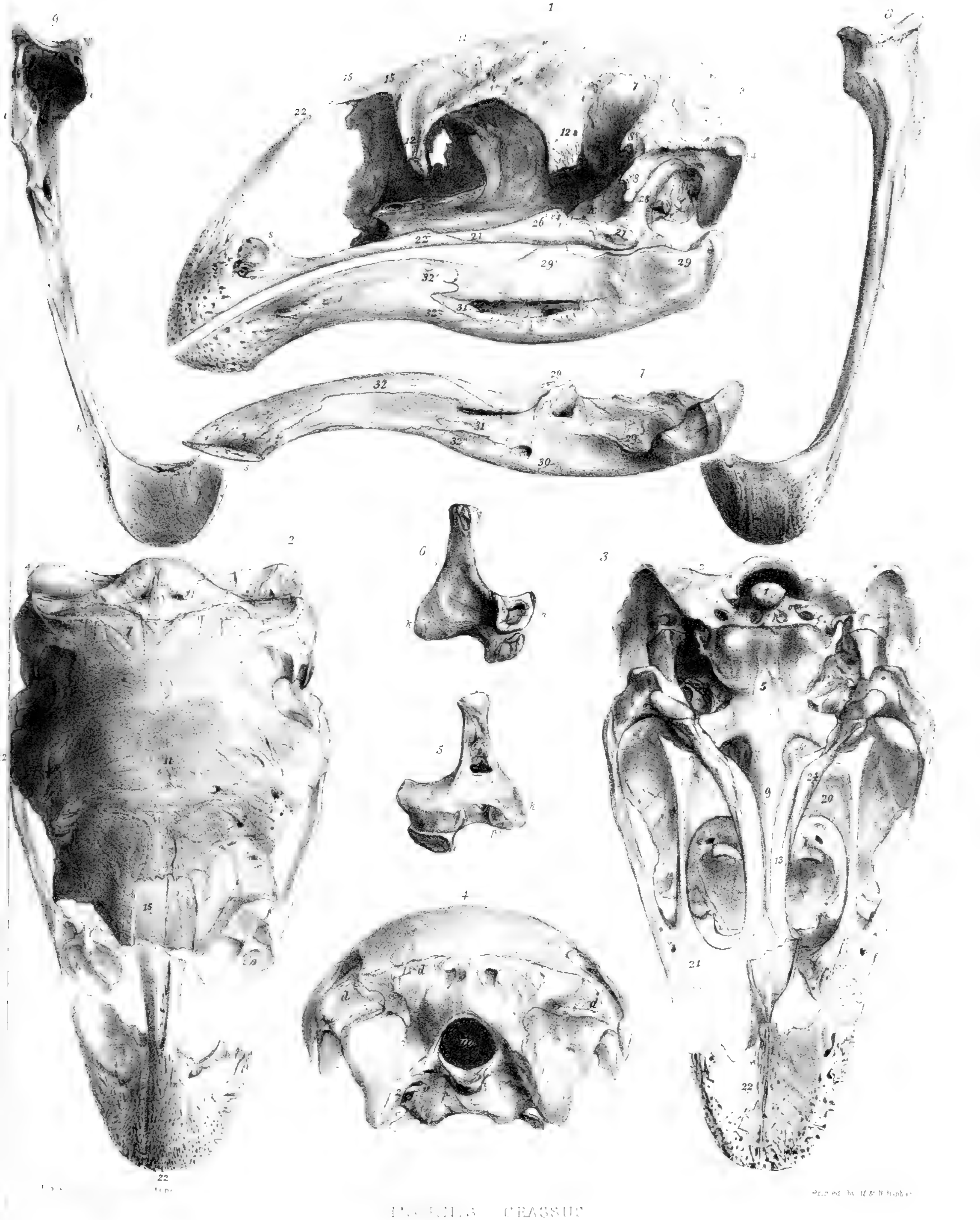
DINORNIS ELEPHANTOPUS



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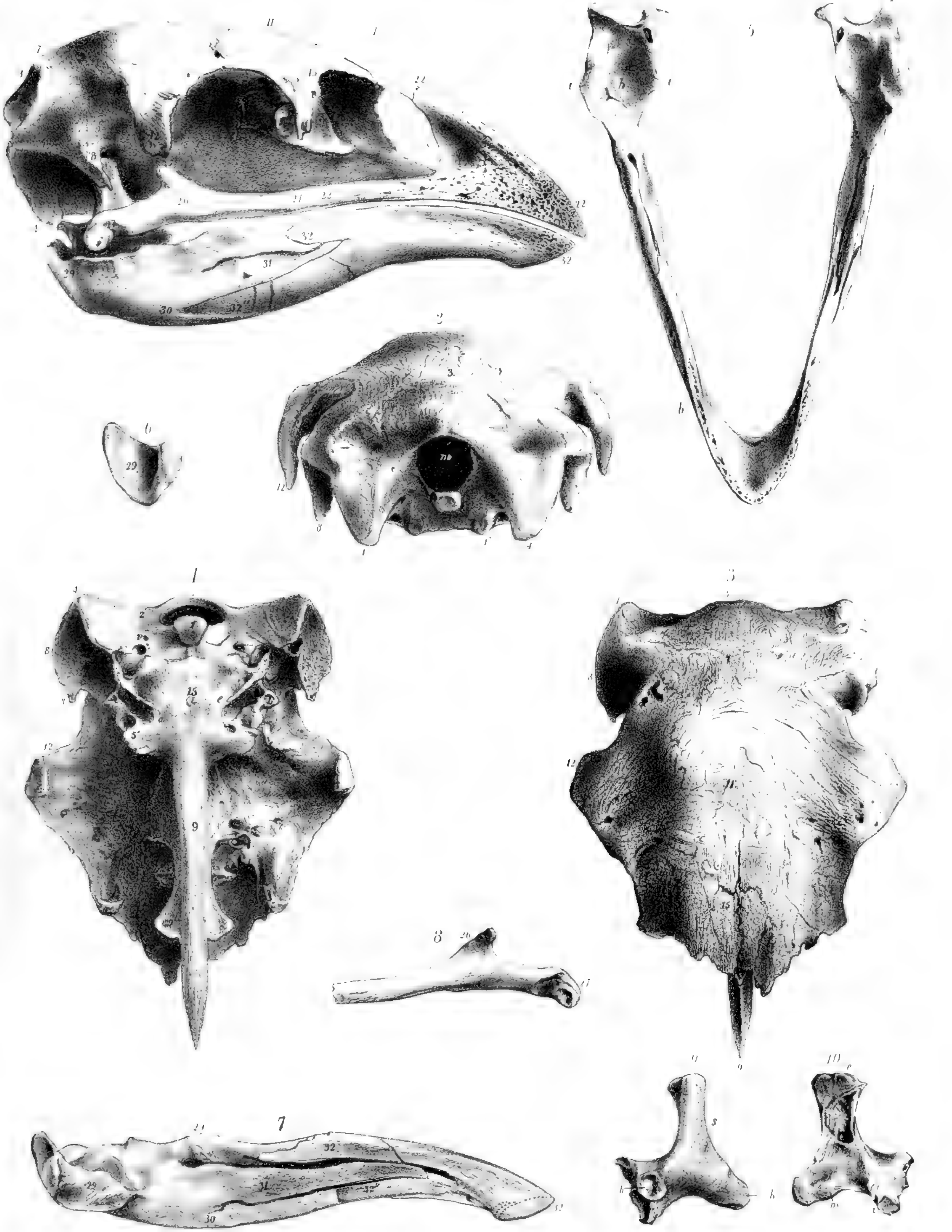

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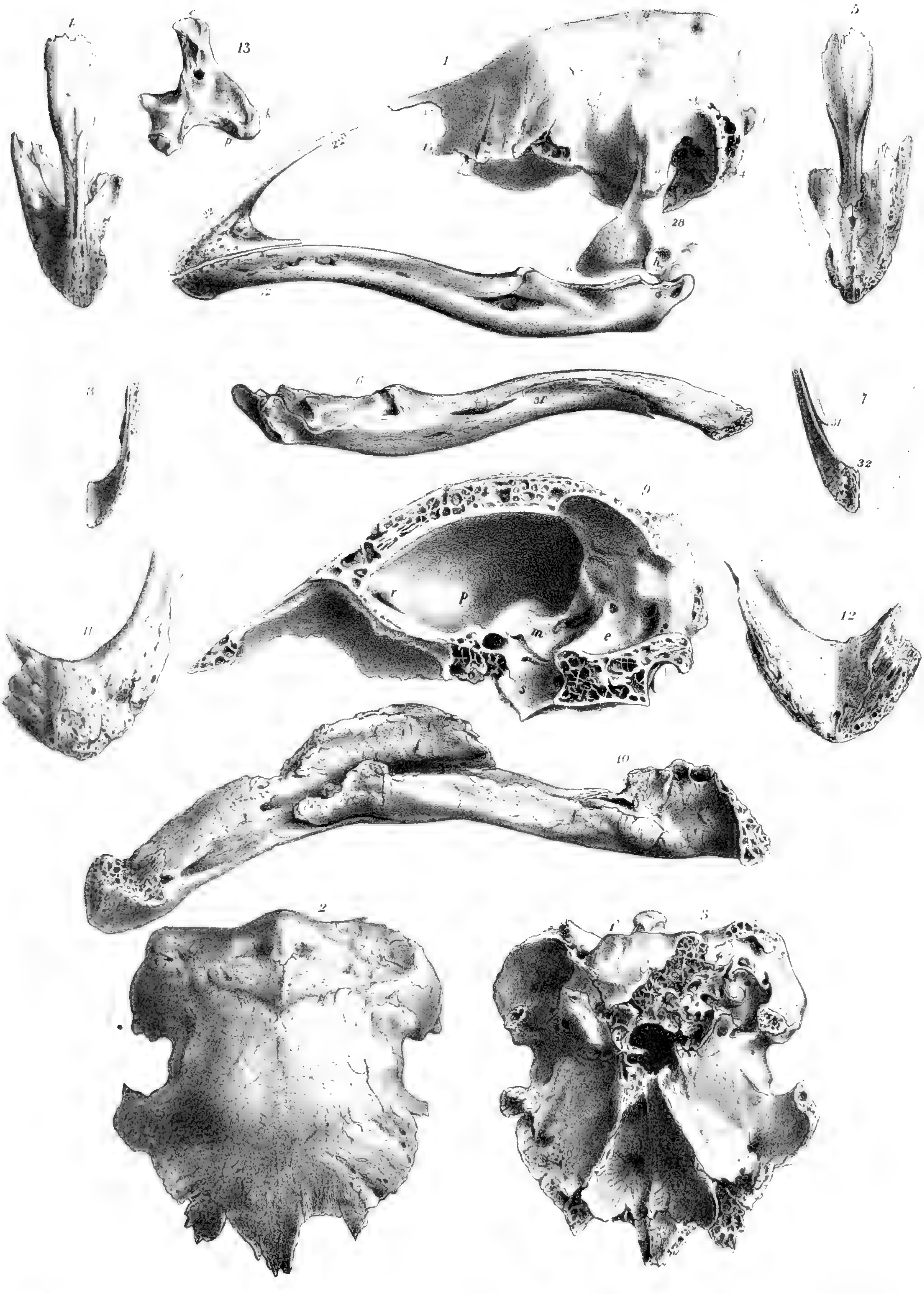
DINORNIS RHEIDES



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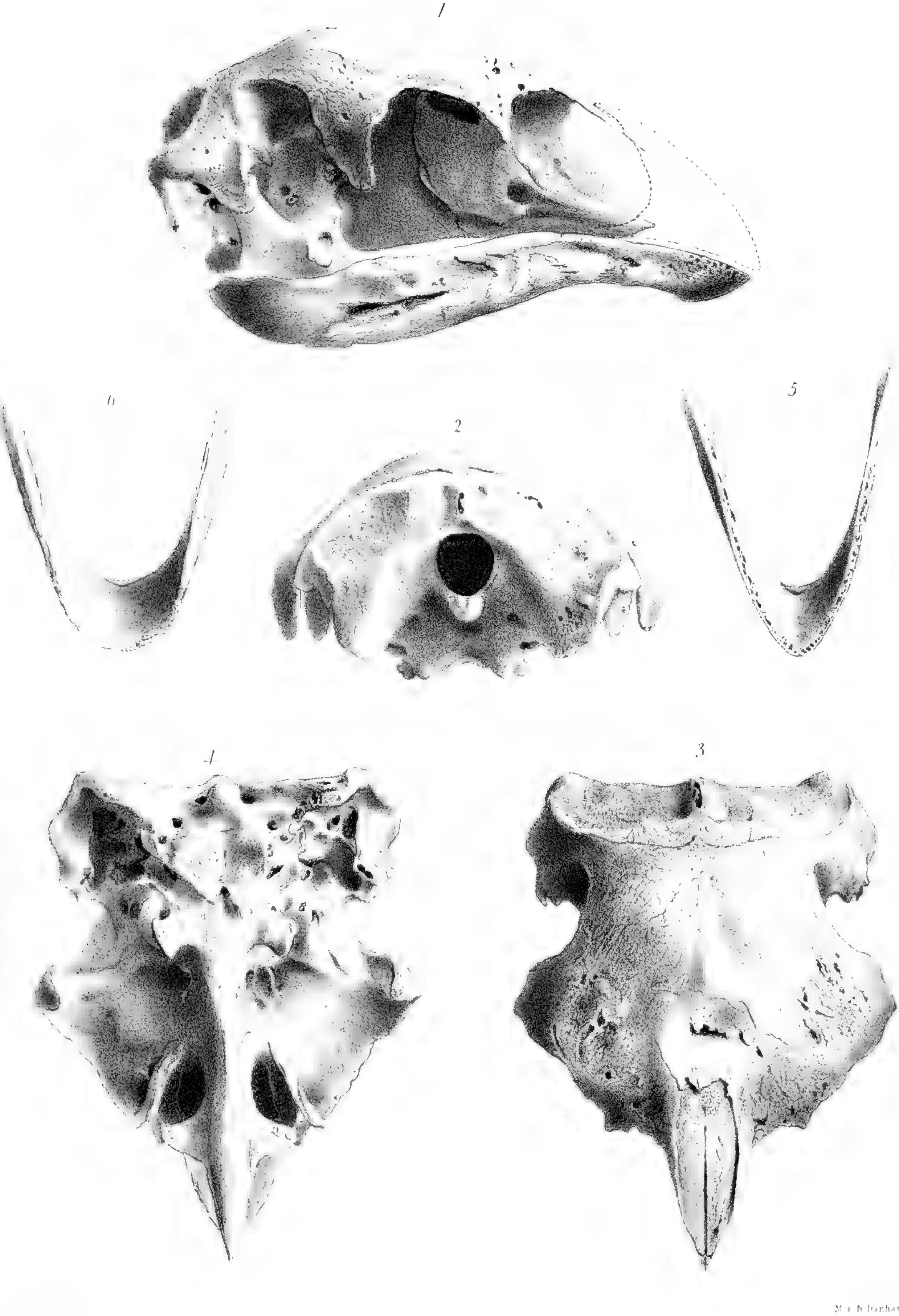

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DINORNIS GRAVIS

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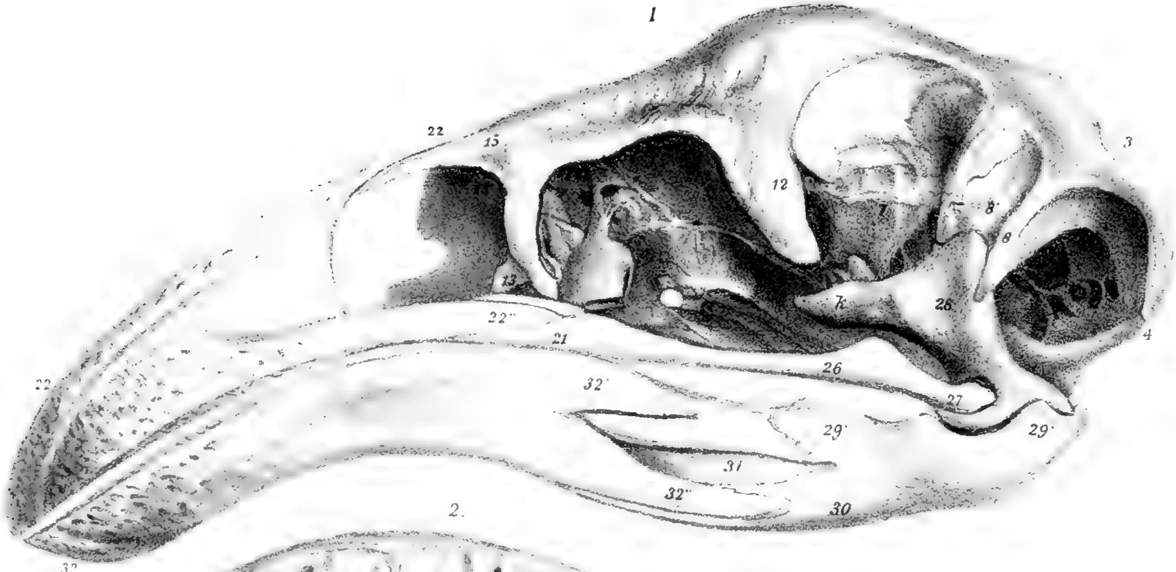

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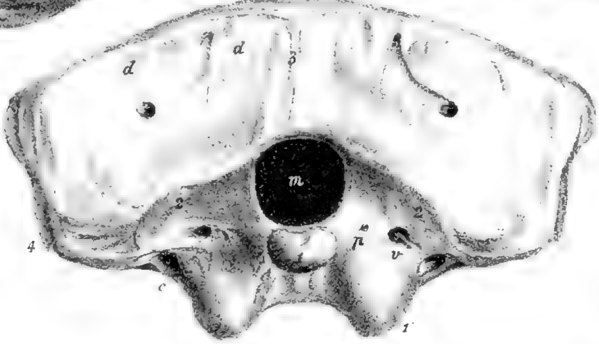

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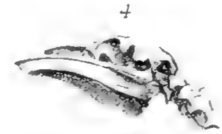

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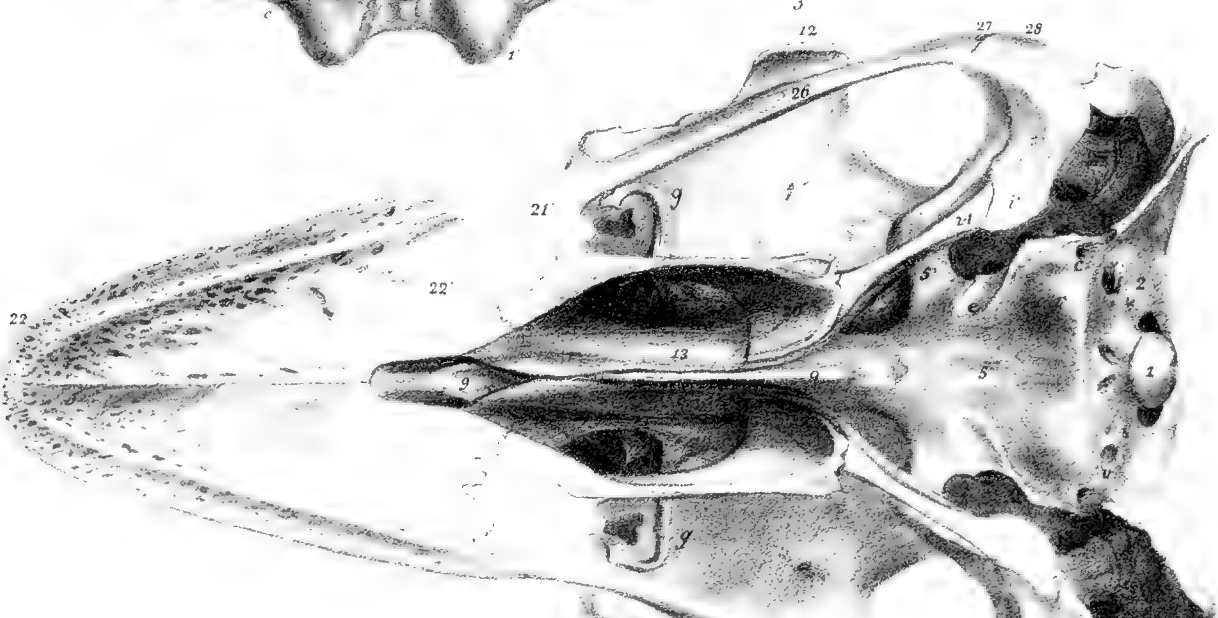

R. Owen del.

J. Erxleben lith.

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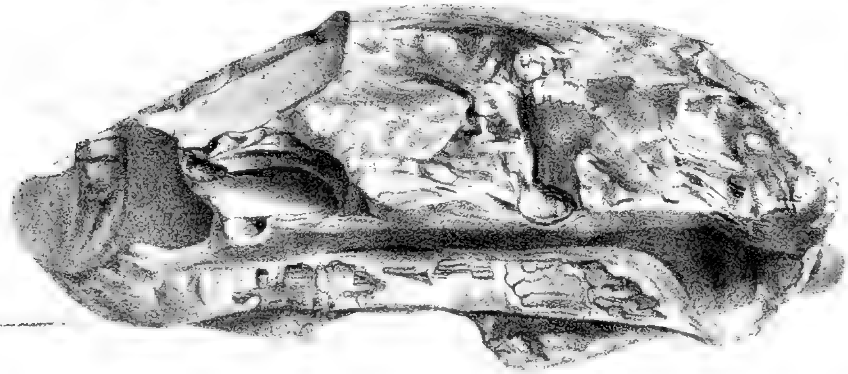
2

3.

4



On stone by J. Erxleben

IV. *Description of the Skeleton of the Chinese White Dolphin* (Delphinus sinensis, *Osbeck*). *By* William Henry Flower, *F.R.S., F.R.C.S., F.Z.S., Conservator of the Museum of the Royal College of Surgeons of England.*

Read June 10th, 1869.

[Plates XVII. & XVIII.]

THE Swedish missionary and naturalist, Peter Osbeck, writing in 1751, says that, while lying at anchor in the Canton River, "Snow-white Dolphins (*Delphinus chinensis*) tumbled about the ship; but at a distance they seemed in nothing different from the common species, except in the white colour"[1]. Upon the strength of this brief description *Delphinus chinensis* is introduced by Desmarest into the list of species of the genus, though with the asterisk indicating "les espèces douteuses ou trop peu connues."[2]

Fred. Cuvier sums up as follows the opinion of the zoologists of his time upon the White Dolphin of Osbeck (whose name he modifies into the more classical *sinensis*):—"Quelques auteurs distinguent ce dauphin comme espèce, et M. Desmarest est du nombre. D'autres, tels que Bonnaterre (Cétologie, p. 21), n'en font qu'une variété du dauphin commun, prenant à la lettre les premiers mots d'Osbeck; et mon frère était disposé à réunir ce dauphin blanc au delphinaptère de Péron (Ossem. Foss. t. v. p. 289). Le fait est que la phrase d'Osbeck est insuffisante pour caractériser aujourd'hui une espèce du genre dauphin."[3]

In Dr. Gray's 'Catalogue of Seals and Whales in the British Museum,' 2nd edit. (1866), "*D. chinensis*, Desm., from Osbeck's Voy.," is admitted among the species "requiring further examination" (p. 266). In the more recent 'Synopsis' of the same zoologist, which is confined to the species which he has "been able to examine, compare, and characterize," it is omitted altogether[4].

As far as I can ascertain, no portion of this striking and well-marked species has ever been examined by any naturalist, and, but for the passing allusion of the Swedish traveller more than a hundred years ago, nothing would be known even of its existence.

Under these circumstances it is a subject of congratulation that our zealous member, Mr. Robert Swinhoe, H. B. M. Consul at Amoy, has succeeded in obtaining a fine

[1] 'A Voyage to China and the East Indies' (in 1751), by Peter Osbeck. Translated by J. R. Forster, Lond. 1771, vol. ii. p. 27.

[2] Desmarest, 'Mammalogie,' Encyclop. Méthod. (1822), p. 514.

[3] F. Cuvier, 'Histoire naturelle des Cétacés' (1836), p. 213.

[4] 'Synopsis of the Species of Whales and Dolphins in the Collection of the British Museum.' By J. E. Gray, 1868.

skeleton of this Dolphin, and has most liberally presented it to the Museum of the Royal College of Surgeons.

In a letter dated "British Consulate, Amoy, 23rd September, 1867," Mr. Swinhoe says, "I have managed during my incumbency here to procure the skeleton of the White Porpoise that rolls in the harbour of Amoy. The live animal is of a milky white, with pinkish fins and black eyes. I desire to present this skeleton to the Royal College of Surgeons, and beg that you will undertake a full description of it in the Zoological Society's Transactions. The weather was very hot when the present specimen was acquired, it being midsummer; and its capture having taken place at Quemoy (a large island to seaward of Amoy) it was found impossible to bring it to me in a fresh condition; my hunter, therefore, had the bones partially cleaned and brought them to me. I had them well dried before I packed them up. I regret that I was unable to see the entire animal, as I would in such case have taken a drawing and a full description of it. I have striven in vain to get another specimen. The animals are of daily occurrence in the harbour; but the Chinese are not adepts at catching them. I have often watched their gambols and have seen them wounded. When wounded they make seaward, the wounded beast generally pursued by his fellows. They appear to occur in this harbour through the greater part of the year. In the box you will find a few bones of a second individual, which I procured from a fisherman here. These seem to differ somewhat from the corresponding bones in the first specimen."

In a subsequent letter, dated "Hongkong, 28th January, 1868," in reply to my inquiries as to the geographical range of the animal, Mr. Swinhoe wrote, "I think I have seen this white species in the Canton river and in the Forchow river, but I have no idea how far it extends north and south. In Formosa I have never seen Porpoises; but the coast there is too exposed and the rivers too barred, I should think, for regular visits of Porpoises."

The specimens received from Mr. Swinhoe consist of:—1. An almost complete skeleton of a perfectly adult individual, all the epiphyses being united to the bodies of the vertebræ. The caudal and pectoral fins were sent entire and dried, thus allowing of a description of their form, as well as preserving the bones of the manus and termination of the vertebral column in a perfect condition. The missing portions of the skeleton are the sternum, some of the sternal ribs, the body of the hyoid, and the pelvic bones. The skeleton as now mounted measures, in a straight line, from tip of lower jaw to end of last caudal vertebra, 7 feet $4\frac{1}{2}$ inches; but as the intervertebral substances which still connect the bodies of the vertebræ have contracted somewhat in drying, the animal during life would probably have been upwards of eight feet in length.

2. Portions of the skeleton of another and slightly smaller individual, viz. a fragment of the cranium, the lower jaw with teeth complete, one lumbar vertebra, two ribs, and two scapulæ.

The genus *Delphinus*, as restricted by F. Cuvier and Rapp, contains numerous species, presenting great diversity of anatomical characters. Unfortunately the requisite materials are still wanting for making a satisfactory arrangement of the group, as complete skeletons of but very few species are preserved in museums, and fewer still have been fully described. Dr. Gray has arranged the species in numerous genera and sections, founded on variations in the characters of the cranium, the only part at present available for the purpose. Although this arrangement is very convenient for the purposes of practical zoology, it is necessarily provisional, and awaits a knowledge of the remainder of the organization to determine its scientific status. On comparing the skull of the present specimen with the description in Dr. Gray's last 'Synopsis' (1868), aided by an examination of the originals in the British Museum, it is perfectly evident that it belongs to a species there undescribed. Its exact position among the numerous divisions of the family can, however, be clearly determined. It belongs to the Tribe *Stenonina*, and genus *Steno* (*loc. cit.* p. 5), characterized by having the "beak of the skull compressed, higher than broad. Symphysis of the lower jaw long." In size and other characters the skull corresponds with Section A of that genus, comprising *S. frontalis* and *S. compressus*; but in the number and size of the teeth it is intermediate between this section and the next, as it has exactly three teeth in each inch of the alveolar margin, whereas in Dr. Gray's first section there are two, in his second (comprising *S. capensis* and *S. lentiginosus*) four in each inch.

This determination of the position of the Chinese White Dolphin, according to its cranial characters, makes an account of its complete osteology particularly important, as no skeleton of any member of this well-marked group (genus *Steno*, Gray) has hitherto been described or figured.

The Cranium (as seen in Plates XVII. and XVIII.) presents the well-known general characters of the allied forms. It closely agrees with *S. frontatus* and *S. compressus* of the British Museum in size, but differs from them in the rostrum being broader at the base and tapering gradually towards the middle, and especially in the form of the pterygoid bones and in the greater number and smaller size of the teeth. In the form of the rostrum and number of teeth it approaches to *S. lentiginosus*, Ow., from the Indian seas, but differs from this species in its superior size, and also in the form of the pterygoids.

The principal dimensions of the skull are as follows:—

	inches.
Entire length	20·7
Length of rostrum	12·8
Breadth of occipital foramen	1·7
Greatest height of occipital foramen	1·8
Breadth of occipital condyles	4·1
Greatest breadth of cranium at parietal region	6·4

		inches.
Greatest breadth at postorbital processes of frontals		8·8
Breadth of anterior narial apertures		2·4
Breadth of rostrum at base		4·7
Breadth of rostrum at a quarter of its length from base		2·9
Breadth of rostrum at the middle		1·85
Breadth of rostrum at three-quarters of its length from base		1·4
Length of upper tooth-line		11·2
Mandible.	Length of ramus	18·
	Length of symphysis	5·5
	Length of tooth-line	11·
	Breadth at condyles	8·
	Height at coronoid process	3·6

The occipital foramen is subcircular, slightly higher than broad. The tentorium is largely ossified. The temporal fossæ are bounded by very prominent ridges. The postorbital processes of the frontals do not meet the squamosals by a space of 2 inches. The anteorbital process is well marked, its depressed outer extremity is formed by the jugal. The styliform portion of the jugal is 4 inches long. The median postnarial prominence of the frontal is strongly marked, and rises slightly higher than the supra-occipital or the nasals; the latter are ankylosed both to the frontals and the ethmoid. The narial apertures exhibit the usual want of symmetry, inclining to the left. The upper extremity of the left præmaxilla is shorter and much more attenuated than that of the right. The rostrum is rather broad at the base, and gradually tapers towards the middle; it then becomes much compressed, and retains very nearly the same breadth to its termination. Correspondingly the palate is broad and flat behind, but narrow and with a deep median groove in its anterior two-thirds; a narrow strip of the vomer appears for a space of 2½ inches in the hinder part of this groove; as in the allied forms, there are no lateral grooves.

The palate-bones are of larger extent than in most Dolphins; and the form of the pterygoids is quite peculiar (see Pl. XVIII. fig. 1, *pt*): instead of meeting in the middle line and concealing the hinder edge of the palatines, they are widely separated throughout their whole extent, and gradually recede from each other till their hinder apices are 2 inches apart. In the other large Stenos, as in nearly all other Dolphins, the pterygoids are in contact in the median line for a distance of 2 inches. In *Steno lentiginosus*, Ow., the inner edges of the pterygoids do not meet, though they are parallel for the greater part of their extent. In *D. gadamu*, which Owen places in this section, and Gray in the genus *Clymenia*[1], the pterygoids appear to resemble those of the present species; the skull, however, cannot be confounded with it, as it is much smaller, has a broader and shorter rostrum, and less numerous teeth.

[1] Synopsis, p. 6.

The petrotympanic bones resemble those of other members of the genus. The greatest length of the scroll-like tympanic is 1″·45, its greatest breadth 0″·85.

The numbers of the teeth of the adult specimen of *D. sinensis*, as indicated by the alveoli, are $\frac{33-32}{32-31}$, total 128. In the second lower jaw there are 32—33. In the former they are unfortunately very incomplete; and as those that remain have mostly fallen from their sockets, and been artificially replaced, absolute reliance cannot be placed upon their present position in the jaws. Many of them, both in the maxilla and mandible, are worn down to flat-topped stumps, which can have scarcely projected above the level of the gum, all of the crown and a portion even of the root having disappeared. Such a mode of wear occurs habitually in *D. tursio*, but I have never observed it in any other of the numerous species of Dolphins. The amount of truncation varies in extent in different parts of the jaw; it affects the lower more than the upper teeth. Those in the posterior part of the maxilla have entirely escaped. Besides the truncation of the apex, many of the upper teeth, especially near the hinder part of the series, have the neck, or that part of the root immediately adjoining the enamelled crown, suddenly contracted for a space of about $\frac{1}{10}''$, apparently by erosion or absorption of the surface.

The characters of the mandibular teeth are well shown in the detached jaw of the younger specimen, as they are nearly all perfect and *in situ*. Truncation of the apex has commenced in nearly all; but the greater number are but slightly affected, and in none is so much as half the crown worn away. The roots of the teeth are much thicker than the crowns, they are slightly flattened from before backwards, and taper upwards to a sufficiently well-marked "neck," above which is the smooth, enamelled, conical, slightly compressed (from before backwards) and incurved crown. In the posterior fourth of the ramus the teeth are placed vertically, but in the remaining portion they incline considerably outwards; the three or four most anterior are again more vertical. Except those at the extreme ends of the series, which, as usual, are somewhat smaller than the others, the teeth of the lower jaw do not differ materially from each other in size. The following are the dimensions of an unworn tooth from near the middle of the series.

	inch.
Entire length	1·00
Length of crown	0·35
Length of crown and portion of root projecting above alveolar margin of jaw	0·50
Greatest (transverse) diameter of root	0·20
Greatest (transverse) diameter of crown	0·23

The teeth are placed at very regular distances, their roots being completely separated by a very narrow strip of alveolus. As nearly as may be, three teeth occupy each inch of the alveolar border.

The stylo-hyals have the usual form, and are 4″·5 long, and 0″·6 in greatest diameter.

The spinal column, which is quite complete, consists of fifty-one vertebræ, seven belonging to the cervical, twelve to the dorsal, ten to the lumbar, and twenty-two to the caudal region. The respective lengths of these four regions in the articulated skeleton are 3 inches, 17½ inches, 16½ inches, and 30 inches.

In the cervical region, the atlas and axis are united, and the remaining vertebræ are free, as appears to be the rule in the genus *Delphinus*. The component parts of the conjoined mass formed of the first two vertebræ can be readily defined. The bodies are thoroughly confluent, though a superficial groove marks the limit of each with tolerable certainty. The arches in their first part, or pedicle, are distinct, and have between them a considerable oval aperture for the transmission of the second spinal nerve. Above this, opposite the zygapophysis, they are firmly united; the laminæ are then separated on either side for a space of half an inch by a linear fissure; and, finally, the spines are completely confluent. This conjoined spinous process is high, massive, sloping backwards, strongly ridged on its median upper or anterior border, and with a rounded and somewhat depressed and truncated apex. The pedicle of the arch of the atlas is very much thicker than that of the axis, and on its anterior border has a deep notch, almost converted into a foramen on the left side, for the passage of the first (the suboccipital) spinal nerve. Both atlas and axis have a single transverse process on each side, that of the former long, stout, rugged, rounded at the end, and directed slightly downwards and backwards. The transverse process of the axis is a small, rough, and rather compressed tubercle, placed nearly on a level with the root of the last, and directed somewhat upwards as well as backwards. The dimensions of these vertebræ are:—

	inches.
Breadth of articular surfaces on atlas for condyles	4·0
Breadth between tips of transverse processes of atlas	5·7
Breadth between tips of transverse processes of axis	3·6
Greatest breadth of spinal canal, inside arch of atlas	1·8
Greatest breadth of spinal canal, inside arch of axis	1·5
Height of spinal canal, inside atlas	1·5
Height of spinal canal, inside axis	1·5
Breadth of body of axis at posterior end	1·7
Height of body of axis at posterior end	1·5
Height from lower surface of body of axis to apex of spinous process	4·0
Length of upper or anterior edge of conjoined spinous process	2·1

The remaining cervical vertebræ have greatly compressed subcircular bodies. The under surface of each has a fringe of rough exostoses growing on each side of the middle line, and leaving (as seen in the figures, Pl. XVIII.) a deep notch at this part.

The arches of all are very similar, and terminate in a very short compressed spine of nearly equal height in all. In the third this spine can scarcely be said to be developed; in the seventh it is very slightly larger than in the others, and the laminæ of the arch are slightly broader. The zygapophyses of all are well developed, and accurately coadapted; the third, fourth, fifth, and sixth have very short superior and inferior transverse processes on each side. In the third these are united together at their extremities on one side only—in the fourth and fifth on both sides, forming complete rings; in the sixth they are not united, and the lower process is greatly developed in the antero-posterior direction; in the seventh vertebra the upper process is alone developed, and the body has on its hinder margin an articular surface for the head of the first rib.

The dorsal vertebræ generally resemble those of other Dolphins. The bodies of the first four only bear articular surfaces for the attachment of the heads of the ribs. The spines are moderately high, compressed, and broad from before backwards. They increase slightly in length from the first. In the posterior part of the region they have a curve forwards. Distinct contiguous articular surfaces to the arches (zygapophyses) cease after the fourth vertebra. The transverse processes have broad concave articular ends for the tubercles of the ribs; they gradually increase in length, but the last two disproportionately so. Tubercles (superior accessory processes or metapophyses), which are first seen on the anterior edge of the transverse process of the third dorsal vertebra, increase in size, and rise up, being transferred to the sides of the arch, and form the characteristic "clasping" processes, which are strongly developed in the hinder dorsal region.

The ten lumbar vertebræ have bodies of nearly equal length, hollowed at the side, and keeled below. The transverse processes are long, flat, broad, and directed nearly horizontally outwards, though the hinder ones are bent down at their extremity, and very rough on their upper surface. The spines are moderately high, broad, and nearly vertical, though curving forwards at their extremities. The clasping processes are less developed at the middle of the region than either before or behind.

The caudal vertebræ present the usual division into two distinct sets—those in front of, and those contained within the expansion of the tail-lobes. The former are twelve in number; they have (especially towards the end of the series) compressed, vertically extended, comparatively long bodies. There is one vertebra which may be called transitional (the thirteenth caudal, see figure); then follow the nine terminal or fin vertebræ, with depressed, transversely extended, and extremely short bodies. The last vertebra is very small, depressed, and triangular when seen from above. The transverse processes of the caudal vertebræ gradually diminish in length to the tenth, where they are mere rough longitudinal ridges: in the eleventh all traces of them have disappeared. The neural arches cease in the thirteenth. The vertical arterial foramina pierce the sides of the first caudal, and are continued throughout the series to the penultimate.

There are fourteen pairs of hæmapophyses (chevron bones), all comparatively short and broad (from before backwards). The first pair are only united for a small space at their backward-directed pointed apex. The others are all firmly united, except the fourteenth pair, which are very minute, flattened, and subcircular. The fifth are the longest. All these bones, as shown in the figure, are exactly in their natural position, as they have never been separated from the bodies of the vertebræ.

The form of the caudal appendage is shown in outline at fig. 2, Pl. XVII., drawn from the dried specimen sent by Mr. Swinhoe, after its natural shape and dimensions had been restored by soaking in water. The length between the extremities of the "flukes" is $20\frac{1}{2}$ inches.

There are twelve pairs of ribs. The five foremost have necks and heads which reach the bodies of the vertebræ. The sixth has a rudimentary neck, the others none, and are only attached to the ends of the transverse processes. The last rib is nearly as well developed as its predecessor. Some of the sternal ribs are wanting; but those that are present indicate that there were at least seven pairs of these bones.

As before mentioned, the sternum is missing.

The scapula generally resembles that of other Dolphins, but it is rather high in proportion to its breadth, and has its posterior angle obliquely truncated. The acromion is broad, and the coracoid rather small. The characters of the scapulæ of the other individual sent by Mr. Swinhoe are precisely similar.

The humerus, radius, and ulna appear to differ little in the true Dolphins, and in the present specimen they offer nothing worthy of note, except that the olecranon is but slightly developed. These bones are ankylosed together at the elbow-joint.

The manus is broader at the base than in most Dolphins (e. g. *D. delphis* and *D. tursio*), and much resembles in form that of *D. guianensis*, as figured by Professor Van Beneden[1]. This breadth is caused by the considerable development and position of the two outer digits. It is falcate and obtusely pointed at the extremity. Considering the age of the animal, the carpal bones are less developed than in other Dolphins available for comparison, as, instead of being united into a sort of closely fitting mosaic, they have rounded borders and are all separated by cartilaginous intervals. They are, as usual, five in number, and probably represent the scaphoid, lunar, cuneiform, trapezium, and unciform. The scaphoid is the largest and of an oblong form, the cuneiform a very small rounded nodule.

The first digit consists of a single, slender, tapering metacarpal, without any ossified phalanx. The other metacarpals are broad and flat. The second digit has six phalanges; the third, five; the fourth, two; and the fifth, one broad phalanx in addition to a well-developed metacarpal. The size of the last two digits (so often almost aborted in the Delphinidæ) is the more remarkable, as the ulnar side of the carpus shows such a comparative arrest of ossification.

[1] Mém. de l'Acad. Roy. de Belgique, Coll. in-8vo, tom. xvi. 1863, p. 33.

The following are the principal dimensions of the pectoral limb:—

	inches.
Scapula.—Height	6·4
Breadth	9·0
Length of acromion	2·6
Greatest depth of acromion	2·1
Length of coracoid process	1·4
Length from head of humerus to tip of fin	13·0
Greatest breadth of fin	5·0
Length of humerus	2·9
Length of radius	3·4
Length of ulna	3·1
Breadth of radius at distal extremity	2·0
Breadth of ulna at distal extremity	1·3

The principal differences between this skeleton and that of all other known Dolphins lie in the vertebral column. The total number of vertebræ is less, the individual vertebræ are proportionally longer, and their transverse processes are shorter and broader than in any other species. Next to it in these characters stands *D. guianensis* (genus *Sotalia*, Gray), which has the following vertebral formula:—C. 7, D. 12, L. 14, C. 22=55; then *D. tursio*, which has C. 7, D. 13, L. 17, C. 25=62. *D. delphis*, with C. 7, D. 13, L. 24, C. 31=75, is at the other extreme, being only exceeded in number of vertebræ, and length and narrowness of the processes by the *Lagenorhynchi*.

If the osteological characters possessed by this specimen be found to exist in other Dolphins with narrow, compressed beaks and long mandibular symphyses, *Steno* will be established as a natural group of generic value.

DESCRIPTION OF THE PLATES.

PLATE XVII.

Fig. 1. Side view of the skeleton of *Delphinus sinensis*, presented by Mr. Swinhoe to the Museum of the Royal College of Surgeons: one-fourth of the natural size.

Fig. 2. Dorsal view of the same skeleton, without the pectoral limbs.

PLATE XVIII.

Fig. 1. Inferior surface of the cranium of the same: half the natural size.

vo. vomer. *pl.* palatine. *pt.* pterygoid. *ty.* tympanic.

Fig. 2. Anterior surface of the conjoined atlas and axis.

Fig. 3. Anterior surface of the third cervical vertebra.

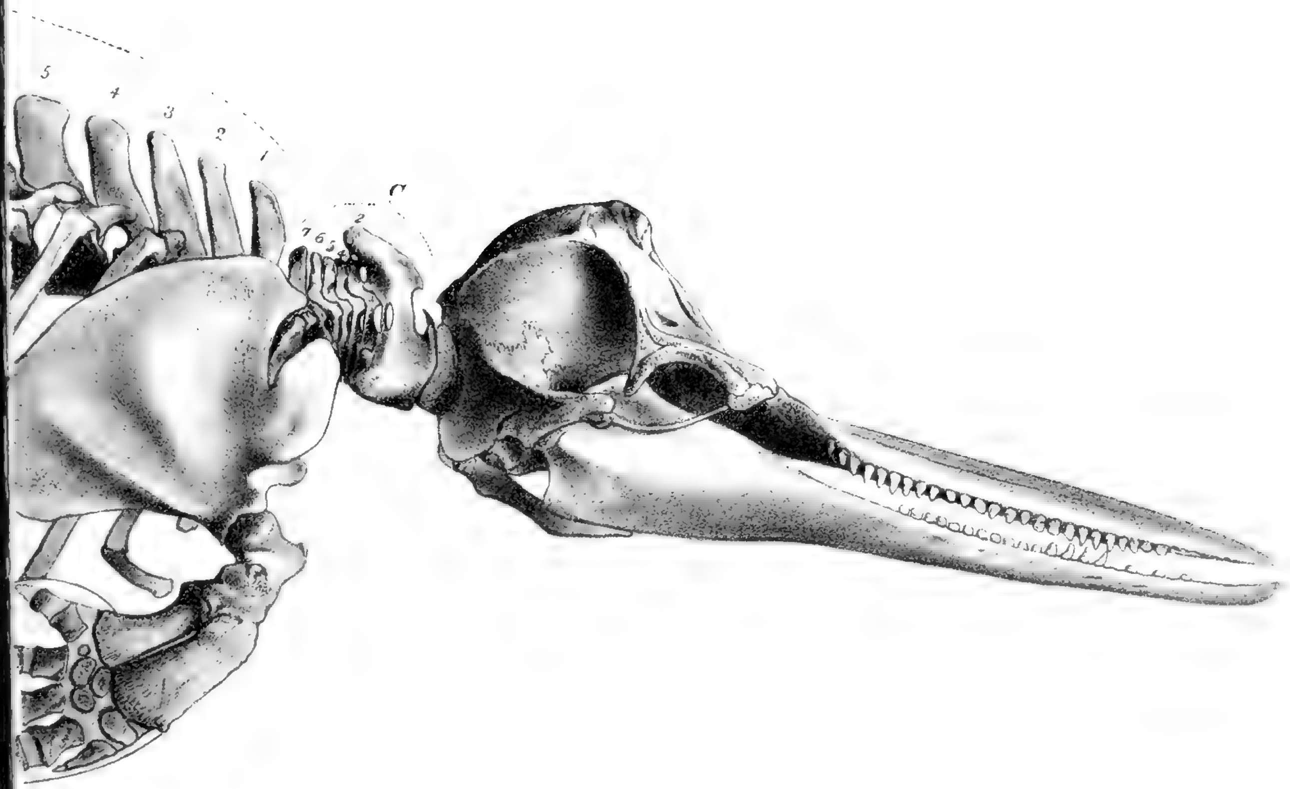
Fig. 4. Anterior surface of the fourth cervical vertebra.

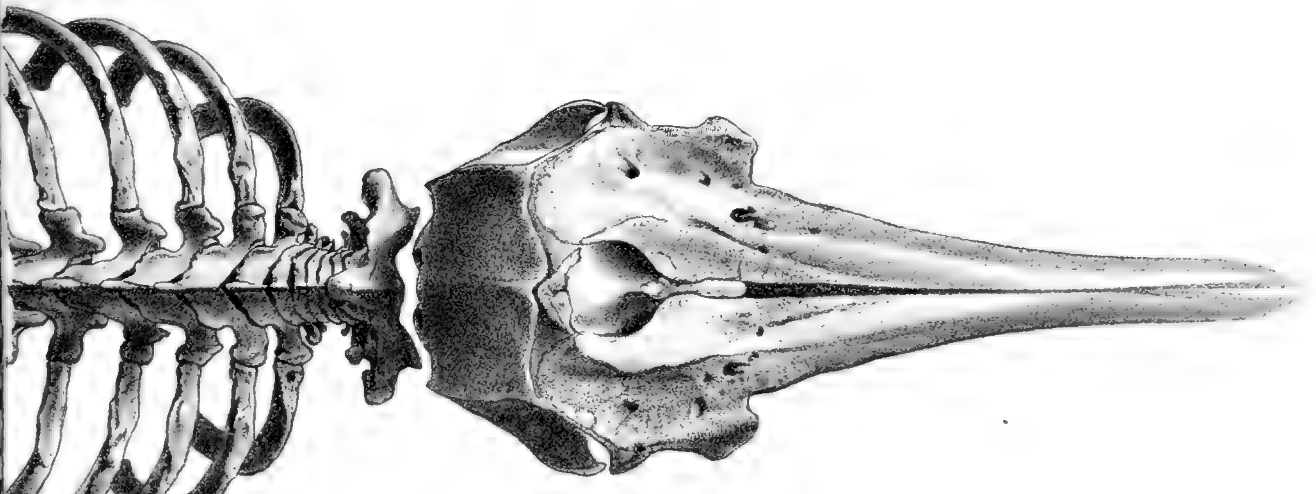
Fig. 5. Anterior surface of the fifth cervical vertebra.

Fig. 6. Anterior surface of the sixth cervical vertebra.

Fig. 7. Anterior surface of the seventh cervical vertebra.

All half the natural size.





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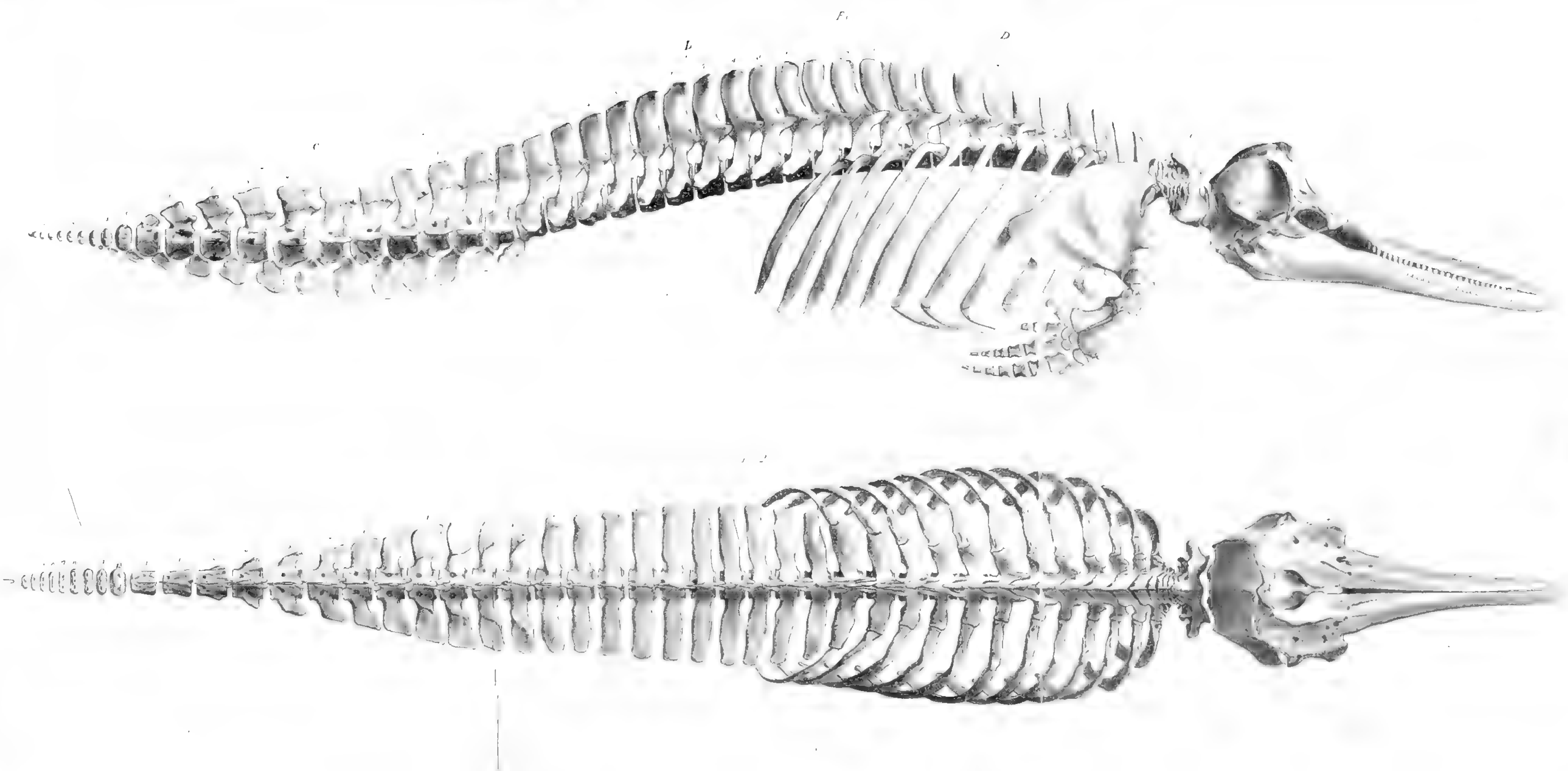

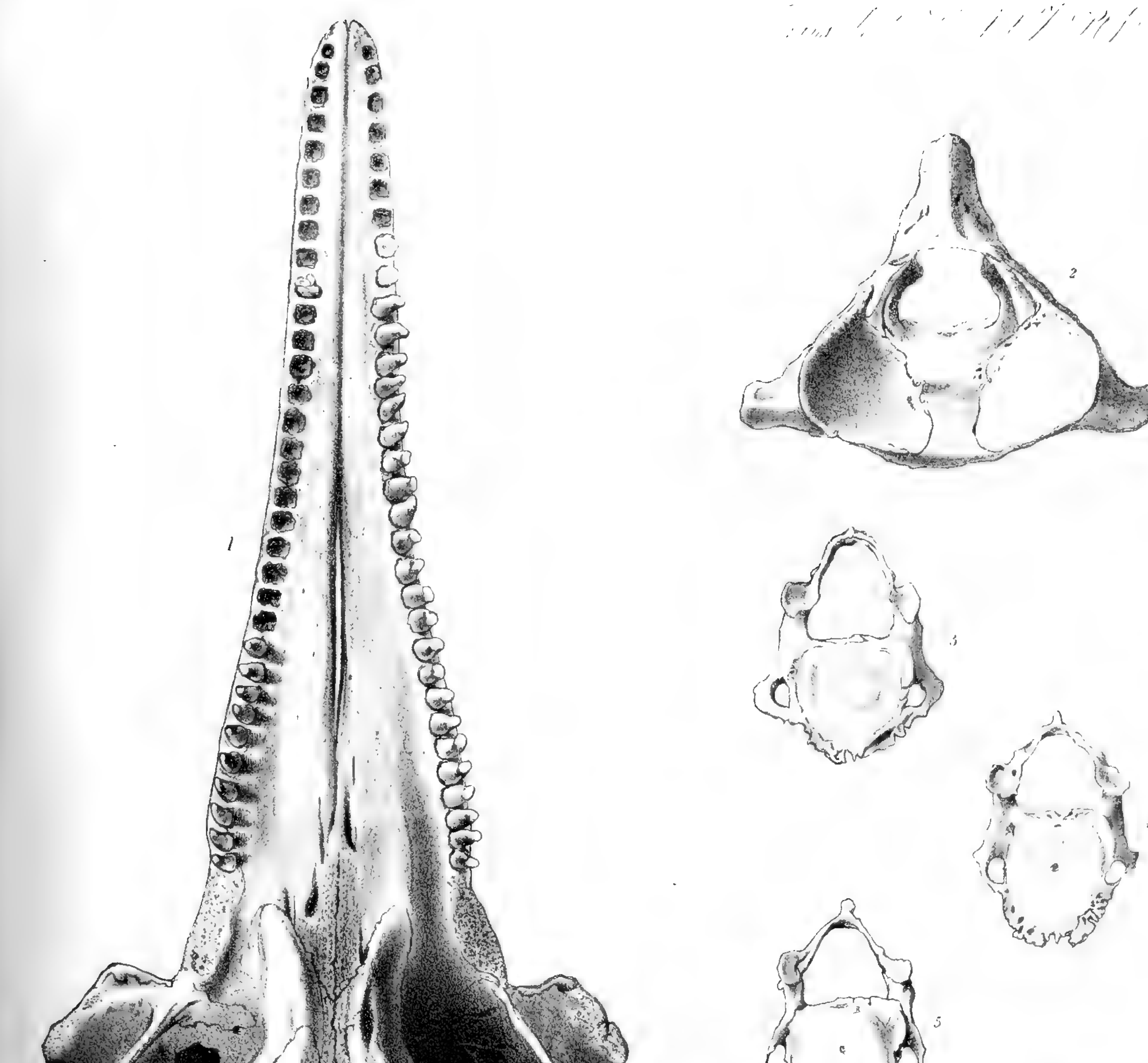

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M & N Hanhart imp

DELPHINUS SINENSIS.

V. *Notes on the Habits of some Hymenopterous Insects from the North-west Provinces of India. By* Charles Horne, *Esq., B.C.S., F.Z.S. With an Appendix, containing Descriptions of some new Species of Apidæ and Vespidæ collected by Mr. Horne: by* Frederick Smith, *of the British Museum. Illustrated by Plates from Drawings by the Author of the Notes.*

Read June 10th, 1869.

[Plates XIX. to XXII.]

I HAVE been encouraged to arrange these Notes in consequence of the interest expressed on looking over my drawings by many of our leading entomologists, more especially by Mr. F. Smith, the well-known hymenopterist of the British Museum, who has so much assisted me in naming known and describing new species. The habits of some of these were little, if at all, previously known; and I trust that other students of nature, with more time at their disposal than I had in India, may take up this very interesting tribe of insects.

C. Horne.

Upper Norwood, April 1869.

Fam. SPHEGIDÆ.

Pelopœus madraspatanus, Fabr. (Plate XXI. figs. 6 & 7.)

This is perhaps the most common of the insects of this genus found in the North-west Provinces, India, and one which attracts the attention of the casual observer.

Its ordinary name amongst Europeans is the "mud-dauber." Its cells are found in the oddest places, but chiefly about the rooms of houses. They are generally constructed from June to October; and the insect is seldom to be seen at all after November, disappearing until the close of the cold weather, *i.e.* in February or March.

It may then be observed, but sparingly, as the individuals may be said to have emerged from the pupa-state before their time.

In May, June, and July, however, they may often be seen sitting by small muddy puddles near wells, working up the mud into little pellets about the size of buck shot, and then flying off with them in or, rather, under their mouths. These are taken to some corner of a window-sill, or hollow in a rough wall, and deposited on the spot which has been previously carefully selected by the insect. As it is perfectly fearless when engaged in cell-building, and as many of the positions selected are very open, it is easy to observe its habits.

This is one of the species which sometimes uses a cavity such as that left by the removal of a lock, a hollow between bricks, or between the wall and door-frame. Sometimes a roughness or slight depression in the floor is the unfortunate selection, where the first passer by will crush the construction, in which case the patient creature will rebuild it three or four times, and at last, in despair, abandon the locality; thus on one occasion I observed a cell built in the corner of the door-frame of a bath-room, so that it *must* be crushed every time the door was closed. The room was used at least once a day; and six times was the cell completely destroyed; it then abandoned the position. This was in October 1867; and I rather think that it ceased building merely in consequence of its season for cell-building having expired.

Sometimes each cell is separately constructed; at others one is placed over another; whilst I have observed them, as hereinafter described, build a mass of cells, as in the case of the corner of a room being selected.

The building of these cells is very regularly conducted, and they are generally placed parallel to the ground. A line of pellets of mud, the base of the cell, is first put down, and each pellet is worked nicely and smoothly with the jaws, assisted apparently by the feet, so that, as the work is performed very quickly, the joins are hardly perceptible. Having finished off its work with one pellet, it stands over it, looks at it with complacency, walks around it, pats it approvingly with its antennæ, and at last, being satisfied, flies off for more material.

I have reason to think that generally but one sex works at nest-building; for often, when I have captured an insect at work, no other has come to complete the structure.

A cell takes about a day to make, the insect working assiduously as long as daylight lasts. As the walls rise, layer by layer, they are contracted until they meet in an arch, the insect meanwhile carefully smoothing and plastering the interior as the work proceeds.

The next employment is the filling of the cell with food for the young grub. On one occasion only I observed *green caterpillars* being stored, although small field-spiders are the regular storing-food.

The egg would appear to be deposited on the body of the first spider placed in the cell. This would lead one to infer that the female is the worker.

Twenty spiders are sometimes packed away; and the egg or young grub of the insect has always been found by me on the lowest one when I have opened a cell directly after it has been closed up, which closing is effected directly the structure is well filled.

Ordinarily, on one cell being finished another is begun alongside, as little space being lost as possible; and in this way four, five, or six cells are made.

Meanwhile the egg is hatched, and the young grub sucks out, one by one, the juices of the comatized spiders, until being fully grown and its stores finished, it spins its strong cocoon of fine agglutinated silk and changes into the pupa-state. In this it remains for periods varying from one to five months according to season.

When the time for emerging arrives, the cap of the pupa-case gives way to the jaws of the larva; and the earthen one of the cell (moistened at its edges by some fluid ejected by the insect) giving way, the *Pelopœus* comes forth fully prepared to mate, and build more cells. Of some of these cells I have observed the cap to be convex on the lower side, so that the least moisture or effort *internally* applied would loosen it, whilst external pressure would only fix it more securely.

I have never seen a sparrow or other bird attack one of these insects. Its sting and an odour it emits would appear sufficiently to protect it.

I forgot to mention that when the number of cells intended to be constructed in one place (generally two or three) is finished, the whole is covered with a smooth coating of mud, making it look like a dab of mud on the wall, and quite disarming the suspicions of the ordinary passer by. On one occasion I observed rays of mud round the nest, even more exactly imitating a lump of mud thrown with some force. This I hold to evince a most wonderful instinct, as they could not be required for strength.

PELOPŒUS BILINEATUS, Smith. (Plate XXI. figs. 14 & 14 *a.*)

This insect, which Mr. Smith has noted as a variety of *P. madraspatanus*, generally resembles it in its habits. It stores spiders, but it affects hedges and trees rather than buildings. A fork in the bough of a "Meendee" (*Lawsonia spinosa*), commonly used for hedges in the North-west Provinces, is often the favoured spot. Its structures are more solid than those of other species, which is the more necessary, as it has to resist greater stress of rain and weather.

PELOPŒUS BENGALENSIS, Dahlb. (Plate XXI. figs. 2 & 2 *a.*)

This insect rather affects the exterior than the interior of houses. In its general habits it very much resembles the last species, and it seldom, if ever, builds its cell separate. A rough wall or corner is its favourite place. It has even more than most *Pelopœi* the quivering motion of the abdomen, also common amongst Ichneumonidæ, and works very fast. Its work is rough, but is most carefully made to assume the form of the object on which it is built; for example, sometimes amongst grass the mud is continued up the stem for some distance, and the eye does not in consequence so readily determine the nature of the structure. The cells are well filled with small spiders.

My former remark, as regards the shape of the cell-doors of *P. madraspatanus*, applies equally to this species.

As there is an account of this insect and its works, in the 'Intellectual Observer,' by Mr. Beavan, I shall not offer any further remarks upon it. I, however, think that a note from my natural-history note-book, with a slight sketch, may prove of interest, and therefore subjoin it:—

"July 12, 1864.—This morning I broke open three cells neatly constructed on my door. I found the contents to be as separately represented, viz. one fed grub, one smaller one sucking a spider (which seemed to be his second, as a dry skin lay before him), and twenty-five spiders of various sizes in the two cells. I could not find the egg or larva in the third cell, which had only just been closed; but the former was doubtless on the body of one of the larger spiders which had been first deposited in the cell.

"Benares."

It is very wonderful to see how well the food is packed, and it is worthy of inquiry how the stored spiders remain alive and *plump* for so many days. It must be the effect of the poison conveyed through the sting of the *Pelopœus* when it captures the insect.

At times it builds its solitary, highly finished cell on some small hanging object, such as a stalk of grass in a thatch under shelter; and then the shape of the cell is curious, being rather ovate, so as to throw off the rain. At others the cells are placed side by side in great numbers, say twelve or fourteen, and so well covered over with mud as to be almost unobservable (Pl. XXI. fig. 2). The situation is very often in the midst of a plant of grass, the stalks of which are, as before observed, covered far up with mud.

Fam. CRABRONIDÆ.

TRYPOXYLON REJECTOR, Smith. (Plate XXI. figs. 4 & 4 *a*.)

This curious little insect, when first hatched from the delicate little Serpularia-like cells, was taken by me for some parasite allied to the Ichneumonidæ, in consequence of my having often observed it hovering at the mouths of the cells of the smaller cell-building insects in my verandah. I found, however, that it brought mud and worked for itself, as well as appropriated the cells of other insects which it found ready to its hand.

I have nowhere found recorded its habits; but I think I have seen it carrying minute green spiders wherewith to fill its cells. It certainly does not feed its young, but stores food; for it closes its cells directly they are ready, which none of the Vespidæ do.

The construction of these is very curious; and the pellets of earth used appear of a sandy character, which gives to the structure great delicacy and fragility. At the same time the interior of the cell is lined with some glutinous ejection which binds it together.

The specimens of cells figured (the originals of which are now all in England) show how strongly this cementing fluid acts. (See Pl. XXI. figs. 4 & 4*a*.)

The nests are extremely difficult to find, being small, and many straws hanging in the places where they are usually constructed, such as under a thatch of coarse grass.

As might have been expected, they remain a very short time in the pupa-state; and the month of September is their favourite season of construction, although they continue to build in October.

I have often watched them as I sat in my thatched summer-house at Mainpurí; and the rapidity with which they came and went was surprising. I know of no other special peculiarity which calls for remark, excepting that all the cells I have found have been under cover.

Fam. LARRIDÆ.

PARAPISON RUFIPES, Smith. (Plate XXI. figs. 1, 1 *a*, 1 *b*.)

This insect, which appears not to have been before noticed, has been described by Mr. F. Smith. It constructs a mass of loosely arranged cells of earth attached to some hanging object, such as a creeper, tendril, or pendent straw, or even a curled dry leaf. The interior of the cell is strengthened by a very fine glutinous silky-looking substance; and this is the more necessary, as the least damp would otherwise destroy the whole fabric.

I believe the insect to apply some kind of gluten, whilst the pupa secures its safety by spinning a very slight silken web within its abode. The cells are very globular, and are filled with the smallest spiders, of which I counted eighteen in two chambers. These are generally of a pale grey-green colour, and their plumpness is curious. Sometimes, however, it builds on walls with more or less regularity. (*Vide* Pl. XXI. figs. 1, 1*a*, & 1*b*.) The pellets used in construction are, comparatively with the size of the insect, very large, and loosely attached to one another: very little smoothing is effected exteriorly; and were it not for the interior binding together of the particles, the cell would apparently fall to pieces of itself.

A small *Pemphredon*, or another even smaller species, often takes possession of the cells of this insect, rendering the identification of the pupa very difficult. The chrysalis is more ovate in form than that of *Pemphredon*; I have no drawing of the grub.

The earth brought is prepared by water, as is the case with all clay-cell-building insects which I have observed; and the insect affects the vicinity of water, and hence probably is seldom found far from wells. It builds in September and October; and the perfect insect sometimes emerges early, although it often delays its appearance until the spring (viz. March or April) of the following year, when the heat sets in.

PISONITUS RUGOSUS, Smith. (Plate XXI. figs. 5 & 5*a*.)

This insect was most abundant in my court-house at Mainpurí. The door-posts had been made of old wood which were full of small and large screw-holes, which were used by it for the purpose of storing the tiny spiders which it provides for its larva.

As a proof that it can build with clay, although I never found its cells in any other position than in that above described, I may state that when the hole was too large for its purpose, it used to fill it in all round with clay, and closed the mouth of its cell with a similar material.

Fam. EUMENIDÆ.

EUMENES CONICA, Fabr. (Plate XX. figs. 2 & 2 *a.*)

As I bred many of these insects, I had ample opportunity of watching them. They place their nests on the walls of houses, but prefer wood, such as door-frames; while sometimes they make series of cells of great length, one such series often extending more than one foot.

One pair of insects will construct twelve or thirteen cells, and it does not take an entire day to complete one of them; yet I have often thought I could detect more than one pair engaged in one place, but at different ends of the structure, which, when completed, contained perhaps twenty-four cells.

It should be remembered that the insect avails itself of the wall or beam for the back of its cell, which is made extremely thin, the clay which is carried beneath the mouth being beautifully fine and well kneaded. Hence it is extremely difficult to detach their cells without breaking them. The cells are high and vaulted, and at the mouth they have a protruding rim, which projects outward and curves slightly downward. Ten or twelve *green* caterpillars are stored in each cell, which is carefully closed with mud.

This insect, like *Pelopæus madraspatanus*, seems very proud of its work, and, before leaving for fresh material, runs about approvingly and thoroughly inspects its performance. If disturbed it flies off, and does not attack you as do the Vespidæ.

The imago generally emerges about five weeks after the cell has been closed; and, owing to the thinness of the walls, which are easily pierced, it is much attacked by parasites. Thus out of one group of five cells, only two specimens of *Eumenes* were hatched. Of these parasites I shall speak afterwards.

In life the *Eumenes* is much brighter in colour than it becomes after death, so that no idea of its beauty when at work can be readily formed from the specimens. It was from *one* of the cells of this species that I took nine caterpillars, eight of them being *black* Geometers, and only one green one; so that it is clear the insect had, contrary to custom, met with a brood of another colour which suited it quite as well as the green, which it generally uses.

EUMENES ESURIENS, Fabr. (Plate XX. figs. 6 & 6 *a.*)

This beautiful insect builds its cells about doors and windows, on the posts; and fig. 6 may be held to be a typical structure. As, however, I bred them from cells of different forms, there can be no doubt that they vary their style with the site. The cells are high, very spherical, and placed generally irregularly. Green caterpillars (chiefly Geometers) are stowed away, whilst one often finds the cells in the possession of a Golden Wasp (*Chrysis*), a parasite. The mouth of the cell resembles that of the other species in having a recurved lip, this being characteristic of this group. The reason why so many cells are empty after the escape of the perfect insect is, that the ants come in troops and carry off the skins of the pupa-cases, and any fragment of food they can find, even to the skins of caterpillars and spiders. From the cells not only was one *Eumenes* hatched, but also a beetle of the genus *Emanadia* (*vide* Pl. XXII. fig. 1 *c*), and a dipterous insect, *Anthrax* ——?

EUMENES MAINPURIENSIS, Smith. (Plate XX. figs. 3 & 3 *a*.)

This nest needs little description. It is beautifully made, has the recurved projecting lip like the rest of its congeners, and is constructed of the very finest earth. (*Vide* Pl. XX. figs. 3 & 3 *a*.) The cell figured was empty; hence I cannot say positively whether it stores very small caterpillars. The insect much resembles *E. coarctata*, an English species; the cells also resemble those of the same insect. Figures are also given of *Eumenes edwardsii* and its nest (*vide* Pl. XX. figs. 4 & 4 *a*).

ODYNERUS PUNCTUM, Sauss. (Plate XX. figs. 7 & 7 *a*.)

This insect, like the others of its genus, avails itself of any hole of suitable size which it can find. In one instance I found a series of six cells (four of them empty, and in two of them dead insects) in the boring of a longicorn beetle; and I have often observed them taking green caterpillars into the holes left by large screws in door-posts. In the latter case, when the hollow is filled, the opening is covered over most smoothly *on a level* with the surface of the wood, so as often to escape notice; for this insect is in general a very neat worker. This covering is sometimes pierced with a hole as fine as that made by a pin, and thus the presence of the ichneumon larva is betrayed. When, however, it has more room, it most carefully fills up the entire space; and in the shape of the interior its cells are rounder than those of *Megachile*, being thus intermediate in form between them and those of *Eumenes*, which builds nearly circular cells.

These insects work in September and October, and in the latter month appear very actively spying for holes and filling them in when found. Their sting is very sharp; and they appear to affect green caterpillars, Geometers in particular; in fact I never found any other kind in their cells.

RHYNCHIUM CARNATICUM, Fabr. (Plate XX. figs. 5 & 5 *a*.)

This insect is very abundant, and may constantly be observed carrying caterpillars to fill its cell, which is made in small hollow bamboos. In the illustration it will be seen that it has taken possession of a hollow in which a *Megachile lanata* had already constructed two cells. It first built a floor over the cells, which was constructed of mud, very finely worked, stout at the edges and thinner in the middle. It then left a space empty and made another floor, after which it commenced its breeding-cells. In these it stored caterpillars of many colours; and it finished off with an empty spare cell, which it covered with a heavy mass of pellets. The clay is kneaded very finely, and, although there are no sides to be made to the cell, the cap is most carefully constructed.

These insects are a very long time in undergoing their changes; and they vary much in size and colour, doubtless in consequence of obtaining more or less food in their larva-state. Their sting is very sharp; but they do not attack one when disturbed, but fly off.

RHYNCHIUM BRUNNEUM, Fabr.

This insect in its habits resembles its associate *R. carnaticum*. It uses holes ready prepared—although, having seen it emerge from a gnawed hole in a soft post, the hole being the work of the insect, I believe it sometimes to work for itself in preparing a habitation. Its body is singularly flexible, so that it is almost impossible to hold it, when alive, without being stung by it.

RHYNCHIUM NITIDULUM, Fabr. (Plate XX. figs. 1 & 1 *a*.)

This extremely interesting insect constructs cells of exceeding strength, mostly upon timber. The clay is very finely worked with water and some kind of gum—not only viscid ejection being employed, but also the juices of the "Peepul" (*Ficus religiosa*), bird-lime in fact, and the gum of the *Acacia catechu* and other trees. Hence there is no need of thickness, and we accordingly find the walls of the chambers very thin, whilst their tenacity is so great that the portion of the hard wood on which the series of cells was fixed I have cut out with a chisel and hammer without in any way injuring the structure. One pair of insects does not usually make more than three cells; but it must be remembered that they take a much longer time in making them than does the rapid rough-working *Megachile*.

The food stored consists of caterpillars; and I have not yet succeeded in hatching a parasite from one of their nests, which are strong enough to resist all ordinary attacks. Until completed, either one or the other of the insects appears to remain at home (fig. 1); and hence parasites have no opportunity of effecting an entrance before the cell is closed over. The covering, though thin, is very tough, so tough that I doubt the power of a parasite to pierce it. In the figure it will be observed that six cells have been built one on another, only *one* being affixed to the door. This one was attached to a smoothly plane surface of "Sāl wood" (*Shorea robusta*); so that the cementing gum must have possessed great strength to allow me to cut it out with a hammer and chisel, as before alluded to.

These insects build on roof-beams, so that their nests generally escape notice, besides which they are far from common. They are externally of a rich brown colour, glistening with gum.

PTEROCHILUS PULCHELLUS, Smith. (Plate XXI. figs. 8, 8 *a*, & 8 *b*.)

This little insect builds its parallel galleries on the nearly smooth surfaces of white-washed and other walls. The cells, as shown in the drawing, are above one another, lined with a gummy substance and fine *silk* (?) The chrysalis resembles that of *Pelopœus*, to which, however, the insect is altogether unlike. The clay must necessarily, from the size of the insect, be very finely worked; and the food stored consists of very minute spiders. I have reason to believe that it sometimes builds its cells on hanging straws under shelter; but the example figured was found in my veranda, built on the walls or pillars, and attached to the plaster.

Fam. VESPIDÆ.

Icaria variegata, Smith. (Plate XX. figs. 8, 8*a*, & 9.)

This pretty little insect lives in small communities, and builds an elegant nest of paper prepared by itself, which is very tough, and attached to leaves, stalks, &c. by thin but strong pedicles. It frequents flowers, and appears to feed on pollen. The posterior segments of the body are very retractile, causing the abdomen to assume a curious truncated appearance. In the example figured on a stalk, the cell-mouths are all upwards, which is strange, as the young grubs, the mouths of whose cells are open to the weather, must need some protection. The same was in a great measure the case with the cells on the Mango leaf. The cells are beautifully regular, being perfect hexagons; and the strength with which the foot-stalk is fastened is surprising. There appears to be used for this portion of the work some kind of gum, with which they cover their plaster; and this much resembles varnish in appearance. It is probably derived from the Babool or Mango-tree, both of which abounded near Benares, where these nests were found. On one occasion I found a group of these little series of cells hanging in a covered tomb; they were attached to a stone slab, and all, of course, face downwards. Unfortunately they were old nests and quite empty. They consisted of a series of combs; and the number of cells in each averaged sixteen only. In this case shelter had evidently been sought, and in the two cases formerly noted the insects were in a measure shielded from the direct influence of the rain by the thickness of the foliage of the Mango-tree above them; for the habit of this *Icaria* is, as a rule, to build under shelter.

In their disposition like the rest of the Vespidæ, they fly with one accord to attack the intruder—although their sting was not very sharp, and nearly resembled the prick of a fine pin, and was in a great measure deficient in the burning feeling experienced when stung by their brethren the *Polistidæ*.

Icaria ferruginea, Fabr.

This insect in its habits resembles *I. variegata*. It feeds its larvæ with ejected juices; hence one never finds any thing but the egg slightly attached to the bottom of the cell, or the more matured grub, which spins itself a silken cocoon over its cell within which to change to a perfect insect. It associates in very large parties, and is extremely vicious when disturbed, and flies at the party interfering with it, hardly ever failing to sting him. The pain of the sting resembles burning; and in one case of my taking a nest, when I was severely stung, the pain lasted for four days. I mention this as it is curious to observe the different degree of virulence of the poison of the various small insects of this class.

The cells extend in masses of great size, and are placed in the midst and amongst the twigs of thick garden bushes. I also believe, from what I have seen, that the comb of one season is *not* used in another; perhaps it becomes weather-worn and incapable of proper repair. This insect also has, like the *I. variegata*, a retractile body; and its cells are beautifully regular hexagons. It is much molested by a small class of moths (Tineidæ), and also by an *Anthrax*. In fact the nest lies very open to the attack of parasites, who, as a rule, care nothing for the sharpest stings. The grubs, which I found in abundance and in all stages of growth in October, have rather a singular shape, being almost conical. The perfect insects are much plagued with a species of *Stylops*, the females of which lie under the scales of the abdomen. I found one piece of comb nearly one foot across each way; but generally the combs are only one-half or two-thirds of this size.

POLISTES HEBRÆUS, Fabr.

This insect, which is generally known to residents in India as the "Yellow Wasp," is a great nuisance. It is very partial to verandas, and builds its cells on a roof-beam. More often, however, it selects trees near houses, and, if not disturbed, builds enormous nests, continuing year after year in the same place, deserting great parts of its comb as they become useless from age, and building others near to the old ones. The food of this insect is of a very general character, and it dearly loves sugar in any form.

It has an unpleasant habit of either flying at you if irritated, stinging you as it touches, and then flying on without stopping, or falling from above upon you and performing the same trick. I am told by a friend that the English Hornet does the same. In the case of the Indian *Polistes*, however, the sting is not very severe.

They sometimes select the oddest places for their combs. On one occasion I was moving some tin boxes, when about thirty flew out of one of them at me; and I found their comb in a corner, *inside*. They had obtained access through the open window of the store-room. I have often observed the commencement of a comb.

In the month of November the females newly hatched sit out on sunny days on the tops of venetian doors and similar situations and buzz for males. Nor do they wait long; for at this season the whole veranda swarms with these *Polistes*, and I have had thousands of them killed in a morning. Having met with a suitable partner, the ova appear to be impregnated; and not long after, the queen, fully prepared, sets to and builds a single cell on a stout foot-stalk, lays an egg in it, and proceeds to build three or four more around it, in each of which she lays an egg.

The young grow very fast, especially at first when so few have to be fed; and thus in a short time there is a well-peopled colony in which there will be a few males and workers of every size.

The tops of the cells of the queen wasps are much elongated with silk; and these insects use some species of gluten wherewith to temper the paper of which the cells are constructed, as well as to solidify the silken cell-coverings.

They are in the habit of seizing insects and sucking out their juices, wherewith they again feed the voracious young grubs, who are always clamouring for food with open mouths.

They are extremely troubled with *Stylops*, every fifth or sixth one taken having a female of one under one of the segments of the abdomen; and I have sometimes seen two or three on one specimen. I have often tried to breed these *Stylops*, but invariably failed, the male *Stylops* being very scarce, and the female, Mr. Smith tells me, never leaving the body of the *Polistes*.

This species is so well known that I do not think any further remarks are needed, excepting a short account of the methods by which these troublesome insects are most easily got rid of.

There is a yellow ant (*Œcophylla smaragdina*) which lives a social life, chiefly upon trees, drawing leaves together in a curious manner with silk, and making in this manner large nests in the Mango-trees. These insects sting severely, and they seem to have a great antipathy to the *Polistes*, who are very fond of feeding on their poorly protected juicy young grubs. If, therefore, you cut off a bough with a nest of these ants upon it, tie it to a long bamboo and put it very near to the nest of the *Polistes*, there will be a general attack by the former upon the latter. An ant will seize on a wasp and bite and sting him, others also coming up to help. They will together fall to the ground, when the *Polistes* dies, and the ant (*Œcophylla smaragdina*) having taken a sip of his blood and juices, runs up again to his nest by a string always left hanging down from the bamboo near to the nest for this purpose. They will also attack hornets. Their native name is "Mātā," and they are used by all classes for this purpose. No heat is too great for the *Polistes*; and in the hottest weather they may be found sitting in large parties by water, evidently enjoying the season.

These insects possess great vitality, of which the following is an instance:—

"Mainpurí, May 28, 1866.—Here is an instance of vitality. Last evening (7 P.M.) I caught a *Polistes* at the edge of my scissor-net, when the frames meeting took off his head. The body remained lively till half-past ten, P.M., when I went to bed; the wings vibrated, and the sting was constantly protruded; but next morning I found him cold and stiff. It is thus that many persons are stung; for they count the insects dead, and take them up unwittingly."

POLISTES STIGMA, Fabr.

This insect frequents sheltered places, such as the verandas of houses, and is extremely common. The description of the comb and the construction of its dwelling, as given under *P. hebræus*, applies also to *P. stigma.* It does not, however, attack so viciously as some others, and stings only when much interfered with. Its cells are beautifully regular hexagons, and, although very light, are of the strongest fabric, being of a paper made by the insect. In its various stages it bears a great resemblance to *P. hebræus.* August, September, and October are its favourite months for working, although it may be seen busily employed at most times during the rains.

Its food consists of small insects, which it eats and prepares for its young.

The cells of the females are longer than those of the workers and males, and their silken covers project much above the ordinary surface of the comb.

They are much troubled with *Stylops*; and I have occasionally bred from their combs specimens of small moths, chiefly of the Tineidæ, several species of which appear to be universal feeders.

VESPA VELUTINA, St. Farg.

This very handsome wasp builds a huge nest, hanging on the boughs of trees, mostly at a great height from the ground. Of its nest there are two handsome specimens in the nest-room of the British Museum. The communities are very numerous, and it is most dangerous to meddle with their nests. A bullet incautiously put through one brings down a swarm of the inhabitants, whose stings are most venomous and often dangerous to life. They will follow a party for miles through the densest jungle, and *are said* often to kill animals and, even, men.

A nest I measured exceeded 4 feet in length, and, when the outer covering was broken away, showed range upon range of cells; but the extreme difficulty of bringing it to England compelled me to abandon it.

They frequent flowers and carry off insects of all kinds wherewith to feed their young; and a wall covered with roses at a house in the Himalehs, 6500 feet above the sea, was a very favourite resort. They then flew off, often many miles, to their nests.

Appended (p. 190) is a description by Mr. Smith of an allied species (*V. vivax*), apparently new, the habits of which are the same as those of *V. velutina.*

VESPA ORIENTALIS, Linn.

VESPA CINCTA, Fabr.

The same notes will apply to both these species, which, I believe, to be already well known. They build their nests of prepared earth, strongly impregnated with some viscid substance, probably derived from the gums of trees.

In confirmation of the above, I may remark that I have often seen them sitting apparently eating the gum of the Acacia (catechu) and also the flowing juice of the Peepul

(*Ficus indica*), and, as they are in general carnivorous, it must have been for some such purpose. At the same time there appears to be some woody or, at least, vegetable fibre mixed with the earth.

The cells are regular hexagons, and built from an hexagonal *ground-plan*—a fact which confirms Mr. Smith's observations to the same effect; and the whole structure often assumes a large size. One found by me was $10'' \times 9'' \times 9\frac{1}{2}''$, in the centre of a wall composed of sun-burnt bricks, in a hollow which had originally been excavated by *Termites* and afterwards enlarged by the hornets, as they are popularly called.

I have often seen these insects pounce upon a sitting fly, just as a hawk would do on a small bird, and they are also very fond of ripe fruit, such as peaches, grapes, and apples. The *Vespa velutina* also indulges in these luxuries, and is especially fond of the hill-apricot.

The stings of four or five of these insects are said to be sufficiently powerful to kill a child; but, as in all such cases, much must depend on the circumstances.

The outside of the nest is, as is usual with wasps, covered with a coating of loose paper.

It is highly dangerous to disturb a colony of these insects; and as they work in gangs at night, it is somewhat hazardous even then to take their nests. As, however, they greatly affect outhouses, it is most necessary to destroy them, as horses have been said to have been stung to death by them; but for this I cannot vouch.

I will here quote *in extenso* from my note-book the notes which refer to Indian *Hornets*, by which terms both *V. cincta* and *V. orientalis* are designated, dated:—

"August 15, 1863.—These insects are very abundant at Benares, in India, but not generally spiteful. One may see hundreds of them flying round the sweetmeat stalls, like wasps in the fruit-shops in England; and the vendor drives them away with a whisk, a piece of palm-leaf, or a cloth, and is very rarely stung. If one, however, be incautiously touched, the sting is very suddenly given and very sharp; its pain is intense, and it induces considerable inflammation. They make their nests in the mud walls; and the form of these is just like that of the English Hornet.

"Yesterday I was drying some sugar in the sun; and this attracted a large number of them. My man killed many, throwing down their bodies on the spot, when the ants appeared to carry off the carcasses; but not only did the ants so employ themselves, for the hornets alighted also and carried off their dead brethren as food! The ants (*Œcophylla smaragdina*) appear to be naturally very destructive to these insects. These ants live both in the ground and in nests made of leaves of trees drawn together.

"I have seen the hornets trying to carry off their tiny tormentors. Again and again have they darted at them; but it invariably ended either in the hornet quietly sitting down amongst his enemies to be bitten or stung to death and then carried off in triumph to be eaten by them, or in his falling to the ground with three or four ants hanging on, when his fate was equally certain.

"One of these insects stung me on the thumb; but by sucking the place for about a quarter of an hour I drew out the poison, and the pain and swelling were afterwards very slight.

"August 20, 1863.—This evening, having prepared two large squibs filled with damp gunpowder, I proceeded to take two nests, one of *V. orientalis* and one of *V. cincta*, both in similar situations. Having lighted the touch-paper, the end was placed at the mouth of the hole and wet clay was plastered around. The dense smoke and intense heat thus killed every perfect insect in the nests, which I shortly after dug out for the purpose of examination. One nest was buried forthwith in a hole previously prepared; and the one taken to be set up was that of *V. orientalis*, to which all the succeeding remarks will refer.

"Both nests were constructed of earth tempered with water, and I could trace no signs of gluten of any kind in them. In the nest prepared by me were seven ranges of cells; and at the time of taking it, from 400 to 500 hornets were at home. Although I took out every dead perfect insect, there were from forty to fifty nearly hatched by 5 A.M. next morning, showing with what enormous rapidity they increase. The nest was placed under a large wire dish-cover, and a nest of the yellow ant before referred to was placed with them, so that every young hornet was killed as soon as born.

"July 1, 1864, Benares.—As a boy, when in England, I have watched a hornet carry off a fly sitting on a door-handle; and to-day I saw one pounce on a small honey-bee deep in the pollen of a flower, and, taking him off, sit down and eat him quietly; and from the number hovering about flowers, this would seem to be a favourite food.

"July 19, 1864.—Watched hornets catching and eating the workers of *Termites*, whose galleries I had just destroyed on the bark of a tree, where, in consequence, the blind insects were running wildly about.

"August 19, 1864.—Watched them more narrowly and carefully. Saw that one caught at least ten *Termites*, one after the other, and made them all up into a ball with his jaws, when the said ball was taken away, evidently to feed the young larvæ with a rich and juicy morsel, which, however, would be strongly tinctured with acid."

VESPA FLAVICEPS, Smith. (Plate XXI. figs. 10 & 11.)

This interesting little wasp lives in banks, making a cylindrical nest covered with party-coloured paper, and filled internally by layer upon layer of cells, seven or eight series generally completing the structure. They were found at Binsur, a mountain about twelve miles from Almorah, about 7500 feet above the sea, in nests about 2 feet under ground, and built up round some root.

The time of their greatest activity is in the rains (*i. e.* July), and they may then be seen coming in and going out of the nest in great numbers.

One of the nests taken was at the side of a garden-walk; and for some ten or fifteen days none could pass that way without a good chance of being stung. Although the queen had been captured, they continued to build cells and repair the injuries done, very neatly uniting the broken bit of covering paper which had been left.

These wasps were often to be seen in flowers on the hill-side, and they appeared to feed freely on fruit and on insects found on the pollen of flowers.

The construction of the pillars of the nest was very neat, light and at the same time strong. No clay would appear to be used in the making of the cells, which were of regular waste-paper, the structure of which is of vegetable fibre.

I took many specimens from a nest in a bank on the footpath which led to the top of the mountain. At first they were very quiet; but after a day or two, directly any one approached they would fly at him if he stood but a moment near to the mouth of their nest. Their instinct of memory is most strange. Their stings are irritating, but not in any way dangerous to man, although it was by wasps of this species that a full-grown sheep belonging to a resident of Ranee Khet, near Almorah, was killed. The animal had doubtless trodden on an entrance to a nest, or pulled up some plant in feeding, and so disturbed them.

I had proposed to append a few notes relative to the parasites of these insects; but on second thought, I have briefly alluded to each in my notes on the species it affects. The genus *Chrysis* is largely represented; and there appears to be one of suitable size for each species of hymenopterous insect, so as to fit the cells.

Fam. APIDÆ.

Lithurgus dentipes, Smith.

This insect in general appearance much resembles a *Megachile*; but its coloration is quite distinct. Its habits, however, are very similar, although the clay would seem to be in general worked smoother. A favourite position for placing cells is the gallery formed by the grub of some longicorn beetle in timber. In one case there were two entrances; and in consequence some of the cells had been constructed to face one way, and some the other, thus providing for the more comfortable exit of the perfect insect.

When considering the working of the cells of these insects, it is necessary to bear in mind the position in which they are placed: *e. g.* in case no. 12 the spirally twisted series is quite as rough exteriorly as those of *M. lanata*, whilst in cases 1 and 2, being pressed for room, the work necessarily appears smoother.

This insect seldom builds mud-daubs on the walls, and generally takes ready-made hollows for its building-purposes, although I have seen them working under the seat of a chair and on a rough part of a wall.

In all its habits it resembles *M. lanata*, and therefore no more remarks upon it will be called for.

MEGACHILE LANATA, Fabr. (Plate XIX. figs. 11, 11 *a*, & 11 *b*.)

This insect is found in almost every house in the North-west Provinces, and, next to the black and yellow *Pelopæus* (*madraspatanus*), is the one which attracts most notice.

The season in which it builds its cells is from March to November; but July and August (*i.e.* during the rainy season) are its favourite months. These cells are placed in every conceivable situation; and it is curious, when sitting quietly writing, to watch the insect coming and going with his material. He or she is so deeply interested in the work that all fear is forgotten, and they will work within a foot of your writing-desk. The mud is carried, so to speak, under the head and in part supported by the fore legs, and is not so finely worked up as that of the *Pelopæus*; hence we find the work much rougher exteriorly, although the inside of the cell is carefully smoothed. I have had a newspaper lying on the table and heard them working inside the folds; in short there is no position too strange for the nest.

The following are a few of the positions in which I have found them:—

1. Between folds of paper; 2. in the back of a book which had been left lying open; 3. on the handle of a tea-cup; 4. in the keyhole of a door; 5. in the barrel of a gun; 6. under a fan on the table; 7. in the hollow of a bolt of a window, where three times the whole structure was crushed by the use of the said bolt in the absence of the insect; 8. on a signet ring from which the stone had fallen out; 9. on the frill of a large fan or punka, which was kept in motion ten or twelve hours out of the twenty-four.

I will now proceed with the method of working. Both sexes appear to labour; for I have sometimes caught a worker, and found that the work was immediately continued, which was not the case with the *Pelopæus.* They come and go incessantly, with a loud buzzing; and whilst they are tempering the clay they keep up the motion, thereby advertising the locality where they are working, although often the *exact* spot is even then difficult to find. The tenacity with which the clay adheres to substances is very curious (although the cells of the insects of the genus *Rhynchium* afford a better instance); and I believe that when the clay, having been first prepared at the water, is brought into use, it is inspissated with some glutinous substance ejected by the insect. It is certainly very carefully kneaded again by many of the clay-cell-builders. The cells are built side by side, with very little cohesion, and are stocked with bee-bread and closed by three or four pellets of mud, united in such a manner as to leave thin edges next to the lips or upper edges, and thus enable the insect easily to escape. The outside is in general rough and adapted to the situation in which it is built. It is scarcely ever truly circular on the outside, even if built free from obstruction.

Amongst the figures will be observed a solitary cell built in a signet-ring. The power of instinct shown here is very great; for to keep the cell secure the clay has been made larger at the base, where it projects interiorly in the ring.

This insect is very annoying from the manner it chokes up small openings, such as barrels of firearms and locks of drawers, in the latter case entering by the keyhole.

I watched the construction of four cells in June 1863; and the perfect insects were matured August 12, 14, 15, and 16 respectively. This would show, what is really the case, that the cells take about a day each to construct. In fact, in one case noted by me, a cell was commenced, finished, stored with food, and closed within certainly ten hours, which is quite possible if both sexes work, as I believe to be the case.

Sometimes, however, a hollow bamboo is the situation selected by this insect. If it be tolerably thick there is room for several cells; and they are built from the bottom of the hollow upwards, either in a straight line or spirally (*vide* Pl. XIX.). In either case I believe the single series to be constructed, and the second series commenced from the very bottom on the completion of the first. In some cases there are as many as eight or ten cells in each line; and probably more than one pair of insects are concerned in this double series.

And this leads me to one of the great difficulties in observing this class of insects. There are many parasites, one or two of which will be hereafter noted. Many, too, of the wasp class seize on cells and fill them with caterpillars or spiders, so that one sometimes finds one cell with bee-bread in it, and another, undoubtedly *made* by the same *Megachile*, filled with insects stored probably by a *Pelopæus*.

There are also dipterous insects (*Anthrax*) who pierce the cell-cap and deposit an egg in the food, their larvæ feeding on the grub of the bee; so that when one keeps them to watch the insects emerge, most strange results follow.

Mr. F. Smith tells me that the lower cells of the series above mentioned in bamboos are those of females, which sex takes longer to develop, and that thus an exit is not required for them so soon as for the occupants of the upper cells, which are males. It had often puzzled me how this was managed.

Megachile proxima, Smith.

This insect is so similar to *Megachile lanata* that had I not caught one with a cut leaf of the Clitoria creeper in its mouth, and traced another to its burrows, I had held it to have been that insect.

Digging between three or four inches in the soft soil I found two cells one over the other. They were composed of these cuttings, four or five folds of leaf, and quite loosely put together. Within was a mass of bee-bread, with a young grub head downward in the midst. This grub was almost transparent, and cylindrical in form.

When opening one of the cells of this insect, I observed that it appeared to be lined with a finer and lighter-coloured leaf than that which constituted its external covering. Mr. F. Smith tells me that he found this to be the case with an English species (*M. argentata*); I have therefore held the fact to be worthy of note.

As I have observed a bee of this species entering a hollow bamboo of suitable diameter with a piece of leaf in his mouth, I have reason to believe that they avail themselves of such situations as well as of the ground. All this class of insects, although generally consistent as to food, vary much, according to circumstances, in the places where they build their homes. Only one pair work together; and they are not at all social, although working often in the closest proximity.

MEGACHILE FASCICULATA, Smith. (Plate XIX. figs. 1–10.)

This fine bee may be observed on the rose-bushes, steadily cutting out portions of the leaf. Each portion is of the same shape, which may be observed in the figure of the leaf; and the work is done in a very rapid manner. There are long pieces and circular ones, the latter being for the caps of the cell. From their size, these bees are easily traced to their nests, which are placed in any suitable hollow; but their favourite position is between bricks in masonry in places where the mortar has fallen out, and I have often taken out series of cells laid side by side in long lines measuring seven or eight inches and containing perhaps fifteen cells each.

From observation, I should think that *one pair* of these insects will construct from thirty to forty cells. These cells are very nearly the size and shape of a common thimble; and some that I examined contained thirty-two pieces of leaf, being of seven thicknesses, besides three round tops each, placed one over another. The leaf employed was in this case that of the "urhur" plant, a large Indian pulse (*Cajanus indicus*) which grew in the field close by, and which is very soft and easy to cut; but in another instance, which is also figured with this paper, the material consisted of the leaves of the rose Edwards (*vide* Pl. XIX. fig. 7). This mass of cells, in which there are no less than seven series, was in the ornamental ear of a garden vase, into which I had observed the insect carrying leaves (*vide* Pl. XIX. fig. 1).

The cells are carefully constructed; and the interior pieces of leaf appear to be slightly cemented together by some fluid, ejected by the insect, of a gummy nature. The exterior leaves are quite loose, but hold firmly together on account of the manner in which they are dove-tailed, each one overlapping the other, as is clearly shown in the figure (*vide* Pl. XIX. fig. 4). Directly one cell is completed, a very large quantity of bee-bread is collected and stored, filling nearly half of it. The lining and exterior leaves of the cell appeared to be constructed of the same quality of leaf. An egg is then laid on the top, in the middle of the mass of food, from which the grub *emerges* a semitransparent cylindrical sac with a little black head. It rapidly increases in size, as shown in the Plate, where the subsequent changes being figured they need no further description. The head remains attached to the food, which, entering at the mouth, passes out as excrement above; this, when the grub spins its cocoon, is excluded. This spinning is effected after the larva has consolidated the inner surface of the cell with what looks like dark glue; and the said cocoon is an extremely tough one, and fit to resist the attacks of all parasites, by which these bees are much molested. Between the consolidation of the wall of the cell and the cocoon remain the exuviæ, which, as before mentioned, have been voided upwards.

In the excrement of the Grey Hornbill (*Meniceros bicornis*) I have found the wings and body-plates of this bee, together with the remains of other species; so that it is clear that this omnivorous bird eats them, catching them probably when they come to feed on the juices of the broken figs (*Ficus religiosa*).

The changes take a long time; and as the construction of the cells is generally accomplished in October to November, the perfect insect does not usually come out until the following March, or even later.

Like all these bees, this species is perfectly fearless when engaged in building, and, from its strength and size, is not often attacked by any bird, although it is probable that the mice cut open the cells for the bee-bread, of which they are very fond. This has a sweet taste, mingled with a slight acridity, as has that of *M. lanata*, and would be fine feeding for mice, which abound in the localities generally chosen by the bee for its nest.

The concluding remarks on *M. lanata* will doubtless apply to this insect, as regards the precedence of emergence.

In a series of cells which I sent to England, taken immediately after construction, the insects came out irregularly; but this was owing to the fact that the occupants of some cells died, so that those below them had to eat their way out of the sides, which they could not have done had the said cells been *in situ*, and not packed loosely in a box with cotton wool.

[*Note.*—In my catalogue of Hymenopterous Insects, part 1. Andrenidæ and Apidæ, published by the Trustees of the British Museum, the male of this insect was described as a distinct species from the female; the former was named *M. fasciculata*, the latter *M. anthracina*.—FREDK. SMITH.]

MEGACHILE DISJUNCTA, Fabr. (Plate XIX. figs. 12 & 12 *a*.)

This insect in its habits agrees with *M. lanata*. In general appearance it is also very similar as regards form. The colour, however, is quite distinct, the broad band from which it takes its specific name being very marked. It makes clay cells separately, and also fills up the hollows of small bamboos with cells one over the other. In one instance I found four series of cells side by side in one bamboo; and in this case two of the cells had been appropriated by a *Pelopœus*—remains of spiders and the pupa-case of one of this genus being found in them. Their great enemies are the *Chrysidites*, or Golden Wasps; these take possession of the ready-made cells, and prey on the larvæ of the bee. They work at the same season as *M. lanata*, but are not so common.

XYLOCOPA CHLOROPTERA, St. Farg. (Plate XXII. figs. 1, 1 *a*, & 1 *b*.)

This fine bee may be heard buzzing in the veranda all day long, selecting hollow bamboos in which to store his bee-bread. The weight of this is surprising. That from one cell alone weighed 21 grains; and this was taken at random.

When once a suitable hollow has been selected, the insect begins to store food. The female then lays an egg on the top of the same, and *both* male and female set to work gnawing at the interior near the mouth of the opening of the bamboo for saw-dust. This they work up with some viscous fluid which is ejected from the mouth, and form therewith a firm floor for the next cell. This floor is much thicker at the sides, where it joins the bamboo, than in the middle: the perfect insect, when emerging, has strong jaws, and his head is in the middle of the cell; he can therefore easily moisten and cut through this thin centre.

The cocoon is very strongly spun; and a long time elapses ere the perfect insect emerges. After all the work is finished (and these insects generally cease working at the end of October), they appear to retire into hollow bamboos to hybernate or die. Later on in the season I have opened bamboos and found six or seven, one after another, all dead; whilst at other times I have found them in a state of stupor caused by the cold. The young, I have reason to believe, do not come out until the spring. Their chief enemy is a species of *Cœlionyx*, of which three were hatched, together with about fourteen bees, from one series of cells.

This species often burrows in soft "seenul" wood (*Bombax heptaphyllum*) (which is used in the building of outhouses), and can then be detected by the heap of coarse raspings under the hole. The bee-bread is very pleasant to the taste, with a slight subacid, and keeps good for a very long time. I am not aware that this bee ever works in living timber.

The insect in the larva-state is often destroyed by a minute Chalcididous insect of the genus *Eucyrtus*. From one single specimen I bred 300 of these insects; and two-thirds of those I tried to rear were destroyed by them.

"Mainpurí, July 10, 1865.—I was somewhat interested to-day in watching the shower of lovely yellow blossoms falling from a fine bush of a beautiful flower, and by observing how it was caused. I noticed the large black Bee (*Xylocopa chloroptera*) cutting the tube of the corolla, and inserting its tongue for the honey which abounded there; the flower immediately after fell; and amongst the hundreds on the ground I could not find one which was not so bitten."

XYLOCOPA ÆSTUANS, Linn.

The habits of this insect are so exactly like those of *X. chloroptera* that they need little further account. They use bamboos for their cells, and make divisions with raspings from the interior. I found three or four of these bees in company with three or four of *X. chloroptera* in the same hollow bamboo. When they cannot find a bamboo, they use any hole in a post or tree for the construction of their cells. I have also found them dead in bamboos, whither they had resorted to hybernate or die; but as their pupæ remain a very long time in their cases ere they emerge, the supply in any case is well kept up, and the insect is a common one. Various species of *Anthrax* and *Cœlioxys* are their great parasitical enemies.

Apis floralis, Fabr. (Plate XXII. figs. 2, 2 *a*, 2 *b*, & 2 *c*.)

This is a very interesting little bee, which builds its beautiful comb on the boughs of orange- and lemon-trees and garden bushes generally. The honey is much prized, and held by the natives to possess medicinal qualities. It is very harmless; and although I have handled them freely, I never remember to have been stung by one. I procured two queens by taking the nests with all the bees in them into a dark room with a small window; the bees gradually flew to the window, and I thus easily found the queen. The males are seldom with the nest; and out of some twenty I only met with them in two cases. I imagine they are driven out when they have performed their functions, as my gardener told me he often found them on and in the ground under the nests. In their general habits they entirely agree with *A. dorsata*; the only difference is that they select the inside of bushes, and loop their nest round the bough, instead of entirely hanging it on below. I have occasionally found nests of this species built in the interior of mud walls, in the cavities between bricks, or in the hollows excavated by *Termites*.

The wax is of a fine yellow colour; but so little of it is found as not to make it worth while to collect it for commercial purposes.

Their nests are infested by several moths, species of *Pampelia*, *Aphomia*, and *Galleria* having been bred by me from them.

Apis dorsata, Fabr. (Plate XXII. figs. 3, 3 *a*, & 3 *b*.)

This is perhaps the best-known of the Indian honey-bees. It is extensively kept in a domestic state in the Himalehs, in hives generally consisting of hollow logs of wood built into the houses. Much honey is collected and brought for sale, especially at Petwaghur, in Kumaon; and the wax is also an article of trade. This bee, when in a wild state, is most savage in its disposition, and is very easily provoked, in which case it sallies forth in large parties, pounces on the supposed offender, and often causes great injury and annoyance.

The Moth (*Galleria mellolella*) will be hereafter described as a parasite; but its appearance in a large comb of three years' standing, and the consequent flight of the bees, gave me the opportunity of recording the following note:—

"Nov. 13, 1866, at Mainpurí.—My head gardener, an intelligent man, came to me reporting that all the bees had swarmed off, leaving entirely deserted a very large comb of the common honey-bee, which was hanging to a branch of a tree. I at once proceeded to the spot, and, after examining the comb with a glass, found his statement to be correct. I also tracked the bees, which had alighted in a very large swarm on a tree about half a mile off. On cutting down the comb I found it to be 28½ inches across by 22 inches, and nearly 5 inches thick at its thickest part. It was about three years old, as was plainly shown by the varied colour of the new ranges of cells.

		inches.
"Measurements:—	General breadth	$28\frac{1}{2}$
	General length	22
	General thickness	$1\frac{1}{8}$
	Diameter of cell	$\frac{3}{16}$
	Depth of honey-cell	$1\frac{7}{8}$
	Depth of ordinary cell	$\frac{10}{16}$ to $\frac{11}{16}$

Number of cells	21106
Honey cells, about	2000

"This nest had been deserted on account of the attacks of a Moth, figured in Pl. XXII. fig. 3*c*, which had fairly taken possession of the citadel, as I have often seen in other instances. The cocoons of some of the escaped moths protruded $\frac{3}{8}$ of an inch above the level of the comb, which, as it then was, still weighed three pounds."

I remember at Bareilly, in 1856, as Mr. Berkeley was sitting in his veranda, on the roof-beam of which a comb of these bees was hanging, he saw them assembling in great commotion, and soon after *all* swarmed off. He sent me the comb forthwith, and I made careful notes upon it, which were destroyed in the Great Indian Mutiny of 1857. In this instance the comb was beautifully clean and semitransparent, one of the first year, and, held between the eye and the light, did not at first reveal any thing. The eggs were there, the seeds of destruction; and I watched it day by day till it all crumbled down into a mass of silk and exuviæ, some forty or fifty moths having been meanwhile hatched therefrom. In this case it is clear that the bees fled at the *first* attack of the quiet little moths. But to return to the Mainpurí nest.

"The mouths of the thick new honey-cells were quite circular from the quantity of wax applied; those of the pupa-cells were hexagonal, as, of course, were the walls of the honey-cells interiorly. The Moth had deposited its eggs at the bottom of the cells prepared for storing honey; and the grubs were working their straight galleries in the flooring between the cells, always working at right angles, and at present feeding on the wax. As they proceeded they wove themselves silken tubes, probably for the purpose of protection."

As, however, they grew larger and stronger they formed their galleries right through the cells, not touching the flooring-wax; and they then spun over the mouth of the cells and changed to the pupa-state. About sixteen moths had escaped from these pupa-cases which had been spun up in the cells and which protruded from them; and many caterpillars were *then* working within the comb.

The habits of these bees have been so often described, that I shall now only mention their plan of covering certain cells scattered over the comb, presenting a curious appearance on its face, which led me to examine them. On one side I counted 186 of such closed cells, and on the other 229, making a total of 415, which appears a large number. I opened many of these, and found them to contain beautifully preserved remains of bees in various stages, whatever their age may have been at the time of death.

The grub of *Galleria mellolella*, the moth above referred to, is of a dull green, very circular, and somewhat tough; and it appears to eat the young bees, the bee-bread, honey, or wax, as may come most handy.

I will now give a few instances of their disposition:—

"A curious accident occurred at this place on Sunday last. A number of bees had built upon the cornice round the tower of the church of St. Paul's, in the Civil Lines, just below the steeple. On Sunday, after the morning service, the bees, disturbed either by a pellet or a stone thrown into their midst, or from some other cause, suddenly attacked a pair of horses in a carriage and stung them so severely that both the animals died the next day. The coachman also was severely stung. It was considered unsafe to hold divine service in the church again that day."—Agra, April 14, 1867.

On another occasion my camp was pitched at Sój, October 19, 1866, under a large Peepul tree. In the camp was my riding elephant, which animal is very fond of the leaves and small boughs of this tree. To enable him to enjoy them he was fastened under the tree, which he shook considerably in his endeavour to break off branches; this disturbed a nest of bees who had an enormous comb high on one of the branches. At first three or four bees came down to see; they flew back, and brought down some fifty or sixty with them: these did not attack the Elephant, but stung almost every one in camp, cattle grazing near, and even a stray dog, which I think they *killed*.

The strangest thing was that a man lying quite unprotected and fast asleep (named Cheda), clad with only a waistcloth, was quite unmolested; and I have often employed him to take the nests of aculeate hymenoptera for me, as they do not harm him, whatever he does. How is this to be accounted for? The natives say that he smells offensively to insects.

I will give two more instances. The bees, in February 1865, had formed their comb on a large tree near the old bridge (on the Grand Trunk Road at Mainpurí) over the river Esa, in a grove of trees at the road-side where travellers usually encamp when marching. My servants were so encamped when attacked by the bees, who had probably been disturbed by the smoke of their cooking-fires.

As Hindoos eat very lightly clad, they got sorely stung. One was nearly drowned in the river in his endeavours to keep under the water and so evade them; another ran between two and three miles, and was found by the villagers (who took him for a maniac) sitting on the ground throwing sand over himself.

It is generally an hour or two ere quiet is restored; and the pertinacity of the insects in following a person is very extraordinary. They espy the smallest bare spot and instantly implant their stings.

They also cause great annoyance, and disfigure old buildings, such as the Taj Mehal at Agra, with their pendent combs. Many vain attempts have been made to clear them from the beautiful white marble arches; but as soon as a nest is destroyed it is renewed at a few feet distance. They sometimes choose cupboards to build their nests in; and when in one case they had made their comb in one in daily use, they molested no one. This was at Nynee Tal, in the veranda of a house called Maldon, now the Government House.

The manner in which these bees adhere, after having planted their stings, as compared with the habits of the *Polistes*, is worthy of note, although of course every one knows how often they leave their stings behind them in the wound, and thus meet their own death.

In one case of an attack by bees in the camp of Mr. B. W. Colvin, Magistrate, of Mainpurí, they looked, I am told, like a black mass of insects on the clothes on the backs of our men, upon which they had alighted; and in this case, I imagine, most of them were unable to withdraw their stings from the cotton-cloth jackets in which they had fixed them.

Besides the moth before alluded to, these insects have many enemies. *Merops viridis* (the Bee-eater) plays sad havoc amongst them; but in the hills, at least, the lizards, who live in the cracks of the rocks and in the hollows in the stone walls, are still more destructive.

Colonel H. Ramsay, C.B., the Commissioner of Kumaon, with whom I was staying last year, near Almorah, North-west Province, settled many hives in trunks of trees covered up with stones, but could make nothing of them by reason of the lizards, the large blue species so common in the Himaleh, probably *Tiliqua rufescens.* These animals would lie in wait and snap up the bees, regardless of their stings, as they alighted at the hive; in fact, they fairly destroyed several swarms.

Again, the Crested Honey-Buzzard (*Pernis cristata*), a small hawk, darts down on the comb and carries off a large portion in its claws, which, in spite of the bees, who fly at and attack it on all sides, it quietly eats on a neighbouring bough. How it escapes their stings I could never make out. I once also saw a nest of *Icaria* taken off a cornice just as I was preparing to secure it, having brought a ladder for the purpose; and these insects sting even more viciously than the bees.

Again, in the hills, as all know, the bears make prodigious efforts to get at the comb and honey when in trees. They also eat, I believe, the grubs and bee-bread; and although they seem annoyed, they care little for the bee-stings. These insects often hang their combs under rocks where no bear can touch them, and where they are also well sheltered from the weather.

Mr. F. Moore, of the India Office, has kindly and carefully compared the *Galleria* of the North-west Provinces with the specimen of the English species in the British Museum, and holds it to be the same insect, viz. *Galleria mellolella*—which is a very curious fact, the more so as this species extends over the whole of the North-western Provinces of India. The native name of this bee in the North-west Provinces is Dingār.

TRIGONA RUFICORNIS, Smith.

This is one of the smallest honey-bees I have ever met with; and its habits are curious. I noticed it under the following circumstances; and I never again met with its nest, although the natives all know it. One evening, at Benares (April 4, 1863), as I was standing at my door I saw a swarm of from 400 to 500 of what I took to be midges rapidly flying about in a mazy kind of dance, occupying a space of five or six feet, and being about ten feet from the ground. I brought out my insect-net and caught about a hundred in one sweep, when, to my surprise, they proved to be bees. On watching them I observed that they went in and out of a little hole in the wall close by, under a beam where was a hollow, and that many of their thighs were laden with pollen.

The insects seemed quite harmless, walking about my hand and not attempting to sting. Digging out some bricks with care, I came on a portion of their nest. The space it occupied appeared to have been originally eaten out by *Termites*. It was coated on all sides with a layer of black wax, and in it was stored their honey. The waxen cells were of a dark brown colour and very globular, pendent side by side from the roof, and not, as far as I could see, arranged hexagonally.

The honey was very dark in colour, but excellent in flavour; and I was told by the natives that it possessed medicinal qualities. It had a slight astringency; and, considering the size of the insect, the quantity stored was very large. I was also told that these insects commonly use hollow trees, in which they store astonishing quantities of honey, which is diligently sought for and highly prized. They called them "Bhōnga," which appears to me to be a generic name for *all* bees in the North-west Provinces. Large bricks prevented my digging further, so that I cannot describe their breeding-cells.

The bees continued to fly in the manner before described till dark, and did not desert their nest.

Note.—As when in India I refrained from capturing the domesticated bees, I had no specimens in my collection; but from examples since obtained I have reason to believe that the species in general domestication is either *Apis indica* or *A. nigrocincta*. Both these species are much smaller; and the comb made in the cupboard at Maldon, Nynee Tal, in 1849, was probably their work, as they prefer hollows of trees, or even crevices in rocks, as opposed to *A. dorsata*, which hang their combs from the underside of boughs of trees or rocks. All the notes above recorded, with this exception, apply to *A. dorsata*, whose savage disposition would seem ill to brook captivity.

APPENDIX.

[Seventeen new species are herein described: seven belong to the Fossorial Group of Hymenoptera, five belong to the Family Vespidæ, and five to the Apidæ.

The habits of eight species are more or less detailed in the Notes by Mr. Horne. The economy of the genera *Pison* and *Parapison* is for the first time made known; and considerable addition is made to our previous knowledge of the habits of several other genera, particularly of the species of *Pemphredon*, and also of the social Apidæ. Very little has been previously published on the habits of Indian Hymenoptera derived from actual observation.

The type specimens have been liberally presented by Mr. Horne to the British Museum.—*F. S.*]

Fam. POMPILIDÆ.

1. Pompilus maculipes.

Female. Length $3\frac{1}{3}$ lines. Black, and thinly covered with cinereous pile; a white spot on the posterior tibiæ near their base.

Head—the clypeus and cheeks bright and silvery in certain lights; the anterior margin of the former rounded; the tips of the mandibles ferruginous. The coxæ beneath and the sides of the metathorax silvery bright, the latter rounded, smooth, and shining; the wings hyaline, the nervures black, with a fuscous cloud occupying the marginal cell and crossing the wing down to the posterior margin of the third discoidal cell. Abdomen smooth, shining, and pilose.

Hab. Mainpurí, North-west Provinces of India.

2. Agenia mutabilis.

Female. Length $3\frac{1}{2}$ lines. Black, and covered with a fine changeable silky silvery pile.

Head covered with silvery pile, which is most dense and bright on the cheeks and clypeus, the anterior margin of the latter rounded; the palpi testaceous, the apical joints palest. Thorax silvery, most bright and dense on the coxæ; metathorax rounded posteriorly, with a deep fossulet in the middle of its base, down the centre runs a marked or defined channel; the wings hyaline, the nervures black; the posterior femora bright ferruginous. Abdomen covered with a beautiful changeable silvery pile, its brilliancy changing in every fresh position, the apical segment very smooth and shining.

Hab. Mainpurí, North-west Provinces of India.

Fam. SPHEGIDÆ.

1. Ammophila fuscipennis.

Male. Length 9½ lines. Black, with red legs.

Head with scattered black pubescence, punctured, but not closely so; a little silvery pubescence on each side of the clypeus and above it as high as the insertion of the antennæ; the clypeus emarginate, the angles of the emargination prominent; the scape of the antennæ ferruginous. Thorax coarsely rugulose; the metathorax obliquely striated; wings fusco-hyaline, with a violet iridescence; the legs red, with the coxæ and claw-joint of the tarsi black. Abdomen black, the basal portion of the petiole more or less ferruginous; the rest of the abdomen with a fine silky pile, observable in certain lights.

Hab. Mainpurí, North-west Provinces of India.

2. Pelopœus curvatus.

Female. Length 6 to 7 lines. Black, variegated with yellow and ferruginous, the petiole black and curving upwards.

Head—a spot on the clypeus and the scape of the antennæ in front reddish yellow; the mandibles ferruginous near their apex. Thorax—a narrow line on the collar, the tegulæ, a transverse spot on the scutellum pointed at each end, and a spot at the insertion of the petiole on the metathorax yellow; the legs ferruginous, with the coxæ, trochanters, a line inside and outside of the femora, as well as the tips of the joints of the tarsi, black. The apical margin of the first segment of the abdomen with a broad reddish-yellow band; a narrow band of the same colour on the apical margins of the other segments; the abdomen curving downwards. The thorax transversely rugose, the metathorax most coarsely so; the wings hyaline, with the nervures bright ferruginous.

Hab. Mainpurí, North-west Provinces of India.

The form of the abdomen of this insect is the same as that of *Pelopœus deformis* from North China.

Fam. LARRIDÆ.

Genus Parapison.

The characters of this genus are in all respects the same as those of the genus *Pison*, excepting the absence of the petiolated second submarginal cell; it can therefore only be regarded as a division of that genus. Shuckard, in his Monograph on these insects, proposed a divisional name (*Pisonitus*). The following are the characters of the genus and its divisions:—

Gen. *Pison*. The eyes reniform; the anterior wings with three submarginal cells, the second petiolated; the recurrent nervures either interstitial or both received by the second submarginal cell.

Gen. *Pisonitus.* The anterior wings with three submarginal cells, the second petiolated; the first recurrent nervure received towards the apex of the first submarginal cell, the second recurrent received about the middle of the second submarginal cell.

Gen. *Parapison.* The anterior wings with two submarginal cells, the first recurrent-nervure received towards the apex of the first submarginal cell, the second recurrent nervure uniting with the apical nervure of the first submarginal cell, usually known as the first transverso-median nervure.

In all these divisions the eyes are reniform, as in *Vespa*; and in all, the apical margins of the abdominal segments are more or less depressed.

1. Parapison rufipes. (Plate XXI. fig. 1 *a.*)

Female. Length 3 lines. Black, with the legs red.

Head—the cheeks, clypeus, and emargination of the eyes with bright silvery pile; the mandibles ferruginous, the palpi pale ferruginous. Thorax—the posterior margin of the prothorax and the sides of the metathorax with silvery pubescent pile; the mesothorax with a deep central longitudinal channel and a short impressed line between it and the tegulæ; the metathorax has also a deep longitudinal channel, which is broadest and deepest at its origin at the postscutellum; the wings hyaline and iridescent; the legs ferruginous, with their coxæ black, the apical joints of the tarsi dusky. Abdomen smooth, shining, and delicately punctured; the apical margins of the segments with changeable bright silvery pubescence; the sides of the abdomen very bright and glittering; beneath smooth and shining.

Hab. Mainpurí, North-west Provinces of India.

Fam. CRABRONIDÆ.

1. Trypoxylon intrudens.

Female. Length 4–4½ lines. Black, with the second and third segments of the abdomen red, legs more or less testaceous.

Head shining and delicately punctured, with an impressed line in front of the anterior ocellus; the clypeus and the emargination of the eyes with bright silvery pubescence; tips of the mandibles ferruginous, the palpi pale testaceous; the extreme apex of the joints of the antennæ more or less rufo-testaceous. Thorax smooth and shining, with a few very fine punctures; the collar and sides of the metathorax silvery, the latter with a deep central longitudinal impression; a semicircular enclosed space at the base of the metathorax, which is transversely striated; the legs black, with the tips of the coxæ, the trochanters, the base of the tibiæ, and the tips of the joints of the tarsi pale testaceous; the wings colourless and brilliantly iridescent. The petiole more than half the length of the abdomen; the second and third segments red, with a fuscous spot in the middle of each.

Hab. Mainpurí, North-west Provinces of India.

This insect was bred from cocoons constructed by *Parapison rufipes*, it having taken possession of one of the cells and reared its own young therein.

2. Trypoxylon rejector. (Plate XXI. fig. 4 *a.*)

Female. Length $5\frac{1}{4}$ lines. Black, with the second and third segments of the abdomen red, the legs black.

Head—the clypeus and the emargination of the eyes silvery; tips of the mandibles ferruginous, the palpi pale testaceous; an impressed line in front of the anterior ocellus, terminating at an elevated carina just above the insertion of the antennæ. Thorax smooth and shining on the disk; the sides of the metathorax with silvery pubescence, and a smooth enclosed space at its base divided by a central channel, beyond the enclosure it widens into a deep and wide fossulet; wings subhyaline, their apical margins clouded and beautifully iridescent; legs entirely black. Abdomen with a long petiole, and smooth and shining; the second and third segments red, their apical margins more or less fuscous.

Hab. Mainpurí, North-west Provinces of India.

This species was bred from cells constructed by *Pterochilus pulchellus.*

Fam. EUMENIDÆ.

1. Eumenes mainpuriensis. (Plate XX. fig. 3 *a.*)

Male. Length 5 lines. Black, with yellow bands and spots, and thinly covered with short pale pubescence.

Head and thorax very closely punctured; the clypeus and a narrow line running upwards and terminating in a round spot yellow; the apical joint or hook of the antennæ reddish yellow; the tips of the mandibles ferruginous. Thorax—the anterior margin of the prothorax yellow above; the tegulæ and postscutellum yellow; the tibiæ, tarsi, and apex of the femora yellow; the posterior tarsi, and apex of the tibiæ above, fuscous; the wings subhyaline, the anterior margin of the anterior pair more or less fuscous. Abdomen with all the segments irregularly bordered with yellow; petiole pyriform, the yellow border deeply emarginate in the middle, and on each side of it a deep impression; the second segment with a small transverse oblong yellow spot on each side, and the yellow border deeply emarginate in the middle and narrowed laterally; the borders of the other segments narrower; the abdomen is slightly shining, finely and closely punctured, but not so closely as the head and thorax.

Hab. Mainpurí, North-west Provinces of India.

This may possibly be the male of the species described by Saussure in his 'Monographie des Guêpes solitaires,' and named *Eumenes affinissima* from its close resemblance to the European species *E. coarctata* and *E. pomiformis*; but I have nothing to justify my considering it to be so.

2. Pterochilus pulchellus. (Plate XXI. fig. 8 *b*.)

Female. Length 3 lines. Black, ornamented with yellowish-white markings; the basal segment of the abdomen red.

Head—a line behind the eyes, the sides of the clypeus, an oblong spot above it, the base of the mandibles and the scape in front yellow white. A transverse line on the thorax in front, the tegulæ, a spot beneath the wings, and the sides of the scutellum and postscutellum yellowish white; the wings hyaline and iridescent; the femora and the tibiæ within pale ferruginous, the coxæ white in front, the tibiæ and tarsi white and more or less stained with pale ferruginous. Abdomen—the first segment red, small, and campanulate, much narrower than the second; the posterior margins of all the segments white, and a small ovate spot on each side of the second segment; beneath, the second segment with a white apical margin.

Male. Rather smaller than the female, and closely resembling that sex, but having the clypeus immaculate (the female has a black spot), and the second abdominal segment without the two ovate white spots.

Hab. Mainpurí, North-west Provinces of India.

Fam. VESPIDÆ.

1. Vespa vivax. (Plate XXI. fig. 9, ☿.)

Worker. Length 9 lines. Black, pubescent, head yellow, the abdomen with orange bands, the legs and antennæ ferruginous.

Head sulphur-coloured; the face above the clypeus as high as the posterior ocelli black; the emargination of the eyes obscurely yellow; a reversed bell-shaped yellow spot between the antennæ.

Thorax black, with sometimes a very narrow orange line on each side of its anterior margin; wings fulvo-hyaline, with the anterior margin of the superior pair fusco-ferruginous; tegulæ rufo-piceous; the tibiæ and tarsi reddish yellow.

Abdomen with the first segment bordered with a broad orange band occupying half its width; the second segment with a very narrow orange band on its apical margin; the third segment yellow, with a quadrate spot on each side at its basal margin; these spots unite with the black basal portion of the segment, which is sometimes partly visible also; the apical margin of the fourth segment, and the fifth and sixth entirely, orange-yellow; the abdomen yellow beneath from the middle of the second segment to the apex.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species most closely resembles *V. velutina*, and must be arranged next to that species.

2. Vespa flaviceps. (Plate XXI. figs. 10, ♀, 11, ☿.)

Female. Length 8 lines. Black, and ornamented with sulphur-yellow spots and bands. Head yellow, with a small quadrate black spot that encloses the ocelli; the flagellum of the antennæ and the teeth of the mandibles black, the scape, and the vertex between the summit of the eyes, ferruginous; the eyes extending to the base of the mandibles. Thorax—the margins of the prothorax and of the scutellum, a spot on each side of the metathorax just above the insertion of the abdomen, and a spot beneath the wings yellow; the legs yellow and stained with ferruginous beneath; the coxæ, and the posterior femora at their base, more or less fuscous; the wings flavo-hyaline, the nervures ferruginous, the costal nervure fuscous. Abdomen—the first, second, and third segments with a yellow band on their apical margins; the bands on the second and third segments widen at the sides, where each is slightly emarginate; the two following segments are yellow, and have an ovate black spot on each side; the apical segment yellow beneath; the basal margins of the first, second, and third segments are black.

Worker. Length 6 lines. This sex differs from the female in many particulars. The vertex is black; the antennæ black, with the scape yellow in front. The thorax, legs, and wings as in the female. The abdomen has the apical margins of all the segments bordered with narrow yellow bands; the second and following segments have a rounded notch on each side. Beneath, the segments with yellow apical margins: that on the second segment is broad, and a curved black line runs into it, emanating from the black base of the segment; the margins of the three following segments have narrower bands, each having a black emargination on each side; very frequently there is a very narrow interrupted line of yellow at the base of the abdomen.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species has the aspect of one of our British, or one of the North-American Wasps; at first sight the workers look somewhat like those of *Vespa cuneata.*

3. Vespa structor. (Plate XXI. fig. 12, ☿.)

Worker. Length 5 lines. Head and thorax black; abdomen reddish yellow, with black bands.

Head yellow, the vertex between the eyes black; the scape yellow in front; the eyes extending to the base of the mandibles. The margins of the prothorax, a line on each side at the base of the scutellum, the tibiæ, tarsi, and tips of the femora reddish yellow; the coxæ, trochanters, and base of the femora black; wings subhyaline, the nervures ferruginous, the costal nervure black. Abdomen reddish yellow, with the basal margins of the segments black; the black bands narrow, but widest in the middle, and there produced into an angular point, and the posterior margins of the bands irregularly notched.

Hab. Binsur, Kumaon, North-west Provinces of India.

Fam. APIDÆ.

1. Megachile proxima.

Female. Length 6–7 lines. Head, thorax, and base of the abdomen with fulvous pubescence, the segments margined with white.

Head—the face clothed with fulvous pubescence; the thorax also with fulvous or fulvo-ferruginous pubescence above; the tegulæ ferruginous; the wings subhyaline, with a dark fuscous cloud beyond the marginal cell; the intermediate and posterior tibiæ with a fine silvery pilosity outside, and the basal joint of their tarsi with bright short ferruginous pubescence beneath. The basal segment of the abdomen with bright ferruginous pubescence; the posterior margin of the second with a narrow fringe of the same colour; the border on the third segment is reddish in the middle and white at the sides; the two following are edged with white; the apical segment is white on each side; the underside is clothed with silvery-white hair, with a fringe of black at the sides.

Male. This sex is coloured like the female, but has more of the red pubescence at the base of the abdomen, its anterior tarsi are simple, and the apical segment of the abdomen has no white at the sides, and its margin is notched in the middle.

This species very closely resembles the *M. lanata* of Fabricius, and is difficult to separate by description: the white pubescence on each side of the apical segment of the abdomen distinguishes the female; the males are alike; but both sexes of *M. proxima* are larger than those of *M. lanata*. The habits of the two species are totally different, as pointed out by Mr. Horne.

Hab. Mainpurí, North-west Provinces of India.

2. Cœlioxys angulata.

Female. Length 5½ lines. Jet black, the abdomen with a row of lateral snow-white angulated spots.

Head and thorax strongly and closely punctured; the face on each side of the clypeus and the anterior margin of the latter with dense short white pubescence, which also covers the head behind the eyes; a white line of pubescence on each side of the mesothorax close to the margins of the tegulæ, two minute spots of the same colour at the base of the scutellum; the thorax beneath, as well as the femora, with fine short white pubescence; the posterior tibiæ are also clothed outside; a stout tooth on each side of the scutellum; the posterior margin of the latter rounded. Abdomen shining, finely and sparingly punctured; a row of minute snow-white scales along the basal margin of the second and following segments, at the lateral margins an angular patch of the same; the patch is quadrate on the basal segment; the apical segment broadly lanceolate, the lower plate of the same shape, and only a little longer than the upper one; beneath, the segments are margined with white, and usually more or less interrupted in the middle; the basal segment has a white patch in the middle.

Hab. Mainpurí, North-west Provinces of India.

This species is parasitic upon *Megachile fasciculata*, from the cells of which bee Mr. Horne bred it. In my catalogue of Andrenidæ and Apidæ I have described the female of *M. fasciculata* as a distinct species under the name *M. anthracina*; Mr. Horne bred both sexes from nests.

3. Bombus atrocinctus. (Plate XXI. fig. 13, ♂.)

Male. Length 7 lines.

Head—the cheeks with griseous pubescence, the clypeus with white, on each side of it the pubescence is thin, long, and black, as it is also at the insertion of the antennæ, leaving the vertex naked, smooth and shining; there are also a few long black hairs on the posterior margin of the vertex. Thorax clothed above with fulvous pubescence, as are also the two basal segments of the abdomen; the wings fulvo-hyaline, with their apical margins fuscous; the third and fourth segments of the abdomen clothed with black pubescence, the three apical ones with white; the four apical joints of the tarsi ferruginous; the tarsi, beneath, have short bright ferruginous pubescence; the thorax and abdomen, beneath, with a long thin griseous pubescence.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species resembles one of the varieties of the *Bombus lucorum* of Europe.

4. Bombus terminalis.

Male. Length 7 lines.

The head clothed with black pubescence, that on the clypeus white and intermixed with some long bristly black hairs; the mandibles with a thick fringe of pale fulvous. Thorax clothed above with bright fulvous pubescence; that on the sides black; beneath it is white; the four apical joints of the tarsi ferruginous; the pubescence on the tibiæ black, intermixed with a few ferruginous hairs on the posterior pair; that on the tarsi beneath is bright ferruginous; wings fulvo-hyaline, the nervures dark ferruginous. Abdomen clothed with black pubescence; a few ferruginous hairs at its base, and the two apical segments clothed with white; beneath, the segments are fringed with pale hairs.

Worker. Length $5\frac{1}{2}$ lines. Clothed exactly the same as the male, and only differs in having the wings darker, and in not having white pubescence on the clypeus; above it, at the insertion of the antennæ, it is short, dense, and fusco-ferruginous.

Hab. The male from Simla.

5. Trigona ruficornis.

Worker. Length $1\frac{1}{2}$ line.

The head smooth and shining, the face with a white downy pubescence; the antennæ and mandibles ferruginous, the clypeus usually more or less so. The thorax smooth, shining, black; the scutellum and metathorax frequently more or less pale ferruginous; wings colourless and iridescent; legs pale ferruginous, varying in colour to dark fusco-ferruginous. Abdomen ferruginous, frequently dark towards the apex, and very smooth and shining.

Hab. Mainpurí, North-west Provinces of India.

DESCRIPTION OF THE PLATES.

PLATE XIX.

Fig. 1. Nest of *Megachile fasciculata*, p. 178.
Fig. 2. Male of *Megachile fasciculata.*
Fig. 3. Female of *Megachile fasciculata.*
Fig. 4. Leaf cells of *Megachile fasciculata.*
Fig. 5. Open cell, with pollen, and grub feeding thereon.
Fig. 6. The skin of the larva of *Megachile fasciculata.*
Fig. 7. Leaves of a rose cut by *Megachile fasciculata.*
Fig. 8. The pupa-case of *Megachile fasciculata.*
Fig. 9. Larva of *Megachile fasciculata.*
Fig. 10. The egg of *Megachile fasciculata.*
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Fig. 11 *a.* Female of *Megachile lanata.*
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Fig. 12 *a.* Female of *Megachile disjuncta.*

PLATE XX.

Fig. 1. Nest of *Rhynchium nitidulum*, p. 168.
Fig. 1 *a.* The female of *Rhynchium nitidulum.*

Fig. 2. Nest of *Eumenes conica* (abnormal form), p. 166.
Fig. 2 *a*. Female of *Eumenes conica*.
Fig. 3. Nest of *Eumenes mainpuriensis*, p. 167.
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Fig. 4 *a*. Female of *Eumenes edwardsii*.
Fig. 5. Nest of *Rhynchium carnaticum*, p. 167.
Fig. 5 *a*. Female of *Rhynchium carnaticum*.
Fig. 6. Nest of *Eumenes esuriens*, p. 167.
Fig. 6 *a*. Female of *Eumenes esuriens*.
Fig. 7. Nest of *Odynerus punctum*, p. 167.
Fig. 7 *a*. Female of *Odynerus punctum*.
Fig. 8. Nest of *Icaria variegata*, p. 169.
Fig. 8 *a*. Female of *Icaria variegata*.
Fig. 9. Nest of *Icaria variegata* on a leaf.

PLATE XXI.

Fig. 1. Nest of *Parapison rufipes*, p. 165.
Fig. 1 *a*. *Parapison rufipes* (♀), p. 188.
Fig. 1 *b*. Pupa-cases of *Parapison rufipes*.
Fig. 2. Nest of *Pelopœus bengalensis*, p. 163.
Fig. 2 *a*. Pupa-cases of *Pelopœus bengalensis*.
Fig. 3. Cell of a species of *Pelopœus* (?) constructed in a finger-ring.
Fig. 4. Nest of *Trypoxylon rejector*, p. 164.
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Fig. 5. Nest of *Pisonitus rugosus*, p. 165.
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Figs. 8 & 8 *a*. Cells of *Pterochilus pulchellus*.
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Fig. 13. *Bombus atrocinctus* (♂), p 193.
Fig. 14. Nest of *Pelopœus bilineatus*, p. 163.
Fig. 14 *a*. *Pelopœus bilineatus* (♀).

PLATE XXII.

Fig. 1. Nest of *Xylocopa chloroptera*, p. 179.
Fig. 1 *a*. Female of *Xylocopa chloroptera*.
Fig. 1 *b*. Larva of *Xylocopa chloroptera*.
Fig. 1 *c*. *Emanadia*, sp. ——?, p. 167.
Fig. 2. Comb of *Apis floralis*, p. 181.
Fig. 2 *a*. The queen of *Apis floralis*.
Fig. 2 *b*. The worker of *Apis floralis*.
Fig. 2 *c*. The male of *Apis floralis*.
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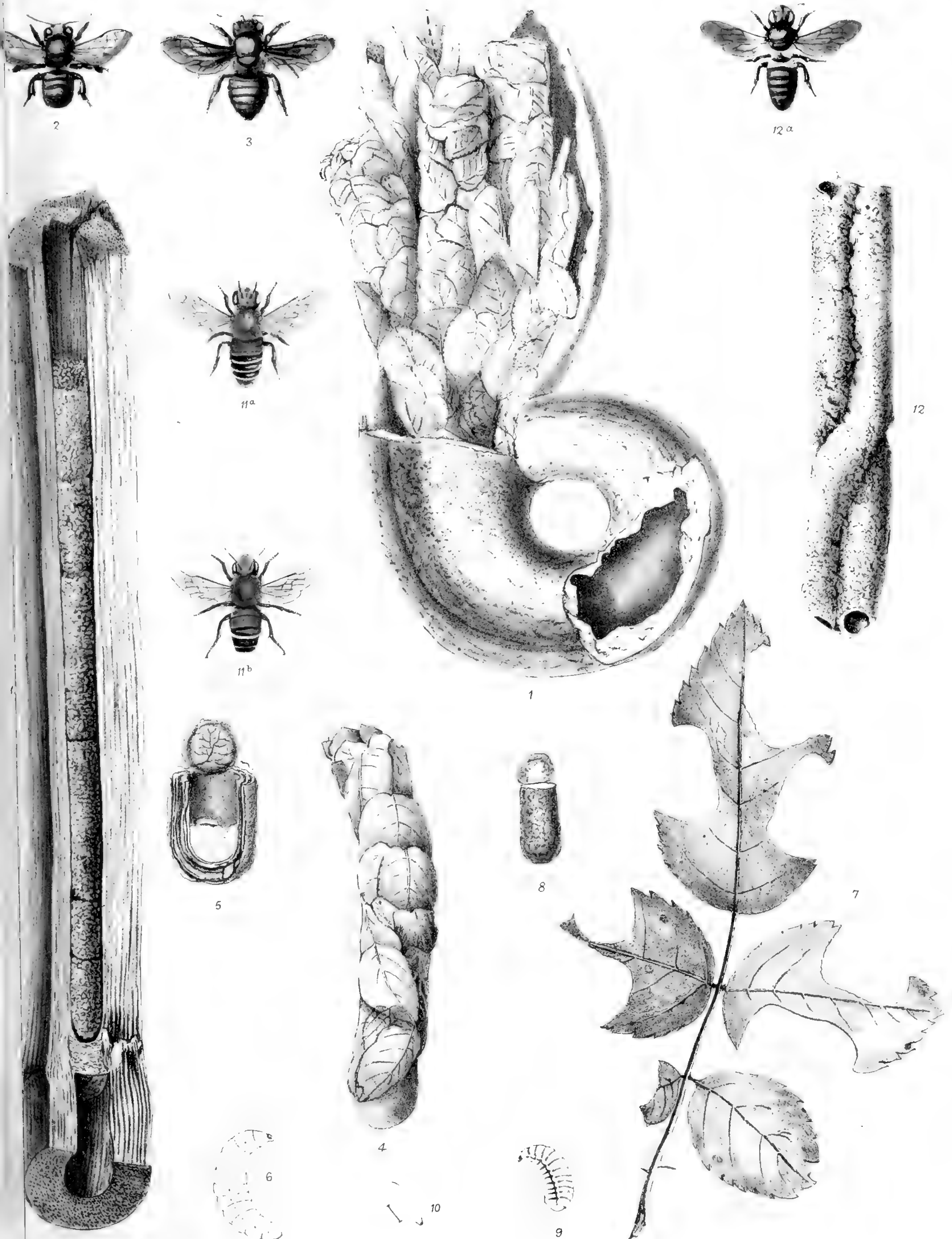
Fig. 3 *a*. The worker of *Apis dorsata*.
Fig. 3 *b*. A closed cell of *Apis dorsata*.
Fig. 3 *c*. *Galleria mellolella*, a moth which feeds upon the comb.



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Indian Hymenoptera.

W West imp

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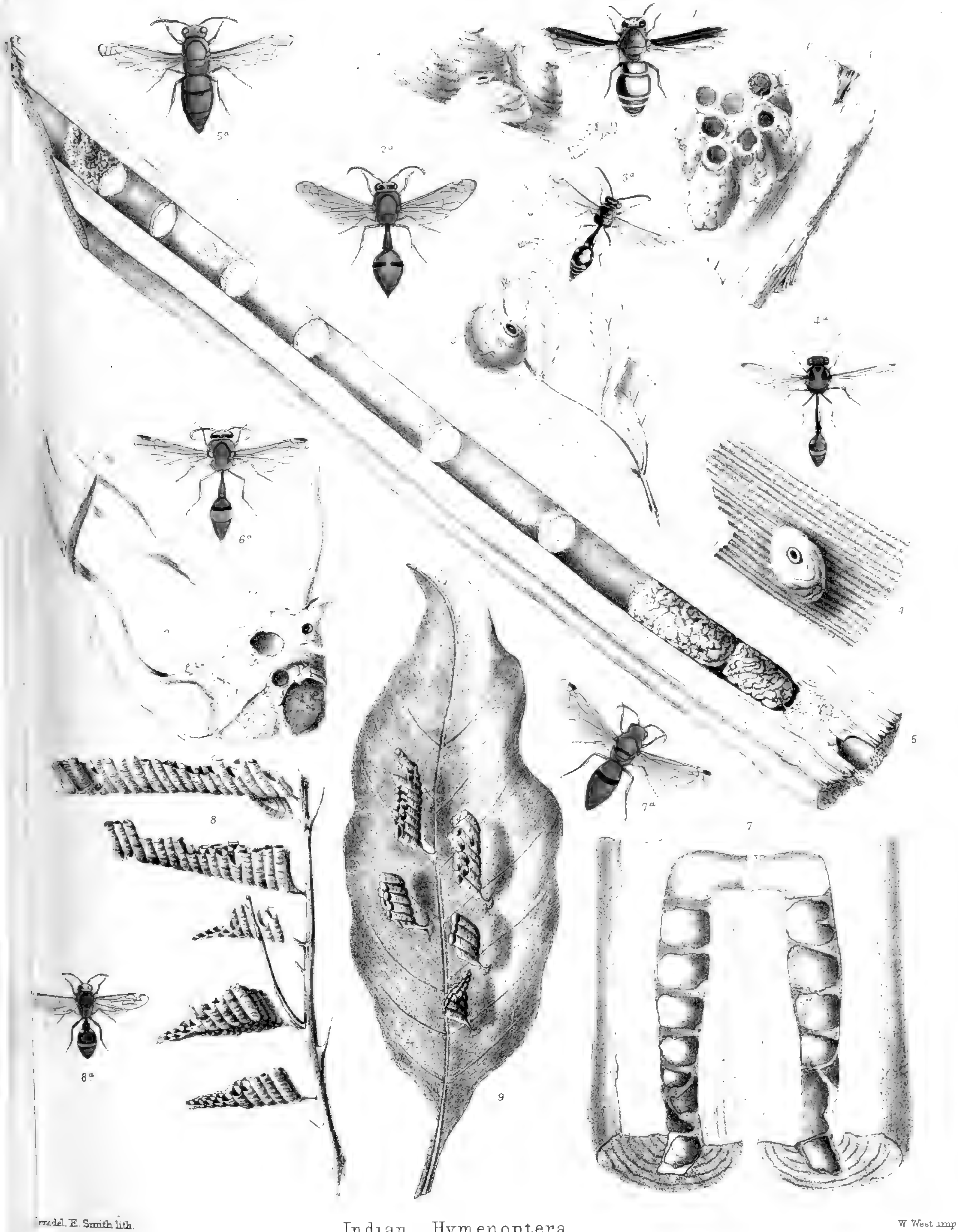

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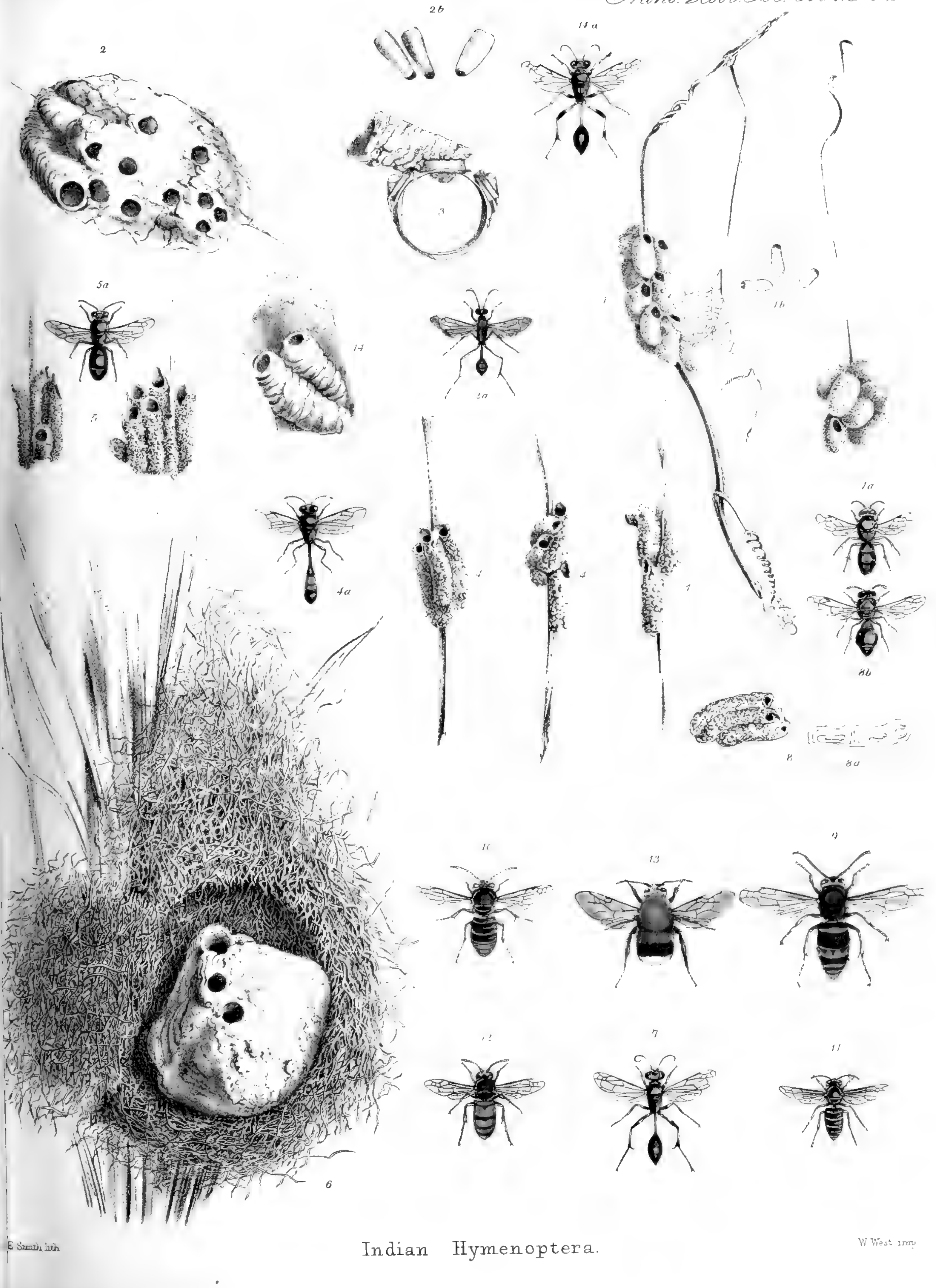

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Indian Hymenoptera.

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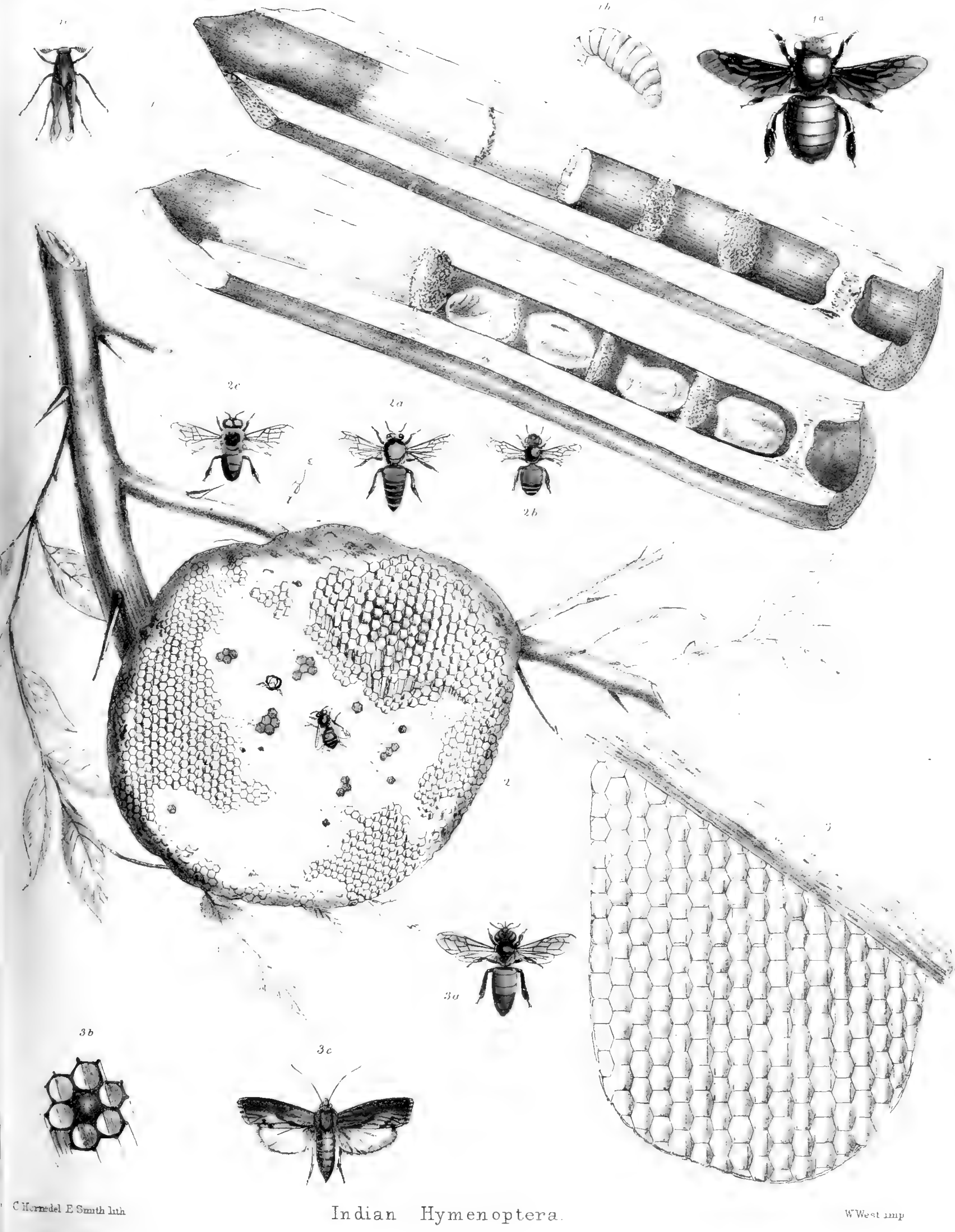

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Indian Hymenoptera.

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VI. *On a collection of Birds from North-Eastern Abyssinia and the Bogos Country.*
By OTTO FINSCH, *Ph.D., C.M.Z.S. With notes by the collector,* WILLIAM JESSE, *C.M.Z.S., Zoologist to the Abyssinian Expedition.*

Read June 10th, 1869.

[PLATES XXIII. to XXVII.]

HAVING for a long time past directed my attention to the study of the avifauna of Africa, I was much pleased to have an opportunity of examining the fine collection of birds brought home by Mr. Jesse, the indefatigable zoologist attached to the late Abyssinian expedition. This collection was formed on the Abyssinian coast-region at Zoulla and Massowah, in north-eastern Abyssinia, and in the Bogos country, all of which parts of Africa had been already tolerably well explored.

With the successful endeavours of Drs. Ehrenberg and Hemprich, the latter of whom lies buried on the island of Tan-el-had, opposite Massowah, began our acquaintance with the avifauna of the Abyssinian coast-lands. Their extensive work 'Symbolæ physicæ' is, from its unwieldy size, and also from the fact of its being without systematic arrangement of any kind, too seldom referred to, and many of the valuable discoveries therein contained have not received the attention they deserve at the hands of scientific men. Dr. Rüppell, the reexplorer of Abyssinia after the celebrated Bruce, obtained many novelties, and published the results of his explorations in handy and convenient volumes. The extensive collections made by Major Harris have only become the property of science in a limited degree, not having been published in a connected form. Amongst those who have enriched our knowledge of the avifauna of Abyssinia I must mention Salt, Théophile Lefebvre, Ferret, and Galinier, travellers whose names will be for ever engraved in the annals of science; nor must I forget to mention the collection formed during a voyage in the Red Sea by Mr. James Daubeny, and recorded by Dr. Sclater in Sir William Jardine's 'Contributions to Ornithology' for 1852 (p. 123).

During the last ten years, however, our knowledge of the ornithology of North-eastern Africa has been most satisfactorily extended by the explorations of Hofrath v. Heuglin and Dr. A. Brehm in the Bogos country. The first-mentioned naturalist, undoubtedly our first authority on Abyssinian zoology, made a long residence in the Bogos country when attached to the German expedition in search of the much lamented Dr. Eduard Vogel, having been elected by the German nation to the command of this once much talked-of, but now almost forgotten, expedition. From the end of July to the end of October he successfully explored the Bogos country; and many new birds were discovered, a few of which, however, have since been referred to previously described species. Dr. A. Brehm, who was attached to the hunting expedition of the Duke Ernst II. of Saxe-Coburg-Gotha, during his short visit of two months, made many valuable observations on the habits of the mammals and birds, which were published in a popular work bearing the ill-chosen title of 'Results of a Voyage to Abyssinia'[1]—ill-chosen, because the author never entered Abyssinia proper, having only reached the coast-land of Samchara and the plateau of Mensa, in the Bogos country, about 4000 feet above the level of the sea.

After such important explorations by so many celebrated travellers, it might be supposed that the researches of Mr. Jesse had not been productive of any great results. His fine and surprisingly rich collection, containing about 735 skins, proves the contrary. Although there are only two new, or, I should rather, say hitherto overlooked species in the collection, namely, a Lark (*Alæmon jessei*) and a Shrike (*Lanius fallax*), we were astonished at the fine series of specimens, all of them bearing a label on which was accurately marked the locality, date, and sex, the latter point being always determined by anatomical dissection. These series of specimens have enabled us to become better acquainted with many species than was before possible, by exhibiting to us the individual aberrations and variations of the birds themselves, which knowledge is in many respects more valuable than the discovery of new species. Our knowledge of the geographical distribution of birds has also been increased by adding species to the avifauna of North-eastern Africa which were either little known (such as *Cossypha gutturalis* and *Charadrius pecuarius*) or entirely unknown (as *Cotyle fuligula, Nectarinia jardinei, Sterna macroptera, Hypolais olivetorum*, and *H. elaica*) to be inhabitants of that part of Africa. The occurrence of many species new to Abyssinia and the Bogos country is also of great interest. For Abyssinia I may mention *Aquila imperialis* (observed on the Red Sea for the first time near Zoulla), *Bubo ascalaphus, Otus brachyotus* (shores of the Red Sea), *Himantopus melanopterus*; for the Bogos country, *Halcyon senegalensis, Irrisor aterrimus, Nectarinia pulchella, Thamnobia albifrons, Zosterops abyssinica, Turdus pelios, Crateropus limbatus, Cr. leucocephalus, Platystira senegalensis, Lanius nubicus, Colius macrourus, Pogonorhynchus undatus, Megalæma pusilla, Oxylophus afer, Indicator sparmanni*, and *Cursorius chalcopterus*.

The total number of species collected by Mr. Jesse is 219, being more than a quarter of all the birds known to inhabit north-eastern Africa, supposing the total number to be somewhere about 800. Rüppell enumerates only 532; Heuglin ten years afterwards 754, and in his fauna of the Red Sea 325 species. Dr. Brehm observed during his short visit 172 species. The results of Mr. Jesse's expedition are therefore not less

[1] Ergebnisse einer Reise nach Habesch im Gefolge Seiner Hoheit des regierenden Herzogs von Sachsen-Coburg-Gotha Ernst II., von Dr. A. E. Brehm (Hamburg, 1863).

than those obtained by any of his predecessors, especially when the short period of his stay is taken into consideration; and the present collection of birds will always remain a proof of the diligence and zeal of this indefatigable collector.

I have given critical remarks, to the best of my power, on all interesting or disputed points connected with the determination of the species in the following list; while Mr. Jesse has furnished some field-notes as to habits and the colour of the eyes, legs, &c., which, as far as I can judge myself, seem to have been recorded with most commendable accuracy.

Fam. VULTURIDÆ[1].

1. Vultur fulvus (Gml.).

Gyps fulvus, Rüpp. Syst. Uebers. p. 9. no. 4 *a*; Heugl. Syst. Uebers. no. 4 *b*; *id.* Faun. des Rothen Meeres, no. 4 *c*.

Vultur fulvus, Finsch & Hartl. Vögel Ostafr. p. 31. no. 1 *d*.

a. Senafé. April 1868.

The plumage of this specimen is strongly tinged with ochre-brown, like the so-called *Vultur fulvus orientalis* of Schlegel. Bill greyish horn-colour, along the culmen yellowish.

	Long. al.	Caud.	Culm.	Rostr. a rict.	Tars.	Dig. interm.
Measurements . .	1′ 11½″	10″	23‴	2″ 10″	4″	3″ 11‴

The length of the bill is taken from the front to the apex. The measurements of the toes are exclusive of the claw. All dimensions are given in old French feet and inches, the inches being divided into twelve lines.

[Common in the highlands.—*W. J.*]

[1] The full titles of the works referred to are:—

a. Systematische Uebersicht der Vögel Nord-Ost-Afrika's, von Dr. Eduard Rüppell, Frankfurt a. M. 1845 (mit 50 Abbildungen).

b. Systematische Uebersicht der Vögel Nord-Ost-Afrika's, mit Einschluss der Arabischen Küste, des Rothen Meeres und der Nil-Quellen-Länder, südwärts bis zum iv. Grade nördl. Breite, von Dr. Th. von Heuglin (aus dem Februarhefte des Jahrganges 1856 der Sitzungsberichte der mathem.-naturw. Classe der Kaiserl. Akademie der Wissenschaften (Wien, Band xix. pp. 255–324) besonders abgedruckt.

c. Th. v. Heuglin's Forschungen über die Fauna des Rothen Meeres und der Somali-Küste. Ein systematisches Verzeichniss der Säugethiere und Vögel (Mittheilungen aus Justus Perthe's geographischer Anstalt über wichtige neue Forschungen auf dem Gesammtgebiete der Geographie von Dr. A. Petermann, 1861, pp. 11–32).

d. We trust we shall be allowed to refer to this unpublished work, which is more than half printed off, and will be published very shortly. The full title will be:—Baron Carl Claus von der Decken's Reisen in Ost-Africa. Vierter Band: Die Vögel Ost-Africa's von Dr. O. Finsch und Dr. G. Hartlaub. Mit 11 Tafeln in Buntdruck. It will contain descriptions of all the birds, about 457 species, known from Eastern Africa, from the southern extremity of Mozambique up to Cape Gardafui and the Somali coast.

2. Neophron pileatus (Burch.).

Neophron pileatus, Rüpp. Syst. Uebers. p. 9. no. 3; Heugl. Syst. Uebers. no. 3; *id.* Faun. d. Roth. M. no. 1; Brehm, Erg. Reis. n. Habesch, p. 205. no. 1; Finsch & Hartl. Vögel Ostafr. p. 35. no. 3.
Cathartes monachus, Temm. Pl. Col. 222.

a. ♂. Zoulla. June 6th, 1868.
b. Zoulla. June 6th, 1868.

[Common from the coast to the highlands.—*W. J.*]

3. Gypaëtos meridionalis, Keys. & Blas.

Gypaëtos meridionalis, Keys. & Blas. Wirbelth. Eur. p. xxviii, Anm. (1840); Rüpp. Syst. Uebers. p. 1. no. 1; Heugl. Syst. Uebers. no. 1; *id.* Faun. des Roth. M. no. 6.

a. ♂ ad. Senafé. April 1868.
b. ♀ ad. Senafé. April 1868.
c. ♀ ad. Senafé. April 14th, 1868.

The distinctive characters pointed out by MM. Keyserling and Blasius for the African *Gypaëtus* (founded on specimens from the Cape of Good Hope) seem to be permanent. Besides the specimens collected by Mr. Jesse, there were two other specimens killed by a gentleman during the expedition. All these birds have the basal portion of the tarsus about three-quarters of an inch to one inch naked, and the space between the angle of the mouth and the ears devoid of black hairs, which are always present in the European *G. barbatus.* The latter species has the tarsus feathered to the base, otherwise there is no difference. The males are very deep fulvous underneath. The following are the dimensions of the specimens brought by Mr. Jesse:—

	Long. al.	Caud.	Culm.	Rict.	Tars.	Dig. int.
No. 1, ♂ . . .	2′ 4″	17½″	22‴	3″ 4‴	3″ 2‴	3″ 1‴
No. 2, ♂ . . .	—	17	23	3 6	3 6	3 5
No. 3, ♂ . . .	2 3	16	24	3 6	3 4	3 1
No. 4, ♀ . . .	2 3	18	21	3 1	3 8	3 3
No. 5, ♀ . . .	2 2½	15½	23	3 4	3 4	3 1.—*O. F.*

[The female (*c*) had the iris yellow, with an outer ring of blood-red; strong hairs over the nostrils; bill bluish horn-colour; feet bluish horn-colour; talons darker. I obtained three specimens of this splendid bird, among them a fine adult male. They were very plentiful in and about the camp at Senafé and further up the country. I never observed them lower than Rayrayguddy, and never saw the bird in the Bogos country. In flight and habits this species resembles the Kites much more than the Vultures. I had no opportunity of finding out whether it ever killed its own game, as there was always a superabundance of carrion about, though I never saw it feasting on a carcass; it always seemed to confine itself to picking up odd pieces of offal about the camp.—*W. J.*]

4. Aquila imperialis, Bechst.

Aquila imperialis, Rüpp. Syst. Uebers. p. 10. no. 12; Heugl. Syst. Uebers. no. 14.

a. ♂. Zoulla. March 3rd, 1868.

A very interesting specimen. It has not yet assumed the full livery, but has the black plumage mixed with some brown feathers, and on the shoulders a white patch is already visible. Not before recorded from the Abyssinian coast-land.—*O. F.*

[This was the only specimen seen or obtained by me, and was shot at Zoulla. It measured 6 ft. 5½ in. from tip to tip of the wings, and 2 ft. 5 in. from the tip of the beak to the extremity of the tail. Contents of stomach, birds. Iris brownish yellow or stone-colour; cere greenish; beak bluish horn-colour; legs and feet yellow; talons nearly black.—*W. J.*]

5. Aquila rapax, Temm.

Aquila nævioides, Cuv.; Heugl. Syst. Uebers. no. 16.
—— *albicans*, Rüpp. Neue Wirbelth. t. 13; Brehm, Reise nach Habesch, p. 206.
—— *rapax*, Rüpp. Syst. Uebers. pp. 7, 10. no. 15; Heugl. Syst. Uebers. no. 18; Brehm, Reise nach Habesch, p. 206; Finsch & Hartl. Vögel Ostafr. p. 44. no. 8.
—— *senegalla*, Heugl. Faun. d. Roth. Meer. no. 7.
—— *substriata*, Heugl. Syst. Uebers. no. 19.

a. ♀. Senafé. April 1868.
b. ♂. Senafé. April 1868.
c. ♂. Senafé. April 1868.
d. ♀. Rayrayguddy. April 27th, 1868 (no. 489).
e. ♂. Rayrayguddy. April 27th, 1868 (no. 407).
f. ♂. Gabena-Weldt-Gonfallon. August 6th, 1868 (no. 1592).
g. Mohaber. July 9th, 1868 (no. 1513).
h. ♂. Maragaz. July 27th, 1868 (no. 1028).

The fine series of specimens in Mr. Jesse's collection shows every gradation in colour, from pale brown (as in *A. albicans*, Rüpp.) to dark brown. The male specimen (*e*) is throughout blackish brown, as in *A. nævia*, excepting some of the upper tail-coverts, which are pale ochre-brown. Other specimens are light ochre-brown mixed with dark brown, especially on the shoulders. *A. rapax* is very nearly allied to our *A. nævia*, but is distinguished by the shorter tarsus and the elliptically shaped nostrils, which are situated perpendicularly, as in *A. clanga*, Pall.

	Long. al.	Caud.	Culm.	Rostr. a rict.	Tars.	Dig. inter.
No. 1, (?) . . .	19½″	10″	16‴	2″ 1‴	3″ 2‴	2″ 0‴
	18	10½	16½	2 3	3 2	2 0
	20	10	—	—	3 2	2 3.—*O. F.*

[No. 489, ♀. Iris brown; cere yellow; beak almost black; legs feathered to the foot; feet yellow; talons black.

No. 457, ♂. Iris yellowish grey; cere dirty yellow; beak bluish grey at base, black at tip; legs feathered to the foot; feet bright yellow; talons black.

The pair above noted were killed the same day, one on the nest, the other as he swooped down to look for his companion. These two examples sufficiently illustrate the variations to which this Eagle is subject—the female bird being almost entirely cream-coloured, and the male so brown as to be verging on black. The iris and beak are different in each. The nest was placed at the top of a gigantic Euphorbia, and was reached by a friend of mine, who, however, found neither eggs nor young, a few bones of the Klippspringer Antelope and a stone being all he got for his climb. The remaining five specimens I got vary considerably, none, however, being so dark or so light as the pair above mentioned. I procured this species at Senafé, Rayrayguddy, Maragaz (Bogos), and Gabena-Weldt-Gonfallon (Bogos).—*W. J.*]

6. Helotarsus ecaudatus (Daud.).

Helotarsus ecaudatus et *H. leuconotus* (Paul v. Würtemb.), Rüpp. Syst. Uebers. pp. 8, 10. no. 23 et 23*a*; Heugl. Syst. Uebers. nos. 35 et 36; *id.* Faun. d. Roth. M. no. 12; Brehm, Reise n. Habesch, p. 206. no. 10; Finsch & Hartl. Vögel Ostafr. p. 51. no. 12.

a. ♂. Maragaz. April 4th, 1868 (no. 1363).

The reddish-white colour of the back in this Eagle is, as Mr. Jesse's specimen shows, by no means a specific character, but seems to be rather a sign of old age. After a careful comparison of many specimens from all parts of Africa, I have come to the conclusion that there is only one species all over the continent.—*O. F.*

[Iris brown, skin round the eye coral-red; cere dark crimson; base of the beak pink, tip pale horn-colour; legs and feet coral-red; talons black.

The only specimen procured by me. Mr. W. T. Blanford obtained two, one shot near Senafé, the other from the Anseba. This species was more plentiful beyond Senafé, but very shy. On the Anseba it was by no means rare, and not so difficult of approach.—*W. J.*]

7. Buteo augur, Rüpp.

Buteo augur, Rüpp. Syst. Uebers. p. 10. no. 10; Heugl. Syst. Uebers. no. 12; Brehm, Habesch, p. 206. no. 6; Finsch & Hartl. Vögel Ostafr. p. 57. no. 15.

a. ♀. Senafé. April 12, 1868 (no. 146).

[Iris dark brown; cere greenish yellow; beak bluish horn-colour, the tip black; legs and feet light greenish yellow; talons black.

This bird was sent to me by a friend at Rayrayguddy. I subsequently shot one between Facado and Addigerat, but the skin was spoiled. I saw another specimen just before entering Goongoona. From information I obtained, this bird was much more plentiful further up the country. Contents of the stomach, lizards.—*W. J.*]

8. Milvus migrans (Bodd.).

Milvus ater, Heugl. Syst. Uebers. no. 59.
—— *migrans,* Finsch & Hartl. Vögel Ostafr. p. 61. no. 17.

a. ♀. Koomaylee. February 29th, 1868.
b. ♀. Koomaylee. March 3rd, 1868.
c. Mohaber. July 9th, 1868.

The occurrence of this species in this part of Africa, which hitherto rested on the authority of Major Harris, is now confirmed by Mr. Jesse. The Black Kite has not been recorded by any other traveller, and is not included in von Heuglin's valuable list of the Birds of the Red Sea.—*O. F.*

[Iris brown. Shot in companionship with many other Kites, among them another species, *Milvus forskali*, shot the same day.—*W. J.*]

9. Milvus forskali (Gmel.).

Falco parasiticus, Daud.
Milvus ater, Rüpp. Syst. Uebers. p. 11. no. 37.
—— *parasiticus,* Heugl. Syst. Uebers. no. 60; *id.* Faun. d. Roth. Meer. no. 16; Brehm, Habesch, p. 207. no. 14.
—— *forskali,* Finsch & Hartl. Vögel Ostafr. p. 63. no. 18.

a. ♂. Koomaylee. February 29th, 1868.

This species is distributed over the whole continent of Africa, Madagascar, some parts of Western Asia, and South-eastern Europe.—*O. F.*

[Iris yellow; cere bluish; beak dirty yellow.

This specimen was the only one I obtained, not that it was at all rare, but other birds occupied my attention; it was shot in company with the other species, *Milvus migrans.*—*W. J.*]

10. Falco tanypterus, Licht.

Falco biarmicus, Rüpp. Neue Wirb. p. 44.
—— *cervicalis,* Heugl. Syst. Uebers. no. 44.
—— *tanypterus,* Finsch & Hartl. Vögel Ostafr. p. 67. no. 20.

a. ♂. Senafé. March 29 (no. 156).

[Iris brown?, rather too far gone to determine for certain; cere greenish yellow; beak pale horn-colour; legs and feet greenish yellow; talons black.

This, the only specimen which came into my possession, was shot near Senafé by a friend. Mr. W. T. Blanford also obtained the species. Contents of the stomach, small birds.—*W. J.*]

11. Falco barbarus, Linn.?

Falco barbarus, Salvin, Ibis, 1859, pl. 6 (ad.); Schl. Mus. P. B. Falcones, p. 5.
—— *lanarius alphanet*, Schl. Tr. sur la Fauconn. p. 23; *id.* Abhandl. Edelfalken, p. 16.
? *Falco peregrinoides*, Rüpp. Syst. Uebers. p. 11. no. 25; Heugl. Syst. Uebers. no. 42; *id.* Journ. f. Orn. 1868, p. 199.

a. Ain. July 5th, 1868 (no. 1746).

The difficulties in determining Falcons, in spite of the recent elucidation of many obscure points by ornithologists, have not entirely disappeared; for we are by no means satisfactorily informed on this subject, especially as regards the plumage of young birds. It is therefore in some instances almost impossible to determine young Falcons with any certainty, because the descriptions are often imperfect. Professor Schlegel, one of our first authorities on this group of birds, seems to be himself in great doubt on many points; at least he has altered his opinion several times.

The Falcon in Mr. Jesse's collection, which is undoubtedly a young bird in the first plumage, I must refer to *F. barbarus*, although it agrees very well with a specimen labelled *F. lanarius nubicus* (No. 2, femelle, dans la première livrée = *F. tanypterus*) in the Leiden Museum, where I had an opportunity of comparing it. Unfortunately I am only acquainted with the adult *F. barbarus* (as figured in the Ibis, *l. c.*), from which Mr. Jesse's specimen differs considerably. I append a full description of his bird.

Front whitish, each feather having a very narrow dark central line; forehead and a mystacal stripe blackish; the feathers on the vertex blackish, with rusty-brown margins, which become broader on the occiput, where the rusty colour prevails; nape and temples fulvous whitish, with large dark brown apical spots; all the upper parts and sides of the neck dark brown, the upper tail-coverts and the feathers on the bend of the wing margined with fulvous brown, the primaries with six or seven large rufous spots on the inner web and a narrow whitish apical margin; secondaries uniform dark brown on both webs; some of the shoulder-feathers very narrowly margined with rufous; tail-feathers dark brown, with a yellowish white end, about 5‴ broad; the four outer feathers with six to eight broad rufous cross bands on the inner web, being paler underneath; chin and cheeks with dark shafts; the rest of the under parts dark brown like the back, each feather having fulvous margins on each side, palest on the throat and breast, darker and broader on the vent and sides; tibia pale fulvous, with broad dark-brown shaft-stripes, the under tail-coverts the same, but the dark shaft-stripes reduced to a narrow central line; under wing-coverts dark brown, each feather with two to three rufous spots on each web; bill bluish horn-colour, blackish on the tip; cere bluish grey, like the legs; nails black.

The wings reach to the tip of the tail.

Long. tot.	Al.	Caud.	Culm.	Tars.	Dig. med.	
c. 15″	12″ 0‴	6″ 6‴	8‴	22‴	18‴	
—	11 3	6 2	9	20	19	ad. Niger.
—	11 7	5 9	9	21	24	♀. Damaraland.
—	11 6	5 9	9	22	24	♀. Cape. *F. minor*, Schlegel.

The old *F. barbarus*, of which I give the above measurements, I got in a collection of birds from Mr. Stevens marked "Niger" (Baikie), which, by the by, is a new locality for the species.

The young bird described above agrees very well with two young ones of *F. minor*, Schleg., from South Africa (one in the Bremen Museum, the other collected by Andersson in Damaraland); but the latter specimens have the secondaries with rufous cross bands which are also visible (but not so strongly) on the outer web, and are further distinguished by the considerably longer toes and shorter tail. As Professor Schlegel suggests, *F. minor* is restricted in its geographical range to Southern Africa. *F. tanypterus*, Licht., of which I examined several specimens, differs in its larger size and in having the cere and legs always yellow, even in the young birds, as Professor Schlegel observes. In that species also the quills do not reach to the tip of the tail.—*O. F.*

[Iris brown; cere dark horn-colour; beak, base light, tip dark horn-colour; legs and feet greenish yellow. The only specimen procured by me.—*W. J.*]

12. Tinnunculus alaudarius, Briss.

Tinnunculus alaudarius, Rüpp. Syst. Uebers. p. 11. no. 27.
Falco tinnunculus, Heugl. Syst. Uebers. no. 50.
Tinnunculus tinnunculus, Heugl. Fauna d. Roth. Meer. no. 14.

a. ♂. Zoulla. March 12 (no. 123).
b. ♀. Zoulla. February.
c. ♀. Ain. July 7 (no. 1910).
d. ♀. Goon Goona. May 2 (no. 1220).
e. ♂. Senafé. May 24.

[Iris dark brown; legs and feet gamboge-yellow.

This species I found widely diffused, obtaining specimens from Zoulla, Senafé, Goon-goona, on the line of march with the troops, and Ain on the river Lebka; I also saw it on the Anseba in Bogos.—*W. J.*]

13. Nisus badius (Gmel.).

Nisus sphenurus, Rüpp. Syst. Uebers. p. 11. no. 41, t. 2; Heugl. Syst. Uebers. no. 66.
Micronisus guttatus, Heugl. Journ. f. Orn. 1861, p. 430.
M. sphenurus, Brehm, Habesch, p. 207. no. 16.
N. badius, Finsch & Hartl. Vögel Ostafr. p. 81. no. 28.

a. ♀. Ain. August 7 (no. 62).
b. ♂. Ain. August 17 (no. 48).

c. ♂. Ain. August 17 (no. 52).
d. ♂. Mohaber. July 8 (no. 1302).
e. ♀. Mohaber. July 8 (no. 668).
f. ♂. Mohaber. July 8 (no. 828).
g. ♂. Mohaber. July 8 (no. 1218).
h. Mohaber. July 8 (no. 468).
i. ♂. Mohaber. July 8 (no. 1443).
k. ♀. Mohaber. July 8 (no. 450).
l. ♂. Kokai. July 9 (no. 1908).
m. ♀. Gabena Weldt Gonfallon. August 7 (no. 1279.)

The fine series in Mr. Jesse's collection has convinced us more than ever that there is no difference between Rüppell's *Micronisus sphenurus* and the Indian *M. badius*. All the younger ones are spotted underneath, like Von Heuglin's *M. guttatus*, which was long before named *Nisus hybris* by Hemprich and Ehrenberg.—*O. F.*

[The specimen no. 52, *c*, had the iris orange-yellow; cere orange-yellow; beak dark horn-colour, nearly black; legs and feet orange-yellow, talons black.

Nos. 1218–19 had the iris pale lemon-yellow; cere pale lemon-yellow; beak dark horn-colour; legs and feet pale lemon-yellow, talons black.

Of this species I obtained a fine series of twelve specimens, the examination of which leads me strongly to doubt the validity of *M. guttatus* of Heuglin as a separate species from *M. sphenurus* of Rüppell. I have six specimens in both stages of plumage, among which the sexes are almost equally distributed. The principal difference in the plumage is, that in the adult birds the colour of the back is of a slaty blue, and on the breast minutely cross-barred with rufescent grey or pale cinnamon; these markings, be it noted, vary more or less in intensity in different specimens: in the young birds the back has a strong tinge of brown, and the breast shows much white, the feathers on the upper portion being blotched longitudinally, and those on the abdomen very broadly barred with pale cinnamon. I note also that each separate feather on the upper portion of the breast shows an incipient tendency to become barred near the root of the feather. Heuglin, I apprehend, bases his classification of *M. guttatus* as a distinct species from *M. badius* (*M. sphenurus*, Rüpp.) probably upon the differences I have alluded to, and the fact of his having seen pairs breeding in both varieties of plumage. This at first sight appears reasonable; but when I mention that I shot eight specimens on one morning within three quarters of a mile of one another, one double shot producing one of each variety, the total being three of one and five of the other, I cannot help thinking that *M. guttatus* is merely the immature bird of *M. badius*. I may also mention that Mr. W. T. Blanford, on the afternoon of the same day, shot four or five specimens on the same ground, and with the same variations. That gentleman also holds the same opinion as myself as to the two varieties belonging to one species, viz. *M. sphenurus* (Rüpp.). All ornithologists are aware of the different stages of plumage and also of the colouring of the iris, according to the age of the bird, to which many of the Falconidæ are liable. I have another instance to quote, namely, in my series of *Aquila rapax*, which vary, in every stage of plumage, from a very dark brown to light cream-colour, the cream-coloured specimen being one of a pair of which the other was dark brown; the iris of the one was yellow stone-colour, and that of the other brown.

The contents of the stomach of these Sparrow-hawks were insects, mostly locusts. —*W. J.*]

14. Nisus gabar (Daud.).

Melierax gabar, Rüpp. Syst. Uebers. p. 12. no. 44.
Micronisus gabar, Heugl. Syst. Uebers. no. 63.
—— *niloticus,* Sundev.
Nisus gabar, Finsch & Hartl. Vögel Ostafr. p. 86. no. 30.

a. ♀. Senafé. May 22 (no. 1043).
b. ♀. Ain. August.

[Iris brown, eyelid bluish grey; cere coral-red; beak dark horn-colour; legs and feet coral-red, talons black.

I procured two specimens of this Hawk, both females—one in the valley at the back of Senafé rock, and the other at Ain on the Lebka. Contents of stomach, small lizards.—*W. J.*]

15. Nisus niger (Vieill.).

Micronisus niger, Heugl. Syst. Uebers. no. 64.
—— *miltopus,* Heugl. Journ. f. Orn. 1861, p. 428.
Falco carbonarius, Licht.
Nisus niger, Finsch & Hartl. Vögel Ostafr. p. 88. no. 31.

a. ♀. Hadoda Pass. April 2 (no. 178).

Agreeing with specimens from West Africa. The colouring of the cere and legs varies much in this species; the latter are mostly yellow, mixed with yellow. Sometimes the cere and legs are vermilion-red. This is the *M. miltopus* of Heuglin, from Sennahr; I have seen such red-legged specimens also from Damaraland in the collection of the late C. J. Andersson.—*O. F.*

[Iris brown; cere salmon-pink; beak black; tarsus pink, with scales of black (occasional) before and behind, inside of the foot salmon-pink, talons black.

This bird was shot up the Hadoda Pass; the only other specimens I saw were obtained by Mr. W. T. Blanford in the neighbourhood of Kokai—a pair, I believe. Those obtained by Mr. Blanford had been feeding on small birds, which rather surprised us both, as most of the smaller Falconidæ we obtained were insectivorous.—*W. J.*]

16. Melierax polyzonus, Rüpp.

Melierax polyzonus, Rüpp. Neue Wirbelth. t. 15; *id.* Syst. Uebers. p. 12. no. 43; Heugl. Syst. Uebers. no. 62; *id.* Fauna d. Roth. Meer. no. 18; Finsch & Hartl. Vögel Ostafr. p. 90. no. 32.

a. ♂. Between Amba and Waliko. August 4 (no. 1006).
b. ♂. Senafé. May 22nd (no. 1992).
c. ♂. Gelamet. August 11 (no. 7).
d. ♀. Zoulla. June 8.

[Iris brown, eyelid coral-red with tinge of orange; cere coral-colour tinged with orange; beak dark horn-colour; legs and feet coral, talons dark horn, nearly black.

This bird, of which I obtained three adult and one immature specimens, I found widely distributed. My examples came from Zoulla, Amba, Gelamet, and Senafé; it was also procured on the Anseba in the Bogos country. This distribution was irrespective of the time of year. Contents of stomach, lizards.—*W. J.*]

17. Circus pallidus, Sykes.

Strigiceps pallidus, Heugl. Syst. Ueber. no. 76; *id.* Fauna d. Roth. Meer. no. 23; Brehm, Habesch, p. 208. no. 17.

♂. Koomayli. March 23 (no. 194).
♂. Senafé. April 17 (no. 151).

Long. al.	Caud.	Culm.	Tars.	Dig. med.
13″	7″ 8‴	7‴	2″ 5‴	13‴
14	7 10	7	2 7	13

Both specimens are in full dress, identical with the old male figured by Naumann (t. 348. f. 1), having the under surface white, without rufous spots. No. 194 has some brownish feathers on the nape, being the remains of the immature plumage; and the dark bands on the tail feathers, five in number, are broader, and tinged with rufous on the outer web. In no. 151 the tail cross bands are more obsolete. Both specimens have the upper tail-coverts white, with broad greyish brown cross bands, three on each feather. There cannot be any doubt that both specimens belong to one and the same species, although there exists a considerable difference in the shape of the quills. As Professor Blasius has pointed out (Naumannia, 1857, p. 314), in *C. pallidus* the excision of the inner web of the first quill reaches to the end of the coverts of the primaries. This is the case in the specimen no. 151; but in no. 194 the excision of the first quill reaches nearly half an inch beyond the end of the first quill-coverts—this being a peculiar character of *C. cineraceus*, Mont. Another specific character, according to Blasius, peculiar to *C. pallidus*, is the third and fourth quill being equal in length. In that respect Mr. Jesse's specimens differ also a little—in no. 151 the fourth quill being 3 lines, in no. 194 5 lines shorter than the third. I mention these differences only to prove how difficult it is to affix characters which are invariable, and that there always exist certain slight differences.—*O. F.*

[Iris pale yellow; legs and feet pale yellow.

A second specimen of this bird was procured (no. 151, ♂) at Senafé, on the 17th of April, 1868, which still bore signs of the first year's plumage.—*W. J.*]

Fam. STRIGIDÆ.

18. Athene perlata (Vieill.).

Athene pusilla, Rüpp. Syst. Uebers. p. 12. no. 51.
—— *occipitalis* et *A. pusilla,* Heugl. Syst. Uebers. nos. 81 & 82.
Strix licua, Licht. Verzeich. Samml. a. d. Kaffernland, 1842, p. 12.
Noctua perlata et *Noctua perlata capensis,* Schleg. Mus. P. B. *Striges,* p. 36.

a. ♂. Maragaz. July 27 (no. 537).
b. ♂. Sooroo. April 4 (no. 161).
c. ♂. Bejook. July 18 (no. 1174).
d. ♀. Senafé. May 22 (no. 1773).
e. ♂. Rairo. August 15 (no. 36).
f. ♀. Rairo. August 14 (no. 99).

The southern form (*Str. licua,* Licht.), which Schlegel keeps as a race, being generally a little darker-coloured than the north-eastern bird, is by no means separable. I have compared numerous specimens from Damaraland with others from North-east Africa, and could not detect any permanent difference. The fulvous cervical collar is somewhat paler and less defined, but I have seen north-eastern ones which also possess this peculiarity. In the females the fulvous collar is less visible.

Long. al.	Caud.	Culm.	Tars.	Dig. med.	
4″–4″ 4‴	2″ 9‴–2″ 11‴	$5\frac{1}{2}$‴	$8\frac{1}{2}$‴	7‴.	North-eastern Africa.
3″ 9‴–4″	2″ 6‴–2″ 10‴	$5\frac{1}{2}$‴–6‴	$8\frac{1}{2}$‴–9‴	7‴.	Damaraland.

An allied but well-distinguished species is *A. spilogastra,* Heugl. (Journ. f. Orn. 1863, p. 15), of which Dr. v. Heuglin obtained one specimen in the Samchara. I had expected to find this rare species in the collection of Mr. Jesse.—*O. F.*

[Iris lemon-yellow; beak greenish yellow; legs and feet greenish yellow, talons pale horn-colour.

The six specimens procured were from Sooroo, Senafé, Bejook (Bogos), Maragaz (Bogos). The position of this bird on a tree is not upright as with most owls, but thrush-like. The different localities are all about the same elevation; the specimen procured at Senafé was in the valley at the back of Senafé rock, say 4000 feet above the level of the sea.—*W. J.*]

19. Bubo ascalaphus, Savigny.

Bubo ascalaphus, Rüpp. Syst. Uebers. p. 12. no. 55; Heugl. Syst. Uebers. no. 85.

a. ♂. Senafé. April 11 (no. 188).

Abyssinia is a new locality for this species, which had hitherto only been observed as far south as Nubia.—*O. F.*

[Iris bright lemon-yellow; beak dark horn-colour; legs and feet feathered to the talons.

This is the only specimen obtained by me of this Owl; it was shot among the rocks near Senafé: there was another, but I did not succeed in getting it. The only subsequent occasion on which I saw this bird was at Guinea-fowl Plain, near Undel Wells. I saw a live specimen which had been brought down from Magdala, where I understood they were plentiful.—*W. J.*]

20. Bubo lacteus (Temm.).

Bubo lacteus, Rüpp. Syst. Uebers. p. 12. no. 53; Heugl. Syst. Uebers. no. 87.
—— *cinerascens,* Brehm, Habesch, p. 208.
—— *verreauxi,* Bp.
—— *lacteus,* Finsch & Hartl. Vögel Ostafr. p. 101. no. 39.

a. ♀. Rayrayguddy. May 9 (no. 121).

[Iris bright yellow; beak pale horn-colour, almost white towards the end; legs and feet feathered nearly down to the talons.

This, the only specimen I procured of this magnificent Owl, was shot at Rayrayguddy by a friend and sent to me. I never saw this species alive until I arrived on the banks of the Anseba in July, where I saw three one day sitting in a row on a large tree on the borders of a nullah; but being out after rhinoceros, neither Mr. W. T. Blanford nor myself could fire. This I regret, as on returning to the same place the next day we did not succeed in finding them; but a short time after, Mr. Blanford shot one near Kokai. Contents of stomach, large locusts and larvæ.—*W. J.*]

21. Scops senegalensis, Sws.

Scops vulgaris, Heugl. Syst. Uebers. no. 83; *id.* Fauna d. Roth. Meeres, no. 26.
—— *senegalensis?,* Heugl. Journ. f. Orn. 1863, p. 14.
—— *zorca africanus,* Schleg. Mus. P. B. *Oti,* p. 20.

a. ♀. Undel Wells. April 6 (no. 477).

Long. al.	Caud.	Culm.	Tars.	Dig. intern.	
4″ 9‴	2″ 2‴	$5\frac{1}{2}$‴	10‴	7‴	
4 8 –5″ 1‴	2 3 –2″ 5‴	$5\frac{1}{2}$	$10\frac{1}{2}$–12‴	7 –8‴	*senegalensis.* Gambia.
5 10 –6	2 5 –2 7	5–$5\frac{1}{2}$‴	11 –12	7	*zorca.* Europe.

The African *Scops* agrees in every respect with our European *S. zorca*, except the shorter wings, this being, as far as I could find out, a permanent character, common also to specimens from the west and north-east as well as to those from the south (*Strix latipennis*, Licht.). I do not hesitate to regard this peculiarity as of specific value.—*O. F.*

[Iris bright yellow; beak dark horn-colour, tip of lower mandible pale yellow; legs and feet feathered to the foot.

This is the only specimen I procured of this species, though plentiful about Undel Wells. The cry at night, when it sits perched up in a mimosa tree, is a low whistle repeated at regular intervals.—*W. J.*]

22. Otus brachyotus, L.

Otus brachyotus, Rüpp. Syst. Uebers. p. 12. no. 56.
Ægolius brachyotus, Heugl. Syst. Uebers. no. 94.

a. ♂. Zoulla. March 11 (no. 190).

This cosmopolitan species, which is known from nearly every part of our globe, had not yet been recorded from the shores of the Red Sea. Specimens from the Sandwich Islands are in the Berlin Museum. *Otus galapagoensis*, Gould (Voy. 'Beagle,' pl. 3), from the Galapagos, is clearly the same species.—*O. F.*

[Iris bright lemon.

Only once did this bird come under my observation during my stay in Abyssinia. Contents of stomach, bones of small birds.—*W. J.*]

23. Strix flammea, L.

Rüpp. Syst. Uebers. p. 12. no. 59; Heugl. Syst. Uebers. no. 95; Brehm, Habesch, p. 265; Finsch & Hartl. Vögel Ostafr. p. 111. no. 44.

[Eye black.

This solitary specimen of our old friend the Barn-owl was shot in the Mangroves on the shore of Annesley Bay, and was the only instance of my meeting with this bird during my stay in Abyssinia.—*W. J.*]

Order PASSERES.

Fam. CAPRIMULGIDÆ.

24. Caprimulgus inornatus, Heugl. (MS.). (Plate XXIV.)

Caprimulgus inornatus, Finsch & Hartl. Vögel Ostafr. p. 120 et p. 855. no. 46.
Caprimulgus, sp.?, Heugl. Fauna d. Roth. Meer. no. 30 et p. 30 (descr.).

a. ♀. Koomaylee. March 18 (no. 152).
b. ♂. Ain. July 5 (no. 1768).
c. ♂. Ain. July 5 (no. 703).
d. ♂. Ain. July 5 (no. 1754).
e. ♂. Ain. July 5 (no. 1352).

f. ♂. Kokai. August 9 (no. 1262).
g. ♂. Kokai. August 9 (no. 1642).
h. ♀. Kokai. August 9 (no. 890).
i. ♀. Kokai. August 9 (no. 1566).
k. ♀. Kokai. August 9 (no. 1227).

Long. al.	Caud.	Culm.	Rost. rict.	Tars.	Dig. int.	
5″ 7‴	4″ 3‴	3‴	12‴	$7\frac{1}{2}$‴	7‴	. . . ♂, no. 1754.
5 9	4 2	—	—	—	—	. . . ♂, no. 1352.
5 10	4 4	—	—	—	—	. . . ♂, no. 1768.
6 1	4 3	—	—	—	—	. . . ♂, no. 1642.
6 1	4 6	—	—	—	—	. . . ♂, no. 703.
6 4	4 8	—	13	8	$7\frac{1}{2}$	. . . ♂, no. 1262.
6 0	4 5	—	—	—	—	. . . ♀, no. 152.
6 1	4 4	—	—	$7\frac{1}{2}$	7	. . . ♀, no. 1566.
6 2	4 3	—	—	—	—	. . . ♀, no. 1227.
6 4	4 5	—	—	8	8	. . . ♀, no. 890.

Male.—All the upper parts, the sides of the head and neck, the throat, and breast of of a greyish brown ground-colour, washed with a faint tint of rufous, which is sometimes more decided, and gives a reddish appearance; all the feathers speckled very minutely with dark brown; on the head some blank shaft-stripes, on the shoulders some larger patches, the end of the outer web of the same colour; the upper quill-coverts with some yellowish fulvous apical spots; the quills dark brown, the first and fourth with a large white patch on the inner web, the second and third with a broad white cross band on both webs, the remaining quills with five yellowish rufous cross bands, which are broader on the inner web, and more or less variegated with darker colour; the point of the quills variegated with pale brown; an ochre-yellow gular patch, undulated with dark brown; on the throat and breast some pale fulvous spots, the same as on the neck behind; rest of the under parts and under quill-coverts ochre-yellow, with narrow dark cross lines (sometimes wanting on the under tail-coverts); tail-feathers dark greenish brown, variegated with ochre-yellow and seven or eight narrow black cross bands; the two outer tail-feathers white on the apical half of both webs.

The female is similar to the male, but wants the white end of the two outer tail-feathers, and the white patches on the primaries, which have from four to six rufous cross bands on the outer web, and three to five on the inner web of the same colour, the one nearest to the apex being very extended; the two outer tail-feathers are crossed with from eight to eleven dark and ochre-yellow bands, and have a broad ochre-yellow end, speckled more or less with dark brown.

The specimens in the fine series collected by Mr. Jesse exhibit considerable variety. The ground-colour is more or less dark, in one specimen decidedly greyish brown; the ochre-yellow spots on the quill-coverts, the breast, and hind neck are in some specimens well marked, in others scarcely visible; the ground-colour of the belly varies also from pale to dark ochre-yellow. The type specimen in the Bremen Museum has the upper parts, the throat, and breast washed strongly with a singular cinnamomeous rufous, which is not so distinctly visible in any of Mr. Jesse's specimens. The measurements also vary much.

A more complete description of this new species, which was first obtained by Von Heuglin on the Somali coast, will be given in the 'Birds of East Africa,' as cited above. Dr. v. Heuglin collected this species also in the Bogos country, where it seems to be very abundant.

It bears a great resemblance to *C. tristigma*, Rüpp. (Syst. Uebers. t. 3. s. n. *poliocephalus*), of which I have examined the type specimen; but the latter has a large white patch on the throat, and is larger (al. nearly 7″). The absence of white patches on the chin, throat, and ears, and of a well-marked neck-collar, is an important peculiarity of this species.—*O. F.*

[Eye black; beak flesh-colour, tipped with black; legs and feet grey, middle toe serrated.

Of this species a series of ten specimens was procured from Koomayli, Ain, and Kokai, where it was plentiful.—*W. J.*]

Fam. CYPSELIDÆ.

25. Cypselus apus (Linn.).

Cypselus barbatus, Gurney, Ibis, 1868, p. 152.
—— *apus*, Rüpp. Syst. Uebers. p. 22. no. 68.
Heugl. Syst. Uebers. p. 105.
Cypselus, sp.?, no. 11 et 12, Heugl. J. f. Orn. 1861, p. 422.
Cf. Sclat. Monogr. Cypsel. Proc. Zool. Soc. 1865, p. 599.

a. ♂. Senafé. April 24.
b. ♂. Maragaz. July 27.
c. ♂. Maragaz. July 27.
d. ♂. Maragaz. July 27.
e. Maragaz. July 27.
f. ♂. Gelamet. August 11.
g. ♂. Gelamet. August 11 (no. 43).

The fine series of our common Swift in the collection of Mr. Jesse gives me a welcome opportunity of making some remarks on the occurrence of that species in Africa, a subject which I have been intending to treat of for a long time, having been able to give a great deal of attention to the subject. Dr. Sclater, in his valuable 'Monograph of the Cypselidæ,' notices a South-African *Cypselus* as being different from our well-known species in its lighter colouring above, and also in having the feathers of the lower part of the back, belly, and under wing-coverts margined with white. Such specimens are labelled "*Cypselus barbatus*" in the Leyden Museum—a

MS. name of Temminck. From the probability of these differences proving to be permanent, Dr. Sclater is not unwilling to base upon them a species, but not having specimens enough, he abstains from speaking decisively on the subject. Mr. Tristram (Proc. Zool. Soc. 1867, p. 887), maintaining that all the southern specimens agree in these peculiarities, declares with more certainty that *Cypselus barbatus* is a well-determined species, being "the South-African representative" of *Cypselus apus*. Having had opportunities of examining a great number of *Cypselus apus* from different parts of Africa (Sennahr, Bogosland, Benguela, Damaraland, the Cape, and Natal), I must say that the so-called *Cypselus barbatus* is nothing more than the *young* bird of our *C. apus*. It is known that our Swift is one of those migratory birds which come latest and depart earliest. Von Heuglin met with the Swift in the beginning of August in Bogosland, and Mr. Jesse in the same country some days earlier, viz. in the end of July (27th). Mr. Victorin observed them in the Cape Colony already in the middle of August. During their stay in Europe they breed, as every body knows, and, after this period, depart as soon as their young ones are able to accompany them. It seems that these young Swifts in the first plumage are less known to ornithologists; for they bear the same white margins on the feathers as the South-African "*C. barbatus*." The old Swifts, when they leave us, have also considerably lighter colours, and change their plumage during their stay in Africa. I have seen many African specimens which were partially moulting. A specimen from Benguela, which M. Barboza du Bocage, believing that it might be new, sent for inspection to Bremen, had the wings 1 inch shorter, and the primaries just developing. There is also a great variation in the extent of the white markings. The above-mentioned specimen from Benguela is greyish brown, having each feather margined with light greyish; the gular patch is greyish white, and very extended. Another one (Cape Town, November 9th) is dark above, only the feathers on the vent, crissum, and under tail-coverts having white margins. A male (Cape Town, November 8th) very similar, but the light margins rather narrower. A male (Damaraland, October 14th) somewhat lighter, nearly without white margins; the white gular patch well defined. Specimens from North-eastern Africa agree in every respect; the white margination varies in individuals. An old female (Chartum, September 26th) wants the white margin, and is nearly as dark as the European ones. The narrow black central line on the feathers of the white gular patch, which Mr. Tristram mentions in the African *C. barbatus*, is not at all a character of specific value; for this peculiarity we find in other species of Swifts (e. g. *C. caffer*, *affinis*, &c.), also sometimes wanting or more or less defined.

To speak with greater certainty on this subject I submitted the Benguela and some white-margined specimens from Bogosland for inspection to Professor Blasius, of Brunswick, one of our first authorities on European ornithology, as is well known by every body. In his kind answer, Professor Blasius writes to me:—"Your specimens from Mossamedes and Bogos are nothing more than the young *C. apus*, and I cannot distinguish them from others collected in our country. No practised ornithologist would hesitate for one moment to express the same opinion, and I am astonished to hear that there can be any question about it. I possess also such young ones from Nubia, as well as old specimens from the Cape and Nubia, which agree, in the darkness of coloration throughout, with specimens from Germany."

Another very important proof that there cannot be a real specific difference is the well-known fact that the so-called *C. barbatus* is only a winter visitor in Africa, and does not breed there, neither in the Cape Colony, nor in North-east Africa. Mr. Layard has given some valuable observations about it, which prove undoubtedly the migratory habits of the southern *Cypselus*. I cannot, therefore, perceive how it is possible to call a periodical visitant, which stays only for a few months, a "representative species" of our *C. apus*. About the migration of this species we are also very well informed. Dr. Brehm has published valuable observations (Journ. f. Orn. 1853, p. 453) made by him in North-east Africa, where *C. apus* goes further than the White Nile; and Dr. Bolle states not only that the Swift is a winter visitor in the Canaries, but that he met with single pairs breeding in Ciudad de las Palmas in the month of July (Journ. f. Orn. 1857, p. 322).

The following measurements, taken from more than twenty-five specimens, will show that there is no difference in dimensions:—

Long. al.	Rectr. intern.	Rectr. ext.	
6″ 3‴–6″ 7‴	1″ 6‴–1″ 10‴	2″ 5‴–2″ 10‴	. . . . Bogosland.
6 8	1 8	2 9	. . . . Chartum.
6 1 –6 5	1 7	2 8	. . . . Damaraland.
6 6	1 8 –1 10	2 7 –2 9	. . . . Cape Town.
5 6	1 4	2 4	. . . . Benguela (in moult).
6 3 –6 6	1 7	2 7 –2 10	. . . . Germany.

I may also be allowed to express my doubts about *Cypselus gutturalis*, Vieill., declared not long ago by Mr. Tristram[1] to be the southern representative of our *C. melba*, and to be distinguished at once by the darker colour above and the very broad jugular collar. The only reference to *C. gutturalis* is Levaillant's "*Martinet à gorge blanche*," figured in his 'Oiseaux d'Afrique,' pl. 243. Professor Sundevall, who inspected South-African specimens himself, declares, in his meritorious Key to the work of Levaillant, that this figure belongs undoubtedly to *C. melba*. I can confirm this so far, as we possess a specimen from Switzerland which agrees very well with Levaillant's figure, having the jugular cross band very broad (more than one inch), whereas another specimen from the same locality has it scarcely half an inch broad. I believe, therefore, that it will be necessary to examine a large series before one can say decidedly that the southern *C. melba* is of a different species.—*O. F.*

[Iris brown; beak black; legs and feet black.

[1] Proc. Zool. Soc. 1867, p. 887.

Common at Senafé (April), Kokai and Maragaz (August), flying in circles in large numbers. Not seen in the lowlands.—*W. J.*]

26. Cypselus caffer, Licht.

Cypselus pygargus, Temm. Pl. Col. 460. f. 1.
?*Cypselus abyssinicus*, Heugl. Journ. f. Orn. 1861, p. 422 (*C. gularis*, in litt.).
Cypselus streubelii, Hartl. Journ. f. Orn. 1861, p. 418.
—— *abyssinicus*, Brehm, Habesch, p. 209. no. 22.

a. ♀. Rayrayguddy. May 27.

Agrees with a Natal specimen in the Bremen Museum. The white gular patch is more defined in the middle of the chin and throat, becoming on the latter broader. The white feathers on the rump have a narrow dark central line, more visible in the South-African specimen. In another specimen from Abyssinia, in the Bremen Museum, these dark central lines on the feathers of the rump are scarcely visible, and the white on the chin and throat is very extended, reaching on each side to the cheeks; this specimen shows also a light supraocular stripe. I was inclined to take these differences as being of specific value; but having seen southern specimens in which the white on the throat is extended as widely, I can only see therein individual variety, and this especially as there are intermediate forms. A specimen from Dembea, in Von Heuglin's collection, exhibits not the slightest difference from our Natal specimen. Dr. v. Heuglin, who compared it with southern ones in the Stuttgart Museum, believed it might be a new species, and named it previously *C. gularis*. It may therefore be considered, as a rule, that the *Cypseli* vary considerably in the peculiarities mentioned above.

Long. al.	Rect. int.	Rect. ext.	Culm.	Tars.	
5″ 2‴	1″ 5‴	2″ 7‴	20‴	4‴	. . . Abyssinia.
5 4	1 6	2 1	—	—	. . . Abyssinia.
5 0 –5″ 3‴	0 0	2 6 –2″ 9½‴	—	—	. . . Abyssinia (after v. Heuglin in litt.).
5 7	1 8	2 9	—	—	. . . Natal.—*O. F.*

[Saw a small colony among the rocks at Rayrayguddy.—*W. J.*]

27. Cypselus affinis, J. E. Gray.

Cypselus affinis, Ill. Ind. Zool. pl. 35. f. 2.
—— *abyssinicus* (Hempr. & Ehrb.), Streubel, Isis, 1848, p. 354; Heugl. Fauna d. Roth. Meer. no. 31.
—— *galilæensis*, Antin.
—— *caffer*, Cab. Mus. Hein. ii. p. 85.

a. ♂. Sooroo. May 30.
b. ♂. Sooroo. May 30.
c. Sooroo. May 30.

Easily distinguished from the foregoing species by the tail being nearly straight; otherwise quite the same.

Dr. Sclater has already pointed out the identity of Indian and African specimens of this species (Proc. Zool. Soc. 1865, p. 603). After having examined numerous specimens from India, Palestine, Sennahr (s. n. *caffer* in Mus. Hein.), the Blue Nile, Anamaboë (Gold coast), St. Thomé, Ilha do Principe, and the Cape, I am quite of the same opinion as Dr. Sclater, and can give some further additions to the knowledge of this species.

The variableness in the intensity of colouring, the greater or less extension of the white gular patch of feathers, and the existence of a more or less visible paler superciliary stripe are as noticeable as in *C. apus*; young ones also show the whitish margination on the feathers of the under parts.

The specimens in Mr. Jesse's collection agree in every respect with those from the Himalayas and Palestine; the latter show the white gular patch rather extended, and an ill-defined pale supraocular stripe, which is more visible in a Cape specimen in the Bremen Museum; the latter has on the feathers of the white gular patch a narrow dark central line. A specimen from St. Thomé agrees in this respect; but the plumage is darker, of a deep greenish black, like *C. caffer*. A specimen from Anamaboë is similar to the Himalayan one; but the feathers on the head and rump have light margins, and the gular patch is less extended and without dark central lines. A specimen (♂) from the Blue Nile (collected by A. Brehm) is much lighter; the feathers on the head and under parts have pale narrow margins; the white gular patch is very extended, not being confined to a median patch, but beginning on each side of the mandible and covering the whole chin and throat to the jugulum; the primaries have, like the Anamaboë specimens, narrow light apical margins. *C. caffer* in the Museum Heineanum, which I examined, is this species.

The measurements of the different specimens are as follow:—

Long. al.	Caud.	Culm.	Tars.	
4″ 9‴–5″	1″ 7‴–1″ 8‴	—	—	. . . Bogosland.
5	1 8	2½‴	4‴	. . . Palestine.
4 10	1 7	—	—	. . . Himalaya.
4 8	1 6	—	—	. . . South Africa.
5 1	1 9	—	—	. . . Blue Nile.
5 1	1 7	—	—	. . . St. Thomé.
4 10	1 8	—	—	. . . Ilha do Principe.
4 5	1 6½	—	—	. . . Anamaboë.—*O. F.*

[Common about Sooroo.—*W. J.*]

Fam. HIRUNDINIDÆ.

28. Atticora pristoptera (Rüpp.).

Hirundo pristoptera, Rüpp. Neue Wirbelth. t. 39. f. 2.
Chelidon pristoptera, Rüpp. Syst. Uebers. p. 22. no. 81; Heugl. Syst. Uebers. no. 121.
Atticora pristoptera, Brehm, Habesch, p. 209. no. 23.

a. ♂. Rayrayguddy. April 27th (no. 109).

b. ♂. Bejook. July 18th (no. 1232).

[Iris dark brown; beak black; legs and feet black.

Another specimen procured at Bejook in July.—*W. J.*]

29. Hirundo æthiopica, Blanf.

Hirundo æthiopica, Blanf. Ann. N. H. ser. 4. iv. p. 329 (1869).

Cecropis rufifrons, Heugl. Syst. Uebers. no. 113; Brehm, Habesch, p. 209. no. 26.

a. ♂. Kokai. July 13th (no. 1813).

b. ♀. Bejook. July 17th (no. 1368).

This Swallow has often been confounded with the *Hirundo albigularis,* Strickl. (Contrib. to Orn. 1849, t. 17; *H. albigula,* Bp. Consp. p. 338), from South Africa, being exactly similar in colours, but distinguishable at once by the smaller size.

Long. al.	Rect. ext.		
3″ 10‴–4″	2″ 3‴–2″ 5‴	. . . *æthiopica.*	N.E. Africa.
4 9 –5	2 9 –2 10	. . . *albigularis.*	S. Africa.

The steel-blue band across the jugulum is sometimes ill defined and incomplete. Levaillant's figure and description of his "*Hirondelle à front roux*" (pl. 245. f. 2; *H. rufifrons,* Vieill. Enc. Méth. p. 524) are incorrect in having the chin and throat black, but are most probably referable to the southern species.

H. æthiopica is the common House-swallow in South Nubia, Cordofahn, Sennahr, and Bogosland; Von Heuglin gives interesting notices about its breeding in the Bogos country. It is strange that Rüppell has overlooked a species so common as this.—*O. F.*

[Iris dark brown.

Two specimens procured at Kokai; not observed elsewhere.—*W. J.*]

30. Hirundo puella, Temm.

Hirundo puella, Temm. Fauna Japon. p. 33 (1842).

—— *abyssinica,* Guér. Rev. Zool. 1843, p. 322; *id.,* Ferret et Galinier, Voy. en Abyss. Atlas, t. 10.

Cecropis striolata, Rüpp. Syst. Uebers. p. 22. no. 74, t. 6; Heugl. Syst. Uebers. no. 115; Brehm, Habesch, p. 209. no. 25; Finsch & Hartl. Vögel Ostafr. p. 140. no. 57.

a. ♂. Senafé. May 21st, 1868 (no. 1486).

b. ♂. Rayrayguddy. April 27th, 1868 (no. 481).

c. ♂. Rayrayguddy. May 27th, 1868.

There is no difference between specimens from Western and North-eastern Africa. Temminck's name has the priority.—*O. F.*

[Iris dark brown; beak black; legs and feet black.

Rayrayguddy and Senafé, May and June; not observed in the plains, nor on the Anseba. It was found associating with *Atticora pristoptera* and *Cotyle fuligula.*—*W. J.*]

31. Cotyle fuligula (Licht.).

Hirundo fuligula, Licht. Verzeich. Samml. aus dem Kaffernl. (1842) p. 18.
Hirondelle fauve, Levaill. Ois d'Afr. t. 246. f. 1.
Hirundo rupestris, Less. Man. d'Orn. i. p. 419.
—— *capensis,* Less. Tr. d'Orn. 1831, p. 269.
—— *rupestris,* jun., Tem. Man. d'Orn. i. p. 431, iii. p. 302.
—— *hyemalis,* Forst. Descr. Anim. p. 55.

a. ♂. Rayrayguddy. May 27.

Long. al.	Rectr. intern.	Rectr. extern.	Culm.	Tars.		
4″ 5‴	1″ 7‴	1″ 11‴	$3\frac{1}{2}$‴	5‴	*a.*	
4 6	—	1 10	—	5	*b.*	
4 6–4″ 10‴	—	2 1	$3\frac{1}{4}$–$3\frac{1}{2}$‴	5–6‴	*fuligula.*	Caffreland (Mus. Berol.).
4 5–4 11	1 6 –1″ 10‴	1 11–2″ 1‴	3 –$3\frac{1}{2}$	5–6	*rupestris.*	Europe.

Nearly allied to our *C. rupestris*, Scop., but of a darker brown above, on the sides, vent, and under tail-coverts; chin and throat pale fulvous; the second, third, fourth, and fifth tail-feathers with a large oblong white mark on the inner web, like *C. rupestris.* The young bird of the latter is very similar to *C. fuligula*, but has all the under parts of a light rusty brown, with indistinct brownish spots on the throat, and the feathers of the upper parts edged with a pale rusty brown.

The specimens collected by Mr. Jesse are the same as those from South Africa in the Berlin Museum, except the under wing-coverts being dark brown, with rusty margins, whereas in the southern specimens the under wing-coverts are of a more uniform fulvous.

The occurrence of *C. fuligula* in North-east Africa is a new fact for the geographical distribution of this species, which was hitherto known only from South and West Africa.—*O. F.*

[Rather common among the rocks as far down as Sooroo.—*W. J.*]

Fam. TROGONIDÆ.

32. Trogon narina, Vieill.

Levaill. Ois. d'Afr. t. 228, 229; Heugl. Syst. Uebers. no. 127; *id.* Fauna des Roth. Meer. no. 39; Brehm, Habesch, p. 210. no. 36; Finsch & Hartl. Vögel Ostafr. p. 155. no. 67.

a. ♂. Taconda. April 21st, 1869 (no. 193).

There is only one species of this (chiefly American) family distributed over the whole of tropical Africa. Dr. Brehm got the *T. narina* in the Bogosland, and Von Heuglin observed it in the Abyssinian coast lands.—*O. F.*

[I obtained only one example of this Trogon, and only know of one other specimen being procured during the expedition, by Lieut. Sturt. Contents of stomach, insects; among them a large *Mantis.* I am almost positive I saw this bird near Gelamet; but, after a long chase, I returned without shooting it. The specimen obtained was sent me in the flesh by Major Thelwall, who shot it.—*W. J.*]

Fam. CORACIADÆ.

33. Eurystomus afer (Lath.).

Eurystomus orientalis, Rüpp. Syst. Uebers. p. 33. no. 82; Heugl. Syst. Uebers. no. 123.
—— *afer,* Finsch & Hartl. Vögel Ostafr. p. 150. no. 63.

a. ♂. Kokai. July 10 (no. 1180).
b. ♂. Kokai. July 11 (no. 1376).
c. ♂. Kokai. July 11 (no. 1388).
d. ♂. Kokai. July 12 (no. 1705).
e. ♂. Kokai. July 12 (no. 984).
f. ♀. Waliko. July 19 (no. 1515).

Long. al.	Caud.	Culm.	Tars.
6″ 9‴–7″	3″ 1‴–3″ 3‴	12‴	8‴
6 1 –6 7‴	3 –3 4	8	8 . West Africa.
6 10	3 5	10	— . Mozambique.

The North-east African specimens are larger than western; but there are intermediate forms in specimens from East Africa, which are also larger, and nearly as big as the Madagascarian *E. madagascariensis*, Gmel. The latter has been procured at Mozambique, and seems to be scarcely distinguishable as a species.—*O. F.*

[Iris dark brown; beak lemon-yellow or chrome-colour.

This bird is an active, noisy individual, and during the breeding-season, like the Missel-thrush at home, drives all intruders from the neighbourhood, even Kites, Vultures, and Eagles. Its flight is singularly rapid and Hawk-like, though without, as far as I saw, the characteristic rolling motion observed in that of *Coracias abyssinica* and *Coracias pilosa*. I have seen these birds (*Eurystomus afer*) in company with *C. pilosa* and *Caprimulgus inornatus* hawking the ants which fly in the gloaming. It was procured and observed only at Kokai on the Lebka, and on the Anseba, in July and August, where it was plentiful.—*W. J.*]

34. Coracias abyssinica, Linn.

Coracias abyssinica, Rüpp. Syst. Uebers. p. 23. no. 84; Heugl. Syst. Uebers. no. 125; *id.* Fauna des Roth. Meer. no. 37; Brehm, Habesch, p. 210. no. 31.

a. ♀. Lake Ashangi. April 2.
b. ♂. Kokai. July 9.
c. ♂. Kokai. July 9.
d. ♂. Kokai. July 11 (no. 1204).
e. ♀. Kokai. July 11 (no. 1400).
f. ♂. Bejook. July 18.
g. ♂. Waliko. July 29 (no. 1978).

[Iris brown; legs and feet greenish yellow.

Procured on Lake Ashangi by Mr. W. T. Blanford (from whom I received my first specimen), 2nd April, 1868, and at Kokai and Waliko in July. I also observed this bird in the desert near Amba in August. Noisy, like the other two species; flight peculiar, rolling right and left, the body acting as the pivot. I shot a young bird also in August, without the long tail-feathers, and with the yellow edge to the base of the bill common to birds just fresh from the nest. Plentiful at Kokai and the Anseba. —*W. J.*]

35. Coracias pilosa (Lath.).

Coracias levaillanti, Rüpp. Syst. Uebers. p. 23. no. 85; Heugl. Syst. Uebers. no. 126.
—— *pilosa*, Heugl. Fauna d. Roth. Meer. no. 38.

a. ♂. Koomaylee. March 22 (no. 166).
b. ♀. Senafé. May 13 (no. 1932).
c. ♀. Kokai. July 9 (no. 530).
d. ♂. Kokai. July 11 (no. 1316).
e. ♂. Kokai. July 11 (no. 1986).
f. ♀. Maragaz. July 27.

Al.	Caud.	Culm.	Tars.	Dig. int.	
6″ 10‴	5″	15‴	10½‴	10½‴	Abyssinia.
6 10	5 2‴	15½	11	11	Gambia.
7	4 7	17	12	— . . . ♂.	Damaraland.
7 6	5 4	16	12	—	Damaraland.

There is no difference between specimens from the north-east, west, and south, either in coloration or in size. I cannot agree with Dr. v. Heuglin, who considers the north-eastern ones to be permanently smaller.—*O. F.*

[Iris brown; legs and feet dirty greenish yellow.

Procured between Koomaylee and Sooroo, 22nd March, 1868; Senafé May 13th. The only specimens I ever saw were shot about there or up the passes through which the expedition passed. It was plentiful at Kokai on the Lebka and along the river Anseba. At Kokai, shot while hawking flying ants in the gloaming, in company with a number of *Caprimulgus inornatus* and a few *Eurystomus afer*. Noisy.—*W. J.*]

Fam. ALCEDINIDÆ.

36. Halcyon senegalensis (Linn.).

Halcyon cancrophaga, Heugl. Syst. Uebers. no. 129.
—— *senegalensis*, Finsch & Hartl. Vögel Ostafr. p. 157. no. 68.

a. ♂. Maragaz. July 29 (no. 1).
b. ♀. Maragaz. July 29 (no. 1161).
c. ♀. Gabena Weldt Gonfallon. August 7 (no. 1885.)

Not yet observed from Bogosland.—*O. F.*

[Iris brown; beak, upper mandible crimson, lower black.

Three specimens obtained on the Anseba during July and August. This bird made its appearance rather suddenly from the northward, down the river Anseba, the first being seen by Mr. W. T. Blanford below Maragaz: by the time our last specimen was shot they had made their way up to Gabena Weldt Gonfallon; and I saw one between that place and Keren. I take it, from this, that this species is migratory. At the time it appeared, the rains had just commenced; so probably this may have in some way influenced its arrival in those parts. I did not meet with this bird anywhere else while with the expedition, nor did Mr. W. T. Blanford. Contents of stomach, Coleoptera.—*W. J.*]

37. HALCYON SEMICÆRULEA (Forskål).

Halcyon semicærulea, Rüpp. Syst. Uebers. p. 23. no. 87; Heugl. Syst. Uebers. no. 128; *id.* Fauna d. Roth. Meer. no. 41; Finsch & Hartl. Vögel Ostafr. p. 160. no. 70.

a. ♂. Ain. July 6 (no. 1230).
b. ♂. Ain. July 6 (no. 1886).
c. ♂. Ain. July 6 (no. 182).
d. ♂. Waliko. August 3 (no. 778).
e. ♀. Waliko. August 4 (no. 532).
f. ♂. Gabena Weldt Gonfallon. August 7 (no. 1874).
g. ♀. Gabena Weldt Gonfallon. July 16 (no. 825).

[Iris brown; beak coral-red; legs and feet coral-red.

First procured by Mr. W. T. Blanford at Ailet, and afterwards by both of us from Ain to the Anseba river during July and August. Saw old birds carrying food in their beaks, but could not discover the nest. Note, a noisy chatter, in a rapid diminuendo. Insectivorous. I did not meet with this species anywhere else during my stay in Abyssinia.—*W. J.*]

38. HALCYON CHLORIS (Bodd.).

Ceryle abyssinica, Licht. Nomencl. p. 67.
Alcedo collaris, Heugl. Syst. Uebers. p. 271 (note).
Halcyon chlorocephala, Faun. d. Roth. Meer. p. 21. no. 42, et p. 30.
—— *chloris,* Finsch & Hartl. Vögel Ostafr. p. 165. no. 73.

a. ♂. Zoulla. March 7 (no. 187).
b. ♀. Zoulla. March 7 (no. 118).

The specimens in Mr. Jesse's collection prove again that there is no difference between African and Indian specimens, as we have already pointed out (Ornith. Central-Polynesiens, p. 35, note).—*O. F.*

[Iris dark brown; beak, upper mandible black, lower one pearl-pink at base, tip black; legs and feet pinky grey.

Procured among the mangrove bushes on the shore of Annesley Bay. At that time they were plentiful, but had disappeared in June. I never saw it elsewhere while in Abyssinia or Bogos. Procured a pair, male and female; the latter slightly paler in plumage, but moulting, had the appearance of being a younger bird.—*W. J.*]

39. Alcedo picta (Bodd.).

Alcedo cærulea, Rüpp. Syst. Uebers. p. 23. no. 93; Heugl. Syst. Uebers. no. 135.
Ispidina cyanotis, Brehm, Habesch, p. 210.
Alcedo picta, Finsch & Hartl. Vögel Ostafr. p. 171. no. 76.

a. ♂. Maragaz. July 29 (no. 601).
b. ♀. Maragaz. July 29.
c. ♂. Maragaz. July 30 (no. 1065).
d. ♂. Waliko. July 31.
e. Waliko. August 2 (no. 1003).
f. ♀. Waliko. August 4.
g. ♂. Gabena Weldt Gonfallon. August 7 (no. 1271).
h. ♀. Gabena Weldt Gonfallon. August 8 (no. 1945).
i. ♂. Bejook. July 14 (no. 1672).
k. ♂. Bejook. July 15
l. ♂. Bejook. July 15 (no. 1470).

[Iris brown; beak coral-red; legs and feet coral-red.

Very plentiful on the Anseba during July and August. Saw one on the Lebka, below Kokai, in August. Note not unlike that of the common brown Wren (*Troglodytes parvulus*). Insectivorous and very voracious; shot one with the legs of a large locust hanging outside the beak.—*W. J.*]

Fam. MEROPIDÆ.

40. Merops apiaster, Linn.

Merops apiaster, Rüpp. Syst. Uebers. p. 23. no. 95; Heugl. Syst. Uebers. no. 137; *id.* Fauna d. Roth. Meer. no. 44; Brehm, Habesch, p. 210. no. 33.

a. ♂. Taconda. April 21 (no. 103).
b. ♀. Taconda. April 21 (no. 426).

[Iris crimson; beak black; legs and feet black.

Shot and sent to me by a friend from the Taconda Pass. I myself neither obtained nor saw this bird, either in Abyssinia or the Bogos country. Contents of stomach, wasps.—*W. J.*]

41. Merops superciliosus, L.

Merops superciliosus, Rüpp. Syst. Uebers. p. 23. no. 96; Heugl. Syst. Uebers. no. 138.
—— *ægyptius,* Heugl. Fauna d. Roth. Meer. no. 46.

Merops savignyi, Brehm, Habesch, p. 210. no. 34.
—— *superciliosus*, Finsch, Journ. f. Orn. 1867, p. 239; Finsch & Hartl. Vögel Ostafr. p. 178. no. 79.

a. ♀. Koomaylee. March 22 (no. 125).

[Iris crimson; beak black; legs and feet brownish grey, toes black.

The only specimen I procured, though I saw others at the time. I never met with this species elsewhere during my stay in Abyssinia or Bogos.—*W. J.*]

42. Merops albicollis, Vieill.

Merops cuvieri, Heugl. Syst. Uebers. no. 139.
—— *albicollis*, Heugl. Fauna d. Roth. Meer. no. 45; Finsch & Hartl. Vögel Ostafr. p. 185. no. 82.

a. ♂. Koomaylee. June 5.
b. ♀. Koomaylee. June 5.
c. ♂. Rairo. August 13 (no. 791).
d. ♂. Rairo. August 13 (no. 787).
e. ♂. Rairo. August 13 (no. 1770).
f. ♂. Rairo. August 13 (no. 870).
g. ♂. Rairo. August 13 (no. 1002).
h. ♂. Rairo. August 13.
i. ♀. Rairo. August 13 (no. 84).
k. ♀. Ain. August 16 (no. 1382).

Specimens from North-east Africa agree in every respect with western and eastern ones.—*O. F.*

[Iris crimson; beak black; legs and feet yellowish grey.

Out of a series of ten of these birds, obtained at Rairo 13th August, Koomaylee 5th June, and Ain 16th August, I remarked that in six specimens the length of the upper mandible is $1\frac{3}{8}$ inch, and in the four others only $\frac{15}{16}$ of an inch, though in other measurements, such as the pinion, length of middle toe, &c., they coincide. Is this usual among the Meropidæ?—*W. J.*]

43. Merops viridissimus, Sws.

Merops ægyptius, Licht. (nec Forsk.) Verz. Doubl. p. 13; Kittlitz, Kupfert. t. 7. f. 1.
—— *viridis*, Rüpp. (nec Linn.) Syst. Uebers. p. 24. no. 97; Heugl. Syst. Uebers. no. 140.
—— *viridissimus*, Hartl. Westafr. p. 40.

a. ♂. Zoulla. June 6.
b. ♂. Zoulla. June 6.
c. ♂. Zoulla. June 6.
d. ♂. Zoulla. June 6.
e. ♀. Zoulla. June 6 (no. E).
f. Ain. July 7 (no. 1286).

Long. al.	Caud.	Culm.	Tars.		
3″ 3‴–3″ 5‴	2″ 3‴–2″ 5‴	9‴–11‴	$4\frac{1}{2}$‴–5‴		
3 4	2 5	$10\frac{1}{2}$–$11\frac{1}{2}$	5 .	. *viridis.*	S. India.

All the specimens in Mr. Jesse's collection, killed in June and July, are young birds in moulting-plumage. The feathers on the back are in some specimens margined with dull blue, as well as the outer web of the quills and tail-feathers in other specimens; the chin and throat is in most of the specimens washed with yellow, the black jugular collar indicated only by some dark-greenish-margined feathers; the two middle elongated tail-feathers are wanting, and all only partially developed in the specimen *f.* Some specimens have the head and neck mixed with faded-fulvous-brownish feathers; the black stripe through the eye shows underneath more or less a narrow light blue margin.—*O. F.*

[Iris brown.

Out of five specimens procured at Zoulla in June, the one here noted, as also another not marked, had the iris brown; the rest were crimson. Possibly in birds of the year the iris does not reach its full colour. They were procured in the mangrove-belts by the shore: some had long tail-feathers; but the generality had not; they were all more or less moulting. I killed this species at Zoulla on my arrival at the end of February, though I have no skin of that date. Did not meet with it elsewhere.—*W. J.*]

44. Merops lafresnayei, Guér.

Merops lafresnayei, Guér. Rev. Zool. 1843, p. 322; *id.* in Ferret & Galinier, Voy. en Abyss. Atlas, t. 15.
—— *lefebvrii*, Des Murs.
—— *variegatus*, Kittl. Kupfert. t. 7. f. 3; Rüpp. Syst. Uebers. p. 24. no. 100; Heugl. Syst. Uebers. no. 143.
—— *lafresnayi*, Heugl. Fauna d. Roth. Meer. no. 48; Brehm, Habesch, p. 210. no. 35; Finsch & Hartl. Vögel Ostafr. p. 192 (Anm.).

a. ♂. Senafé. May 12 (no. 831).
b. ♂. Senafé. May 12 (no. 1216).
c. Sooroo. April 5 (no. 191).

[Iris crimson; beak black; legs and feet greyish stone-colour.

This Bee-eater was common up the pass from Sooroo to Senafé during April and May.—*W. J.*]

45. Merops minutus, Vieill.

Merops collaris, Kittl. Kupfert, t. 7. f. 2.
—— *erythropterus*, Rüpp. Syst. Uebers. p. 24. no. 99; Heugl. Syst. Uebers. no. 142; *id.* Fauna des Roth. Meer. no. 47.
—— *minutus*, Finsch & Hartl. Vögel. Ostafr. p. 188. no. 84.

a. ♂. Bejook. July 14 (no. 1524).
b. Bejook. July 13.

[Iris crimson; beak black; legs and feet black.

I procured only two specimens of this species at Bejook, on the Anseba, and did not observe it elsewhere on my trip.—*W. J.*]

Fam. UPUPIDÆ.

46. Upupa epops, L.

Upupa epops, Rüpp. Syst. Uebers. p. 27. no. 102; Heugl. Syst. Uebers. no. 145; *id.* Fauna d. Rothen Meer. no. 49; Finsch & Hartl. Vögel Ostafr. p. 195. no. 87.

? *Upupa senegalensis?,* Brehm, Habesch, p. 211. no. 37.

a. Koomaylee. June 5.
b. ♀. Between Ain and Monbar Harat-b'. August 16 (no. 49).
c. ♂. Rairo. August 13 (no. 25).
d. ♀. Rairo. August 13.

Von Heuglin met with our common Hoopoe only during the months of September and October on the Danakil coast of the Somali country, and asks "whether it may be a resident bird." The specimens in Mr. Jesse's collection answer this question. Having been shot in the beginning of June and in the middle of August, there cannot well be any doubt that the Hoopoe stays, perhaps in less numbers, all the year round in the Bogos country. It may be remarked that Mr. E. C. Taylor found the Hoopoe breeding in Egypt as early as the month of March.—*O. F.*

[Observed this bird in Koomaylee plain about the 11th and 12th of March. Procured, Koomaylee, June 5; Rairo, August 13; between Ain and Monbar Harat-b', August 16. Not seen elsewhere during my trip.—*W. J.*]

47. Irrisor erythrorynchus (Lath.).

Promerops erythrorhynchus, Rüpp. Syst. Uebers. p. 28. no. 103.

Irrisor erythrorhynchus, Heugl. Syst. Uebers. no. 146.

Irrisor, spec. nov.?, Heugl. Fauna d. Rothen Meer. no. 51.

Promerops erythrorhynchus, Brehm, Habesch, p. 211. no. 38; Finsch & Hartl. Vögel. Ostafr. p. 202. no. 89.

a. ♂. Kokai. July 12 (no. 1817).
b. ♂. Kokai. July 12 (no. 683).
c. ♀. Maragaz. July 27.
d. Maragaz. July 27.
e. ♂. Maragaz. July 29.

The collection of Mr. Jesse contains red- and black-billed specimens, the latter being most probably younger ones. Specimens from the different parts of Africa are not separable, but vary very much in coloration, shape of the bill, and size.—*O. F.*

[Iris brown; legs and feet coral-red.

The beaks of some of the specimens procured varied considerably, from black to nearly red, probably a difference of age. These birds are excessively noisy and active, climbing in all sorts of positions along the trunk and branches of the *Adansonia* hunting for insects; when frightened they fly off in a long string to the next tree. They have a peculiarly disagreeable smell, which I cannot well describe; it is not *unlike* guano. Contents of stomach, small Coleoptera. Met with these birds only at Kokai and on the Anseba.—*W. J.*]

48. Irrisor aterrimus (Steph.).

Promerops pusillus, Sws. B. W. Afr. ii. p. 120.
Irrisor cyanomelas, Heugl. Journ. f. Orn. 1864, p. 263.
Rhinopomastes pusillus, Antinori, Catal. p. 32.
Irrisor aterrimus, Finsch & Hartl. Vögel Ostafr. p. 209. no. 92.

a. Senafé. May 13 (no. 1039).
b. Mohaber. July 9 (no. 1015).
c. Rairo. August 13 (no. 1086).

Not included in the lists of North-east-African birds by Dr. Rüppell, Von Heuglin, and Dr. Brehm, but already known from that part of Africa. Specimens from Sennahr are in the Berlin Museum; others from the interior, collected by Von Heuglin in Bongo, on the Bahr-el-ghasal, I examined also. For the Abyssinian coast lands, *I. aterrimus,* which has often been confounded with *I. cyanomelas,* Vieill., is new.—*O. F.*

[Iris brown; beak black; legs and feet horn-colour.

Three specimens procured. Senafé, May; Mohaber, July 9; Rairo, August 13.—*W. J.*]

Fam. PROMEROPIDÆ.

49. Nectarinia tacazziana (Stanl.).

Nectarinia tacazze (!), Rüpp. Neue Wirbelth. t. 31. f. 3; *id.* Syst. Uebers. p. 28. no. 108; Heugl. Syst. Uebers. no. 152.

a. ♂. Rayrayguddy. April 8 (no. 445).
b. ♂. Rayrayguddy. April 8.
c. ♂. Rayrayguddy. April 8.
d. ♀. Rayrayguddy. April 8 (no. 486).
e. ♂. Goongoona. May 7 (no. 1944).
f. ♂. Facado. May 8 (no. 1752).
g. ♀. Senafé. May 25.

[Iris brown; beak black; legs and feet black.

A series of seven specimens procured at the following places:—Rayrayguddy, April 8; Goongoona, May 7; Facada, May 8; Senafé, May 25. Never met by me elsewhere, either in Abyssinia or Bogos. Females scarce.—*W. J.*]

50. Nectarinia pulchella (L.).

Nectarinia pulchella, Rüpp. Syst. Uebers. p. 28. no. 107; Heugl. Syst. Uebers. no. 151; *id.* Journ. f. Orn. 1864, p. 261.

a. ♂. Waliko. August 4 (no. 507).
b. ♀. Waliko. July 4 (no. 508).

c. ♂. Bejook. July 4 (no. 442).
d. ♂. Bejook. July 15 (no. 1082).
e. ♂. Bejook. July 15 (no. 806).
f. ♀. Bejook. July 15 (no. 770).
g. ♂. Bejook. July 16 (no. 1202).
h. ♂. Bejook. July 16 (no. 1639).
i. ♂. Bejook. July 17 (no. 805).
j. ♀. Bejook. July 17 (no. 1966).

The specimens from north-east Africa agree with western ones. I saw this species also amongst a collection of Dr. v. Heuglin from Wau, on the Bahr-el-ghasal, in the interior. The Bogos country is a new locality for this species.—*O. F.*

[Eye black; beak black; legs and feet black.

Ten specimens in this series, among which are three females, were all procured on the river Anseba from July 4 to August 4. I only met with this beautiful little bird in this locality, and always near the river—that is to say, within a mile and a half. I did not even see it on the other side of the hills, at Mashalite, though not ten miles from the Anseba. It was plentiful.—*W. J.*]

51. Nectarinia metallica, Licht.

Nectarinia metallica, Hempr. & Ehrb. Symb. Phys. t. i.; Rüpp. Syst. Uebers. p. 28. no. 109; Heugl. Syst. Uebers. no. 153; *id.* Fauna d. Rothen Meer. no. 52; Finsch & Hartl. Vögel Ostafr. p. 214. no. 95.

a. ♂. Koomaylee. March 18 (no. 170).
b. ♂. Koomaylee. March 18 (no. 134).
c. ♂. Koomaylee. March 18 (no. 179).
d. ♀. Koomaylee. May 27 (no. 568).

[Eye black; beak black; legs and feet black.

Three male specimens procured about two miles from the plain of Koomaylee, up in the hills, in quite a cool temperature, surrounded by plenty of verdure, the shrubs in blossom, I should say full 1200 feet above the sea; this was in March. On my return at the end of May they were plentiful in the plain at Koomaylee, but in very bad plumage, the males having all lost the long tail-feathers. At this period I obtained the female; these being plentiful, I concluded the breeding-season was over. I also found specimens in the female plumage with signs of the bright mature plumage. I did not meet with this species in the Bogos country, nor on the highland plateau of Senafé.—*W. J.*]

52. Nectarinia affinis, Rüpp.

Nectarinia affinis, Rüpp. Neue Wirbelth. t. 31. f. 1; *id.* Syst. Uebers. p. 28. no. 110; Heugl. Syst. Uebers. no. 156; *id.* Fauna des Roth. Meer. no. 55; Brehm, Habesch, p. 211. no. 41; Finsch & Hartl. Vögel Ostafr. p. 224 (Anm.).

a. ♂. Undel Wells. May 27.
b. ♂. Undel Wells. May 27.
c. ♂. Rayrayguddy. May 27.
d. ♂. Rayrayguddy. April 8.
e. ♂. Facado. May 2 (no. 1911).

[Iris black; beak black; legs and feet black.

Procured from Undel Wells to Facado; plentiful about Rayrayguddy. Did not see it during the trip to Bogos. From April 8 to May 27.—*W. J.*]

53. Nectarinia cruentata.

Nectarinia cruentata, Rüpp. Syst. Uebers. t. 9. p. 28. no. 113; Heugl. Syst. Uebers. no. 159; Brehm, Habesch, p. 211. no. 43.

a. ♂. Senafé. May.
b. ♀. Kokai. July 13 (no. 627).
c. ♂. Bejook. July 13 (no. 1182).
d. ♂. Bejook. July 16 (no. 1196).
e. ♂. Gabena Weldt Gonfallon. August 6 (no. 1983).

[Eye black; beak black; legs black.

Rare about the valleys near Senafé in April and May. More common, though not plentiful, during July and August between Kokai and the river Anseba. One female procured.—*W. J.*]

54. Nectarinia habessinica.

Nectarinia habessinica, Hempr. & Ehrb. Symb. Phys. Zool. i. *Aves* (1828), t. iv.
—— *purpurata* (Ill.), Kittl. Kupfert. t. 28. f. 1.
Cinnyris gularis, Rüpp. Neue Wirbelth. p. 88, t. 31. f. 2 (♂ jun.).
Nectarinia gularis et *habyssinica*, Rüpp. Syst. Uebers. p. 28. no. 111 et 112; Heugl. Syst. Uebers. no. 157 et 158; Brehm, Habesch, p. 211. no. 40; Finsch & Hartl. Vögel Ostafr. p. 221. no. 100.

a, b. ♂. Koomaylee. March 18 (no. 149).
c. ♂. Koomaylee. March 18 (no. 189).
d. ♂. Koomaylee. March 18 (no. 157).
e. ♂. Koomaylee. March 19.
f. ♂. Koomaylee. (no. 153).
g. ♂. Sahati. June 23.
h. ♂. Waliko. June 24 (no. 1242).
i. ♂. Maragaz. July 29 (no. 1060).
k. ♂. Rairo. August 13 (no. 57).

All the specimens are males in full dress. The steel-blue lustre on the rump is visible only in a few specimens; most of them have the rump of the same metallic green as the other upper parts of the body.

Long. al.	Caud.	Rostr.
2″ 5‴–2″ 7½‴	1″ 6½‴–1″ 9‴	8‴–9‴.—*O. F.*

[Eye black; beak black; legs and feet black.

The first four specimens were procured in the same locality and at the same date as *Nectarinia metallica*; plentiful and well distributed. Subsequently specimens were obtained at Sahati, June 23; Waliko, June 24; Maragaz, July 29; and Rairo, August 13. Female seen, and dull in plumage like those of other species.—*W. J.*]

55. Nectarinia jardinei, Verr.

Nectarinia jardinei, Hartl. Syst. Orn. W. Afr. p. 47; Finsch & Hartl. Vögel Ostafr. p. 218. no. 97, tab. ii. f. 1.

a. ♂. Senafé. May 22 (no. 1280).
b. ♂. Senafé. May 27 (no. 498).

Long. al.	Caud.	Culm.	Tars.	
2″ 5‴–2″ 7‴	1″ 8‴–1″ 9‴	8‴	7½‴	. . . Senafé.
2 1 –2 3	1 5 –1 7	6½–7‴	6½ –7‴	. . . Angola, Zanzibar.

The discovery of this species, which was only known from West and East Africa, is a very interesting contribution to the avifauna of North-east Africa. A careful comparison with specimens from Angola and Zanzibar shows not the slightest difference in coloration, but a considerably larger size. I hesitate to make a new species upon this character alone, fearing a larger series would perhaps offer forms intermediate in size, which would not permit the two species to be distinguished with certainty. If further researches prove that the differences in size are permanent, I propose to call the North-eastern form *Nectarinia osiris*.—*O. F.*

[Eye black; beak black; legs and feet black.

Two specimens, both male, procured at Senafé, were all I ever saw either in Abyssinia or Bogos. These were killed in a valley some 1200 feet below Senafé, on the western side.—*W. J.*]

Fam. CERTHIADÆ.

Troglodytinæ.

56. Oligocercus rufescens (Vieill.).

Troglodytes microurus, Rüpp. Neue Wirbelth. t. 41.

Oligura microura, Rüpp. Syst. Uebers. p. 56. no. 115; Heugl. Syst. Uebers. no. 161; *id.* Fauna des Roth. Meer. no. 56.

Oligocercus rufescens (ex N. O. Afr.), Finsch & Hartl. Vögel Ostafr. p. 227. no. 104.

a. ♂. Waliko. July 21 (no. 1512).

b. ♂. Waliko. August 4 (no. 436).
c. ♂. Waliko. August 4 (no. 1214).

Long. al.	Caud.	Culm.	Tars.	
2″–2″ $1\frac{1}{2}$‴	8‴–10‴	$4\frac{1}{2}$‴	8‴	
2 1	10	$5\frac{1}{2}$	10	. . . Cape.

The north-eastern form seems not to be separable from the southern, although there are certain slight differences. Levaillant's figure (t. 135) is incorrect, showing the bill $7\frac{1}{2}$‴ long.—*O. F.*

[Iris brown; legs and feet pinkish.

Three specimens, all procured at Waliko. I observed this species on the Lebka, above Gelamet, and on the Anseba, nowhere else.—*W. J.*]

Fam. LUSCINIADÆ.

57. Drymoica rufifrons, Rüpp.

Prinia rufifrons, Rüpp. Neue Wirbelth. t. 41. f. 2; *id.* Syst. Uebers. p. 56. no. 121; Heugl. Syst. Uebers. no. 168; *id.* Fauna d. Roth. Meer. no. 61; Brehm, Habesch, p. 212. no. 44; Finsch & Hartl. Vögel Ostafr. p. 234. no. 109.

a. ♂. Koomaylee. May.
b. ♂. Rairo. August 13.
c. ♀. Rairo. August 13 (no. 94).
d. ♀. Rairo. August 14 (no. 97).
e. ♀. Rairo. August 14 (no. 54).

[Iris pale burnt-sienna.

This species was common about Koomaylee in June; four specimens procured at Rairo, one of which was a bird of the year; not observed by me elsewhere.—*W. J.*]

58. Drymoica erythrogenys, Rüpp.

Syst. Uebers. p. 56. no. 125, t. 12; Heugl. Syst. Uebers. no. 165.

a. ♀. Goon Goona. May 8 (no. 142).

A closely allied species is *D. marginalis*, Heugl. (Syst. Uebers. no. 175).—*O. F.*

[Iris light brown; beak horn-colour; legs and feet dirty yellowish brown.

I do not remember meeting with this species elsewhere.—*W. J.*]

59. Camaroptera brevicaudata (Rüpp.).

Sylvia brevicaudata, Rüpp. Atlas, t. 35 (pess.).
Ficedula brevicaudata, Rüpp. Syst. Uebers. p. 57. no. 149.
Orthotomus clamans et *Syncopta brevicaudata*, Heugl. Syst. Uebers. no. 197 et 196.
Camaroptera brevicaudata, Brehm, Habesch, p. 212. no. 45; Finsch & Hartl. Vögel Ostafr. p. 241. no. 112.

a. ♀. Undel Wells. May 27.
b. ♂. Maragaz. July 27 (no. 1942).

c. Maragaz. July 27 (no. 1832).
d. ♂. Waliko. July 23 (no. 1786).
e. Waliko. July 27 (no. 1755).
f. Gabena Weldt Gonfallon. August 8 (no. 1259).
g. ♂. Bejook. July 13 (no. 645).

Long. al.	Caud.	Culm.	Tars.
2″–2½″	1″ 2‴–1″ 5‴	5‴–5½‴	9½‴–10½‴

This species occurs also in South (*C. olivacea*, Sundev.) and West Africa (*C. tincta*, Cass.). The figure in Cretzschmar's 'Atlas' is incorrect, and not to be recognized. I have examined Rüppell's types in the Senckenberg Museum.—*O. F.*

[Iris light brown; legs and feet yellow.

This species is well distributed, having been procured at Undel Wells, May 27, and all along the Anseba, from Bejook to Maragaz. Though a very noisy little bird, it was difficult to get, as it always kept in the thickest bushes. Its voice is so powerful that it was some time before I recognized the performer; the note is very harsh.

Contents of stomach, minute coleoptera.—*W. J.*]

60. Phyllopneuste umbrovirens, Rüpp.

Ficedula umbrovirens, Rüpp. Neue Wirbelth. p. 112; *id.* Syst. Uebers. p. 57. no. 148; Heugl. Syst. Uebers. no. 194; Brehm, Habesch, p. 212. no. 46.

a. ♀. Undel Wells. May 27.

[I have no recollection of meeting with this species elsewhere, nor have I any further particulars.—*W. J.*]

61. Hypolais elæica (Linderm.).

Salicaria elæica, Linderm. Isis, 1843, p. 342.
Ficedula ambigua, Schleg. Krit. Uebers. (1844) p. 53.
Hypolais pallida, Gerbe, Rev. & Mag. Zool. (1852) p. 174. t. iv.
—— *cinerascens*, De Selys.
Sylvia preglii, Frauenfeld.
Hypolais arigonis, A. Brehm, Thierleben, p. 865.

a. ♀. Gelamet. August 11.
b. ♀. Gelamet. August 11 (no. 44).
c. ♂. Rairo. August 13 (no. 19).

Long. al.	Caud.	Culm.	Lat. max. basin.	Tars.	
2″ 6‴	2″ 0‴	5½‴	2¼‴	9‴	. . . *a.*
2 10	2 3	6	2½	11	. . . *b.*
2 8	—	6	2½	10	. . . *c.*
2 7	2 1	5½	2½	10	. . . Spain.

The specimens in Mr. Jesse's collection agree with specimens from Greece and Spain; the latter, collected by Dr. A. Brehm at Valencia, have the bill a little more depressed and broader (*Hypolais megarhyncha*, Brehm). Between *H. elæica* and *H. pallida* I cannot find a real difference; the colouring varies between a greyish- and pale brownish-olive; in the shape of the bill there are also slight differences. I have compared specimens from Algiers and Dalmatia—the latter, collected in the neighbourhood of Cattaro, being the type of *Sylvia preglii*, Frauenfeld.

Whether *Curruca pallida*, Hempr. & Ehrb., from Egypt and Nubia, is this species or *Calamoherpe arundinacea*, one cannot say, because the description given by Hemprich and Ehrenberg (Symb. Phys. 1828, fol. bb) is too short to recognize the species exactly. —*O. F.*

[Only met with at Gelamet and Rairo.—*W. J.*]

62. Hypolais olivetorum (Strickl.).

Temm. Man. d'Orn. iv. p. 611; Gould, B. of Eur. pl. 109.
Salicaria olivetorum, Schleg. Rev. Crit. p. 56.

♂. Amba. 21st August.

Apparently a young bird, having the feathers on the back and rump faintly margined with pale brown, like the outer webs of the quills; the under parts white, strongly washed with pale ochre on the sides; otherwise similar to an old male from Greece.

Long. al.	Caud.	Culm.	Tars.	Dig. int.	
3″ 2‴	2″ 8‴	6‴	11‴	6½‴	
3 3	2 6	6	11	6	. . . Greece.

Not included in the lists of North-east African birds by Drs. Rüppell, Von Heuglin, and Brehm, therefore an interesting addition to the avifauna of this part of Africa, and a valuable contribution to the geographical distribution of the species.

Von Heuglin (Syst. Uebers. p. 277) is certainly wrong in thinking that *Sylvia crassirostris*, Rüpp., may be identical with the present bird, the former species having the outermost tail-feather white.—*O. F.*

[The only specimen procured. I saw one other the same day.—*W. J.*]

63. Sylvia cinerea, Briss.

Rüpp. Syst. Uebers. p. 57. no. 133; Heugl. Syst. Uebers. no. 210; *id.* Fauna d. Roth. Meer. no. 71.

a. Mai Wallet. August 18 (no. 27).

Von Heuglin observed this species also in the month of August on the Island of Dahalak.—*O. F.*

[Iris grey.
The only specimen procured.—*W. J.*]

64. Aëdon galactodes (Temm.).

Aëdon galactodes, Sclat. Contrib. Ornith. 1852, p. 125.
—— *minor*, Cab. Mus. Hein. i. p. 39.

Aëdon galactodes et *minor*, Heugl. Syst. Uebers. nos. 218, 219.
—— *familiaris*, Heugl. Fauna d. Roth. Meer. no. 67.
—— *minor*, Brehm, Habesch, p. 212. no. 48.
—— *galactodes*, Finsch & Hartl. Vögel Ostafr. p. 246. no. 115.

a. ♂. Koomaylee. April 5 (no. 169).
b. Koomaylee. June 5.
c. ♂. Undel Wells. May 28.
d. ♂. River Amba. August 19.
e. ♀. River Amba. August 20.
f. ♂. Ain. July 6.
g. ♂. Bejook. August 18 (no. 23).

The fine series in the collection of Mr. Jesse proves that there is no difference between Abyssinian and European specimens. Cabanis's *A. minor*, said to be the eastern form of *A. galactodes*, distinguished by smaller size, is by no means separable. Dr. Brehm is therefore wrong in maintaining the Abyssinian *A. galactodes* to be permanently smaller. The black marking across the tail-feathers varies much. A male (*c*) has a broad cross band on the tail-feathers, the two middle ones pointed with black, and agrees in every respect with the female (*e*). Another male wants the black apical spot on the two middle tail-feathers; in another specimen the black cross band is indistinct and restricted to the inner web.

Long. al.	Caud.	Culm.	Tars.	
2″ 10‴–3″ 2‴	2″ 3‴–2″ 7‴	6‴	11‴–12‴	. . . Abyssinia.
3 –3 2	2 2 –2 7	6–6½‴	10 –12	. . . Europe.—*O. F.*

[Seven specimens, procured at Koomaylee, Undel, Ain, Bejook, and Amba, show this species to be well distributed from the lowlands to the highlands, though more plentiful in the former.—*W. J.*]

65. Cercotrichas erythroptera (Gmel.).

Cercotrichas erythropterus, Rüpp. Syst. Uebers. p. 60. no. 195; Heugl. Syst. Uebers. no. 278; *id.* Faun. des Roth. Meer. no. 94; Brehm, Habesch, p. 214. no. 67; Finsch & Hartl. Vögel Ostafr. p. 250. no. 116.

a. Zoulla. May.
b. ♂. Koomaylee. May.
c. ♂. River Amba. August 21.
d. ♀. Between Gelamet and Kokai. August 10 (no. 45).
e. ♂. Bejook. July 16 (no. 1777).

[This species I observed at Zoulla in March, and procured them in May; Bejook, July 16; Gelamet, August 10; Amba, August 21. Plentiful in the lowlands. I only saw one other specimen on the Anseba besides the one procured at Bejook.—*W. J.*]

66. Thamnolæa albiscapulata, Rüpp.

Thamnolæa albiscapulata, Rüpp. Neue Wirbelth. t. 26. f. 1; *id.* Syst. Uebers. p. 58. no. 168; Heugl. Syst. Uebers. no. 250; Brehm, Habesch, p. 213. no. 53.

Thamnolæa casiogastra, Bp. Compt. Rend. xxxviii. p. 7 (1854).

a. ♂. Koomaylee. March 22 (no. 145).
b. Sooroo. May.

Long. al.	Caud.	Culm.	Tars.
4″ 6‴	3″ 1‴	7‴	13‴

This species has often been erroneously confounded with the southern *Th. cinnamomeiventris*, Lafr. (Rev. Zool. 1836, t. 56; *Petrocincla montana*, Licht. Nomencl. 1854, p. 26), a very nearly allied but different species. The north-eastern *Th. albiscapulata* is distinguished by having the upper and under tail-coverts black, the latter being only cinnamomeous at the base, whereas in *Th. cinnamomeiventris* these parts are uniform cinnamon, like the rump and under surface. Mr. Layard and Mr. Gurney have overlooked these differences, and make the southern bird the same as the north-eastern. *Saxicola albiscapulata* (Layard, B. S. Afr. p. 106), *Thamnobia ptymatura* (Gurney, Ibis, 1863, p. 328), and *Th. albiscapulata* (Gurney, Ibis, 1868, p. 157) belong therefore as synonyms to *Th. cinnamomeiventris.* I have compared both species carefully in the Berlin and Frankfort Museums.

Thamnolæa casiogastra, from Abyssinia, seems to be, from the short description of Bonaparte, nothing more than the female of *Th. albiscapulata*, which differs from the male only in wanting the white patch on the shoulders.—*O. F.*

[Iris dark brown; beak black; legs and feet black.

This specimen was shot in the Sooroo Pass, seven miles higher up the road to Senafé than Koomaylee. I procured another specimen at Sooroo in May. It was tolerably plentiful about this locality, but I did not come across it anywhere else during my stay in Abyssinia or Bogos.—*W. J.*]

67. Thamnolæa melæna (Rüpp.).

Saxicola melæna, Rüpp. Neue Wirbelth. t. 28. f. 2; *id.* Syst. Uebers. p. 58. no. 154; Heugl. Syst. Uebers. no. 230.

a. ♂. Senafé. April 24 (no. 137).

Agrees very well with the description and figure given by Dr. Rüppell, who collected a few specimens in the Abyssinian province Agame. Heuglin observed it in the mountains of Simehn and Woggara. A comparison with *Thamnolæa æthiops*, Licht. (Cab. Mus. Hein. p. 8; Hartl. W. Afr. p. 65), from West and South Africa, would probably prove the identity of the two species.—*O. F.*

[Iris brown; beak black; legs and feet black.

The only specimen procured; two others seen near Senafé.—*W. J.*]

68. SAXICOLA ŒNANTHE (L.).

Saxicola œnanthe, Rüpp. Syst. Uebers. p. 58. no. 161; Heugl. Syst. Uebers. no. 236; *id.* Fauna d. Roth. Meer. no. 84; Brehm, Habesch, p. 212. no. 49.

a. ♂. Senafé. April 24 (no. 104).

[Iris brown; beak black; legs and feet black.

The only specimen procured.—*W. J.*]

69. SAXICOLA ISABELLINA, Rüpp. (*nec* Temm.).

Saxicola isabellina, Rüpp. Atlas, t. 34. f. 6; *id.* Syst. Uebers. p. 58. no. 159; Heugl. Syst. Uebers. no. 233; *id.* Fauna des Roth. Meer. no. 89; Brehm, Habesch, p. 212. no. 50; Finsch & Hartl. Vögel Ostafr. p. 252. no. 118.

a. ♀. Zoulla. March 12 (no. 127).

Long. al.	Caud.	Culm.	Tars.
3″ 8‴	2″	6‴	$13\frac{1}{2}$‴

There is no difference between specimens from Africa and Western Asia (*S. saltatrix,* Ménétr.).—*O. F.*

[Eye, beak, legs and feet, black.

Neither observed nor procured elsewhere. Rather plentiful about Zoulla in March. Not seen in May and June, nor at Massuah in August.—*W. J.*]

70. SAXICOLA STAPAZINA (L.).

Saxicola stapazina, Rüpp. Syst. Uebers. p. 58. no. 162; Heugl. Syst. Uebers. no. 237; Sclat. Contrib. to Ornith. 1852, p. 125.

♂. Gelamet. August 11 (no. 51).

A young bird, in moulting-plumage, similar to the female; but the head and upper parts olive-brown, not so bright ferruginous as in the female, the light supercilium indistinct, the ferruginous margins on the quills and quill-coverts rather narrow and paler.

Long. al.	Caud.	Culm.	Tars.
3″ 3‴	2″ 1‴	$5\frac{1}{2}$‴	10‴

The rediscovery of this species in the Abyssinian coastlands is interesting. It had been hitherto only once obtained, by Mr. Daubeny, who collected the species near Massowa. Von Heuglin includes this species also in his list of the birds of the Red Sea (Ibis, 1859, p. 341) as being observed on the Somali and Danakil coasts and in Southern Arabia, but says, in a later paper on that subject (Peterm. Geograph. Mittheil. 1861, p. 21), "*S. stapazina* and *S. aurita,* which are common in the Nile region, I have not seen along the shores of the Red Sea."—*O. F.*

[No notes on this species.—*W. J.*]

71. Saxicola lugubris, Rüpp.

Saxicola lugubris, Rüpp. Neue Wirbelth. p. 77, t. 28. f. 1.; *id.* Syst. Uebers. p. 58. no. 153; Heugl. Syst. Uebers. no. 229; Brehm, Habesch, p. 212. no. 51.

a. ♂. Rayrayguddy. May 27.
b. ♂. Senafé. April 25 (no. 451).

A beautiful species; the old male accurately figured by Dr. Rüppell.—*O. F.*

[Iris brown; beak black; legs and feet black.

Only two specimens procured; one at Rayrayguddy, May 27, 1868.—*W. J.*]

72. Saxicola melanura, Rüpp.

Saxicola melanura, Rüpp. in Temm. Pl. Col. 257; *id.* Syst. Uebers. p. 58. no. 158.
Pratincola melanura, Heugl. Syst. Uebers. no. 245; *id.* Fauna des Roth. Meer. no. 90.
Cercomela asthenia, Bp.
Saxicola melanura, Brehm, Habesch, p. 213. no. 52; Finsch & Hartl. Vögel Ostafr. p. 257. no. 120.

a. Undel Wells. May 5.
b. R. Amba. August 18 (no. 21).
c. ♀. R. Amba. August 19.
d. ♂. R. Amba. August 21.

The sexes are similar.

Long. al.	Caud.	Culm.	Tars.
2″ 11‴–3″ 1‴	2″–2″ 3‴	5‴–5½‴	9½‴–10‴—*O. F.*

[Plentiful in the lowlands in August, has a peculiar habit of spreading out its tail in the form of a fan; *Cercotrichas erythroptera* and *Aëdon galactodes* also have this peculiarity.—*W. J.*]

73. Thamnobia albifrons (Rüpp.).

Saxicola albifrons, Rüpp. Neue Wirbelth. 1835, p. 78; *id.* Syst. Uebers. p. 58. no. 155, t. 17.
—— *frontalis*, Sw. W. Afr. ii. (1837) p. 46.
—— *albifrons*, Heugl. Syst. Uebers. no. 231.
Thamnobia frontalis, Hartl. W. Afr. p. 68.

a. ♂. Bejook. July 13 (no. 1765).
b. ♀. Bejook. July 13 (no. 1273).

The female has no white on the forehead.—*O. F.*

[Iris brown.

The only two specimens procured or observed, as well as I can recollect: both shot on the same day, and male and female.—*W. J.*]

74. Ruticilla phœnicura (L.).

Ruticilla phœnicura, Rüpp. Syst. Uebers. p. 57. no. 142; Heugl. Syst. Uebers. no. 224; *id.* Fauna d. Roth. Meer. no. 78; Brehm, Habesch, p. 213. no. 56.

a. ♂. Senafé. April 25 (no. 402).

Long. al.	Caud.	Culm.	Tars.	
2″ 10‴	2″ 1‴	4½‴	9‴	
2 10	2	4¾	9½	. . . (*R. pectoralis,* Heugl.)
2 11	2	4¼	10	. . . Germany.

The specimen in Mr. Jesse's collection is an old male, and agrees exactly with the figure given by Naumann (tab. 79. f. 1). Heuglin's *R. pectoralis* (Journ. f. Ornith. 1863, p. 165), of which I have inspected the type specimens from the Bahr-el-ghasal, is nothing more than our *R. phœnicura.* The male described by v. Heuglin has the black feathers on the throat and breast margined with white, as is often the case with specimens killed in the spring in Europe.—*O. F.*

[Iris brown; beak black; legs and feet black.

Common about Senafé and down the Sooroo Pass.—*W. J.*]

75. Parus leucomelas, Rüpp.

Parus leucomelas, Neue Wirbelth. t. 37. f. 2.
—— *leucopterus,* Sws. B. W. Afr. ii. p. 42.
—— *leucomelas,* Rüpp. Syst. Uebers. p. 59. no. 170; Heugl. Syst. Uebers. no. 252.

a. ♂. Undel Wells. April 7 (no. 412).
b. ♂. Rayrayguddy. May 27.
c. ♂. Kokai. July 12 (no. 1980).
d. ♂. Kokai. July 12 (no. 1027).
e. ♂. Between Kokai and Gelamet. August 10 (no. 42).

Long. al.	Caud.	Culm.
2″ 11‴–3″ 1‴	2″ 4‴	4‴–4½‴.—*O. F.*

[Eye, beak, legs and, feet black.

Not very plentiful anywhere where I passed, except near Kokai, where I fell in with a family and shot four. Did not observe this species in the low plains.—*W. J.*]

76. Parus leuconotus, Guér.

Parus leuconotus, Guérin, Rev. Zool. 1843, p. 162; *id.* in Ferret & Galinier, Voy. Abyss. Atlas, t. 9. f. 1.
—— *dorsatus,* Rüpp. Syst. Uebers. p. 59. no. 171, t. 18; Heugl. Syst. Uebers. no. 253.

a. ♀. Senafé. April 27 (no. 128).
b. ♂. Goon-Goona. May 9 (no. 172).

Both sexes are alike.—*O. F.*

[Iris brown; beak black; legs and feet black.

I only procured one other specimen of this species, a male, at Goongoona, 9th May, and never saw it again.—*W. J.*]

77. Zosterops abyssinica, Guér.

Zosterops abyssinica, Guér. Rev. Zool. 1843, p. 162; *id.* in Ferret et Galinier, Voy. en Abyss. t. 9. f. 3.
—— *madagascariensis,* Rüpp. Syst. Uebers. p. 57. no. 150; Heugl. Syst. Uebers. no. 199.

a. ♀. Rairo. August 13 (no. 87).

Long. al.	Caud.	Culm.	Tars.	
1″ 11‴	1″ 5‴	3‴	7‴	. . . Abyssinia.
2 2	1 8½	3¾	7½	. . . South Africa. (*Z. sundevallii.*)

The southern representative is *Z. sundevallii,* Hartl. (*Z. lateralis,* Sund. *nec* Lath.), distinguished by larger size, the uniform dirty greyish white under surface, without having the sides washed with fulvous, and wanting the yellow superciliary stripe. —*O. F.*

[Iris pale burnt-sienna.

I unfortunately only procured this one specimen, having confounded it with *Camaroptera brevicaudata.* I did not shoot any others.—*W. J.*]

78. Motacilla flava, L.

Var. *melanocephala,* Licht.

Motacilla flava, Rüpp. Atlas, t. 33 *b*; *id.* Syst. Uebers. p. 59. no. 178; Heugl. Syst. Uebers. no. 260.
Budytes melanocephala, atricapilla, cinereocapilla, campestris, et *flava,* Brehm, Habesch, pp. 214, 215, nos. 59–63.
Motacilla flava, Finsch & Hartl. Vögel Ostafr. p. 268. no. 123.

a. ♂. Senafé. April 24 (no. 491).
b. ♂. Senafé. April 24 (no. 136).
c. ♀. Senafé. April 24 (no. 131).
d. ♀. Senafé. April 25 (no. 499).
e. ♂. Amba. August 25.

The old males, with the black cap, without a light supercilium, agree with the figure given by Rüppell, which, however, is incorrect in representing the four outer tail-feathers on each side white.

This variety occurs also in Scandinavia, India, and South Europe. The females are not distinguishable from our common ones. The specimen (*e*) from Amba in the Bogos has been apparently bred in that country, being in first plumage.—*O. F.*

[Iris brown; beak horn-colour; legs and feet horn-colonr.

I observed this species very common about Zoulla and Koomaylee in March occupied in catching flies about the dead carcasses; at Amba, on the 25th of August, I procured a specimen (a young male) minus any yellow.—*W. J.*]

79. Anthus pratensis (L.).

Anthus cecilii, Savign., Rüpp. Syst. Uebers. p. 59. no. 181.
—— *cervinus,* Heugl. Syst. Uebers. no. 263; *id.* Fauna d. Roth. Meer. no. 99.

a. ♂. Senafé. April 25 (no. 159).

The specimen has the chin and throat pale rose-coloured, washed with ferruginous, like the male in the spring figured by Naumann (Vög. Deutschl. t. 85. f. 1).—*O. F.*

[Iris brown; beak horn-colour; legs and feet very light brown.

The only specimen procured during my stay either in Abyssinia or Bogos.—*W. J.*]

80. Anthus sordidus, Rüpp.

Anthus sordidus, Rüpp. Neue Wirbelth. p. 103, t. 39. f. 1; Syst. Uebers. p. 59. no. 184; Heugl. Syst. Uebers. no. 266.

?♂. Bejook. July 16 (no. 794).
Waliko. July 21 (no. 1571).

The only description of this rare species by Rüppell is not correct in every respect, and it will therefore be useful to give another.

All the upper parts dark earth-brown, each feather with a somewhat lighter margin; primaries and secondaries dark umber-brown, a little darker than the back; the outer web very narrowly margined with earth-brown, uniform on the inner web, without paler margins: quill-coverts margined on the outer web like the remiges, but broader; from the nostrils to the temporal a narrow ochre whitish supercilium; sides of the head and the body beneath pale brownish fulvous, darkest on the breast and sides; chin more whitish; under quill-coverts brownish; tail-feathers dark blackish brown, the outermost on the outer web and the apical third of the inner web pale brownish white; the second tail-feather only with a small brownish white apical spot on the inner web; under surface of wings greyish brown.

Bill horn-brown, the mandible on the basal half pale yellowish; legs pale yellowish brown.

This specimen (no. 1571) agrees very well with the figure given by Rüppell.

The other specimen in Mr. Jesse's collection (no. 794) is similar to the one above described, but shows on the feathers of the throat and breast very narrow dark-brown shaft-stripes, also some on the feathers of the sides.

Long. tota.	Al.	Caud.	Culm.	Tars.	Dig. int.	Dig. post.	Cum ung.	
c. 6½″	3″ 7‴	2″ 8‴	6½‴	12‴	7‴	4‴	8‴	
—	3 9	2 9	6	11½	7	3½	7	
—	3 6	2 7	6	12	6	4	4	*A. gouldi*. Casamanse.

About this species there is some confusion. Bonaparte, in uniting *A. gouldi*, Fraser, with *A. sordidus*, is, I believe, wrong. A specimen of *A. gouldi*, from the Casamanse, in the Bremen collection, is distinguished by the distinct dark-brown pear-shaped spots on the throat (jugulum), the dark-brown mystacal stripe, and the pale rusty margin on the basal portion of the inner web of the remiges; the fulvous colour of the under parts is also brighter, especially on the under tail-coverts. A specimen from the Bahr-el-ghazal in v. Heuglin's collection (s. n. *A. mystacalis*) agrees with the West-African specimen. The Indian *Agrodroma sordida* of Jerdon (B. of Ind. ii. p. 236), which is mentioned in von Pelzeln's paper on the Himalayan and Thibet Birds collected by Dr. Stoliczka (Journ. f. Ornith. 1868, p. 30; Ibis, 1868, p. 312), is an allied, but certainly not the same, species. A specimen from Kotegurh, in the north-west Himalaya, collected by Dr. Stoliczka and procured from von Pelzeln (s. n. *A. sordidus*, Rüpp.), is at once distinguished by having the primaries narrow, the secondaries and quill-coverts broad, margined with ochre-fulvous on the outer web; the outermost tail-feather is, except the black basal half of the inner web, of the same colour, the second tail-feather has a broad fulvous apical spot running on both webs; the under surface is light fulvous with some obsolete dark blotches on the throat. This Indian species, not being the *A. sordidus* of Rüppell, merits a new name. I propose to call it *Anthus jerdoni*.

Guérin, in the Zoology of the 'Voyage en Abyssinie,' by Ferret et Galinier, p. 228, describes a specimen of *A. sordidus* which has on the breast some dark striæ, like the specimen no. 794. He says, that species is not rare at the Cape of Good Hope; but I could never find any reference to its existence in that locality.—*O. F.*

[Iris brown; beak pink flesh-colour, the upper mandible somewhat darker; legs and feet pink flesh-colour.

I only procured one other specimen at Waliko. This bird perches on trees.—*W. J.*]

Fam. TURDIDÆ.

81. TURDUS SIMENSIS, Rüpp.

Turdus simensis, Rüpp. Neue Wirbelth. t. 29. f. 1; *id.* Syst. Uebers. p. 60. no. 190; Brehm, Habesch. p. 214. no. 65.

a, ♂. Taconda. April 21st, 1868 (no. 417).

b, c, d. ♀. Taconda. April 21st, 1868 (nos. 408, 414, 492).

Long. al.	Caud.	Culm.	Tars.	
4″ 8‴–5″ 0‴	2″ 4‴–2″ 5‴	9‴–10‴	16 ‴	. . . Abyssinia.
4 10 –4 11	2 1	10 0	14½ –16‴	. . . South Africa.

Prince Bonaparte and Dr. Hartlaub unite this species, as the young bird, with *T. strepitans*, Smith (*T. crassirostris*, Licht.)—but erroneously, as it is always to be distinguished by having the superciliary stripe, sides of head, breast, and sides of the belly strongly tinged with cinnamon fulvous, instead of white, washed faintly with pale ochraceous. Otherwise both species are similar.

The *T. simensis* from Sierra Leone, mentioned by Professor Sundevall (Œfvers. Akad. Förh. 1849, p. 157), belongs to the true *T. strepitans*, which is therefore not restricted to the south.—*O. F.*

[Iris brown; beak—upper mandible blackish brown, lower one yellowish; legs and feet brown.

I never saw this bird alive; the four specimens in my collection were sent me, *in the flesh*, by a friend who shot them in the Taconda Pass.—*W. J.*]

82. Turdus pelios, Bp.

Turdus pelios, Bonap. Consp. Av. i. p. 273.
—— *icterorhynchus,* P. v. Würtemb.; Heugl. Syst. Uebers. no. 275.
—— *pelios,* Hartl. W. Afr. p. 75.

a. ♂. Waliko. July 22nd (no. 1184).
b. ♂. Waliko. August 3rd (no. 1446).
c. ♂. Gabena Weldt Gonfallon. August 6th, 1868 (no. 643).

Long. al.	Caud.	Culm.	Tars.	
4″ 2‴	3″ 2‴	8‴	14‴	. . . . . Abyssinia.
4 2	3 6	7	14½	. . . . . N.E. Africa.
4 1	3 1	7½	13	. . . . . N.E. Africa.
4 2	3 2	8	12	. . . . . Gaboon.
4 0	3 2	7½	14	. . . . . Gaboon.
4 7	3 5	7½	13	. . . . . Gaboon.
4 6	3 6	8	14	. . . . . Type of Bonap.

The Bogos country seems to be a new locality for this species, which has been noticed only from Abyssinia, Kordofahn, and the Blue and White Nile. Specimens from North-east Africa agree with Western ones.—*O. F.*

[Iris brown; beak pale lemon-colour; legs and feet flesh-colour.

Did not either procure or observe this bird, except on the river Anseba.—*W. J.*]

83. Petrocincla saxatilis (Lath.).

Petrocossyphus saxatilis, Rüpp. Syst. Uebers. p. 60. no. 188.
Petrocincla saxatilis, Heugl. Syst. Uebers. no. 270; *id.* Fauna d. Roth. Meer. no. 108; Brehm, Habesch, p. 214. no. 66.

a. ♂. Koomaylee. March 24th (no. 165).
b. ♂. Senafé. March 25th (no. 864).

[Iris dark brown; beak black; legs and feet black.

I procured one other male specimen at Senafé; these were the only ones I ever saw.—*W. J.*]

84. Cossypha semirufa (Rüpp.).

Petrocincla semirufa, Rüpp. Neue Wirbelth. (1835) p. 81.
Bessonornis semirufa, Rüpp. Syst. Uebers. p. 60. no. 186, t. 21.
Cossypha nigrocapilla, Guér. Rev. Zool. 1843, p. 162.
Bessonornis semirufa, Heugl. Syst. Uebers. no. 268.

a. Addigerat. May 7 (no. 948).

[Beak black; legs and feet black.

The only specimen procured or observed during my stay in Abyssinia or Bogos; shot near water.—*W. J.*]

85. Cossypha gutturalis, Guér.

Cossypha gutturalis, Guér. Rev. Zool. 1843, p. 162; Ferret & Galinier, Voy. en Abyss. Atlas, t. 5 (pess.).

Saxicola albigularis, Pelzeln, Verh. Z. B. Ges. Wien. (1863) xlviii. p. 149.

Irania finoti, De Filippi, Viaggio in Persia, p. 347.

Bessornis albigularis, Tristr. Ibis, 1867, p. 89, t. i.

a. ♀. Koomaylee. April 3 (no. 158).

b. ♀. Mai Wallet. August 18.

Guérin described this species after specimens brought home by MM. Ferret et Galinier from Abyssinia, without giving a certain locality. Neither Dr. Rüppell nor v. Heuglin, nor any other traveller, obtained this rare species, it is therefore of much interest to find them in the collection of Mr. Jesse. A male from North-east Africa I saw in the Berlin Museum. There is no doubt that the so-called *Saxicola albigularis* from Smyrna and Palestine, and the *Irania finoti* from Persia[1] are the same birds. The female marked *a* agrees very well with a male from Smyrna, except being beneath of a somewhat lighter and duller cinnamon-colour, and having a narrower white stripe along the chin and throat. The female, *b*, agrees very well with the figure given in the 'Ibis' (back-ground) as that of the female, but is certainly a young bird. The two sexes are alike, a fact hitherto unknown.

It must be remarked that the figure in the Atlas of the 'Voyage en Abyssinie,' by Ferret et Galinier (tab. 5), is not very correct, having the white superciliary stripe too much extended, the tail too long, &c.

Long. al.	Caud.	Culm.	Tars.	
3″ 6‴	2″ 7‴	c. 6‴	12‴	. . . . *a*.
3 6	2 7	5½	11	. . . . *b*.
3 6	2 8	6	11½	. . . . ♂. Smyrna.—*O. F.*

[Eye black; beak black; legs and feet black.

Procured two specimens, both in the plains on the coast; did not observe this bird elsewhere.—*W. J.*]

86. Crateropus leucopygius, Rüpp.

Ixos leucopygius, Rüpp. Neue Wirbelth. p. 82, t. 30. f. 1.

Crateropus leucopygius, Rüpp. Syst. Uebers. p. 60. no. 199; Heugl. Syst. Uebers. no. 282; *id.* Fauna d. Roth. Meer. no. 112; Brehm, Habesch, p. 214. no. 68.

a. ♂. Undel Wells. May 5th.

b. ♀. Rayrayguddy. May 27th.

The female shows the rump only dirty white, the white of the head washed with ashy.—*O. F.*

[Iris crimson.

I have only two specimens of this species. On first looking over Dr. Finsch's list

[1] Since the above was written I have examined the type of De Filippi in the Turin Museum myself. It is a young bird of the present species.—*O. F.*

I perceived that he had divided my *Crateropodes* into three species, *C. leucopygius*, *C. limbatus*, and *C. leucocephalus*. This struck me as extraordinary, as from observation of these birds in the flesh I had mentally classed them in *two* species, though ignorant of their names. The first two I took to be one species, with only differences of plumage ascribable to age alone. While preparing these notes the doubt of the three species again struck me, and I examined the birds side by side, and finally referred to Dr. Finsch's notes to see what remarks he had made; I there find he has made the same observations as I have. Had I entertained a doubt on the subject of *C. leucopygius* and *C. limbatus* being other than one species, I would have brought home a larger series; but so certain did I feel of their identity, that, though shooting other specimens, I sacrificed them to preserve other species which I considered more valuable at the time. All three are similar in their habits and cry, which is very noisy; on alarm they fly from one bush to the other in a regular string, and are very annoying, as they often give the alarm to game or other birds the sportsman may be in pursuit of.—*W. J.*]

[Since these notes were written, I have communicated my opinion to Dr. Otto Finsch, and have received a letter from him wishing me to record my opinion that *C. limbatus* is a synonym of *C. leucopygius*.—*W. J.*]

87. CRATEROPUS LIMBATUS, Rüpp.

Rüpp. Syst. Uebers. pp. 48, 60. no. 202; Heugl. Syst. Uebers. no. 288.

a. ♂. Kokai. August 10 (no. 76).
b. Kokai. August 10 (no. 78).

A doubtful species, and probably the former (*C. leucopygius*) in immature state.

One specimen has the front white like a supercilium; the head, sides of head, and chin are dark brown, with indistinct ashy edgings of the feathers; the rump dirty white, like the female of the preceding species. Another specimen shows the whole forehead greyish white, passing into brown on the top of the head. Both species are of the same size.

Iris crimson.

The series in Mr. Jesse's collection proves that *C. limbatus* is probably nothing more than the young of *C. leucopygius*. There are intermediate forms with the head partially white (front and supercilium in the one, the whole forehead in the other).—*O. F.*

88. CRATEROPUS LEUCOCEPHALUS, Rüpp.

Crateropus leucocephalus, Rüpp. Atlas, tab. 4; *id.* Syst. Uebers. p. 60. no. 198; Heugl. Syst. Uebers. no. 281.

a. ♂. Ain. July 6 (no. 1468).
b. ♀. Ain. July 6 (no. 586).
c. ♂. Waliko. July 21 (no. 510).
d. ♂. Waliko. August 2 (no. 996).

Long. al.	Caud.	Culm.	Tars.
4″ 1‴	4″ 1‴	$8\frac{1}{2}$‴	15‴ . . . . ad.
3 $9\frac{1}{2}$	—	7	$14\frac{1}{2}$ . . . . jun.

A young bird in the collection of Mr. Jesse has only the chin and the region adjoining the angle of the mouth whitish; the head brownish grey; vent and crissum brighter, tinged with fulvous.—*O. F.*

[Iris lemon-yellow.

Four specimens procured, two at Ain in July, and two at Waliko, on the Anseba.

No. 586 *b*, ♀, Ain, 6th July 1868, had the iris brown.

I did not observe this species while with the army.—*W. J.*]

89. Pycnonotus arsinoë (Licht.).

Ixos arsinoë, Rüpp. Syst. Uebers. p. 60. no. 196; Heugl. Syst. Uebers. no. 279; *id.* Fauna d. Roth. Meer. no. 114; Brehm, Habesch, p. 214. no. 69; Finsch & Hartl. Vögel Ostafr. p. 296. no. 139.

a. Ain. July 6.
b. ♂. Rairo. August 13 (no. 1921).
c. ♂. Kokai. July 6 (no. 1715).

[This bird was found to be very common from Ain to the Anseba, and proved to be a great nuisance, as rarely a day passed without my shooting one, taking it for a new species.—*W. J.*]

Fam. MUSCICAPIDÆ.

90. Muscicapa grisola, Linn.

Muscicapa grisola, Rüpp. Syst. Uebers. p. 61, no. 207; Heugl. Syst. Uebers. no. 295; *id.* Fauna d. Roth. Meer. no. 117; Brehm, Habesch, p. 215, no. 70; Finsch & Hartl. Vögel Ostafr. p. 300, no. 141.

a. Zoulla. June 13.
b. ♂. Mai Wallet. August 18.

It is very probable that occasional specimens of our common Flycatcher remain the whole year in Africa, as Mr. Jesse obtained it in the month of June.

Long. al.	Caud.	Culm.	Tars.
3″ 3‴	2″ 2‴	$4\frac{1}{2}$‴	7‴—*O. F.*

[I only procured two specimens of this species, and did not observe it anywhere else but at Maiwallet, and this only in the plain.—*W. J.*]

91. Muscicapa fuscula, Sundev.

Oefvers. Akad. Förh. 1850, p. 105.
Le gobe-mouche ondulé, Levaill. t. 156. f. 1.
? *Muscicapa undulata*, Vieill.
? *Butalis adusta*, Boie.

Alseonax undulata, Cab. Mus. Hein. i. p. 52.
Muscicapa minuta, Heugl. (*nec* Schilling) Syst. Uebers. no. 296.
—— *minima,* Heugl. Journ. f. Ornith. 1862, p. 301.

a. Rayrayguddy.

Long. al.	Caud.	Culm.	Lat. rostr. ad basin.	Tars.	
2″ 5‴	1″ 9‴	3½‴	3½‴	7‴	
2 5	1 9	3½	3¼	7	(*M. minima,* Heugl.)

The single specimen in the collection of Mr. Jesse agrees in every respect with the representation of Levaillant's *L'ondulé* (male), and proves evidently the occurrence of that southern species in North-east Africa. Heuglin's *M. minima* from central Abyssinia, of which the Bremen Museum possesses a typical specimen from Gondar, is also undoubtedly the same. That specimen has the under surface a little darker, washed with brownish fulvous, and shows the obsolete dark markings on the breast more decidedly than the specimen in Mr. Jesse's collection, which is of a rather brownish white underneath.—*O. F.*

[Only observed at the above locality.—*W. J.*]

92. Terpsiphone melanogastra (Sws.).

Muscipeta melanogastra, Sws. B. W. Afr. ii. (1837) p. 55.
"*Tschitrea melampyra,* Verr." Hartl. W. Afr. p. 90.
Muscipeta ferreti, Guér. Rev. Zool. 1843, p. 162.
—— *melanogastra,* Rüpp. Syst. Uebers. p. 61. no. 211; Heugl. Syst. Uebers. no. 302.
Tschitrea melanogastra, Brehm, Habesch, p. 215. no. 71.
Terpsiphone melanogastra, Finsch & Hartl. Vögel Ostafr. p. 309.

a. ♂.
b. ♂. Sooroo. April 5 (no. 140).
c. ♀. Sooroo. April 5 (no. 129).
d. ♂. Kokai. July 13 (no. 813).
e, f. ♀. Kokai. July 13 (nn. 1912 et 1753).

A careful comparison of these birds with specimens from Western Africa has convinced us that there is no difference. The females in the collection agree in every respect with the types of *T. melampyra,* Verr., in the Bremen Museum. The male marked *a* has the two middle tail-feathers very much developed (13 inches), and white; the upper tail-coverts are also white, but the back is chestnut. The male, no. 140, has the two middle tail-feathers less developed, but also white; in the male, no. 813, all the tail-feathers are chestnut, like the back. The females have no prolonged tail-feathers.

Antinori's interesting observations prove that there is a very great variation in colour in this species according to the season of the year and age of the bird (see his Catalogue, pp. 46–50). A description of all the known African species of the genus *Terpsiphone* will be given in our 'Birds of East Africa.'—*O. F.*

[Iris dark brown, eyelid turquoise-blue; beak slate-colour, skin at the gape same as eyelid; legs and feet slate-colour, toes black.

I did not get any specimens of the male bird with the two white tail-feathers in very good condition, though an officer of my acquaintance obtained a good many. I did not see one with a white tail during my Bogos trip in July and August; possibly this distinction is carried only in the breeding-season, all the white-tailed specimens having been obtained in April and previously.—*W. J.*]

93. Platystira pririt (Vieill.).

Muscicapa molitor, Hahn, Vög. aus Asien, etc. (1822), Liefer. xx. t. 2.
Platystira melanoleuca et *P. molitor*, Licht. Nomencl. p. 20.
—— *pririt*, Hartl. W. Afr. p. 94; Heugl. Faun. des Roth. Meer. no. 120; Finsch & Hartl. Vögel Ostafr. p. 314. no. 147.

a. ♂. Waliko. July 27 (no. 460).
b. ♂. Undel. July 27.
c, d. Young. Waliko. July 27.
e. ♂. Rairo. August 13 (no. 58).

The two old males (*a* and *b*) agree in every respect with specimens from Damaraland and Gaboon in the Bremen Museum. The specimen *e*, marked male, has instead of a black a broad chestnut band across the throat, and the indistinct superciliary stripe pale fulvous—differences which are considered to be peculiar to the female. The two specimens *c* and *d* are young birds, apparently having left the nest only a short time. They have all the feathers on the crown, and some on the back, spotted with pale brownish white, as in our common Flycatcher; and the secondaries and tectrices are margined with pale brownish. In the one there is an indication of a chestnut cross band on the throat; in the other the throat-feathers have only pale brownish apical spots, not forming a distinct cross band.—*O. F.*

[Iris lemon-yellow.

This species common up the pass to Senafé. I cannot see any difference between this bird and *P. senegalensis* on comparing my specimens.—*W. J.*]

94. Platystira senegalensis (Linn.).

Platyrhynchus velatus, Vieill.
Platystira succincta, Licht. Nomencl. p. 20 (♀).
—— *senegalensis*, Rüpp. Syst. Uebers. p. 61. no. 212; Heugl. Syst. Uebers. no. 303; Hartl. W. Afr. p. 94; Finsch & Hartl. Vögel Ostafr. p. 317. no. 148.

♂. Waliko. August 2 (no. 1275).

The only specimen in the collection of Mr. Jesse is marked as male, and is of great interest, because it has not a black but a dark chestnut cross band on the throat, showing that this character does not belong only to the female. Otherwise it agrees very well with male specimens from Western Africa in the Bremen Museum; the measurements are a little larger.

Long. tota.	Al.	Caud.	Culm.	Tars.	
$4\frac{1}{2}''$	$2''$ $4'''$	$1''$ $7''$	$5'''$	$8'''$	. . . Abyssinia.
$4\frac{1}{4}$	2 1	1 6	5	8	. . . Senegal.—*O. F.*

[Iris lemon-yellow.

Only one specimen procured: I doubt whether different from *P. pririt*.—*W. J.*]

Fam. AMPELIDÆ.

95. Bradyornis chocolatinus (Rüpp.).

Muscicapa chocolatina, Rüpp. Neue Wirbelth. p. 107; *id.* Syst. Uebers. pp. 49 et 61. no. 210, t. 20.
Muscicapa fumigata, Guér. Rev. Zool. 1843, p. 161.
Bradyornis chocolatinus, Finsch & Hartl. Vögel Ostafr. p. 323.

a and *b*. Senafé. May 25.

A very rare species. Excepting that the bill is a little stouter, this bird may be considered a typical *Bradyornis*. Dr. Rüppell's *Curruca chocolatina* (Syst. Uebers. t. 14) is, as proved by a careful comparison of the type in the Senckenbergian Museum, the same species as his *Muscicapa chocolatina*. The measurements are given in the following list:—

Long. tota.	Al.	Caud.	Culm.	Tars.	
c. $6''$	$3''$ $3'''$–$3''$ $4'''$	$2''$ $8'''$–$10'''$	$5'''$–$5\frac{1}{2}'''$	$10'''$	Coll. Mr. Jesse.
—	3 3	2 9	5	10	*Muscicapa chocolatina.*
—	3 3	2 8	$4\frac{3}{4}$	$9\frac{1}{2}$	*Curruca chocolatina.*

The only species of *Bradyornis*, besides the above-mentioned *Br. chocalatinus*, are *Br. mariquensis*, Sm., of South and West Africa, *Br. pallida*, Müll. (*Musciapa pallida*, Müll. Beitr. t. viii.), and *Br. pammelæna*, Stanl. (*Sylvia pammelæna*, Stanl. in Salt's Trav. in Abyss.; *Melanopepla atronitens*, Cab.; *Bradyornis ater*, Sundev.), from South-eastern and North-eastern Africa.—*O. F.*

[Iris dirty white.

I only procured two specimens of this bird, both at Senafé on the same day. Contents of stomach Coleoptera.—*W. J.*]

96. Campephaga phœnicea (Lath.).

Ceblepyris phœnicea, Rüpp. Syst. Uebers. p. 61. no. 214; Heugl. Syst. Uebers. no. 307.
Lanicterus phœniceus, Hartl. Journ. f. Orn. 1865, p. 172.

a. ♂. Senafé. April 16 (no. 444).

[Iris dark brown; beak black; legs and feet black.

I never either procured or observed another specimen of this bird, either during the campaign or in the Bogos country. A friend at Rayrayguddy sent me up the wing of one and promised to procure specimens should I be in want of any. I requested he would, but I did not receive any more. Either the birds had left the neighbourhood, or his duties were too pressing.—*W. J.*]

97. Dicrurus divaricatus (Licht.).

Edolius lugubris, Hempr. & Ehrb. Symb. Phys. t. viii. (jun.).
Dicrurus canipennis, Sws. B. W. Afr. i. p. 254.
—— *lugubris*, Rüpp. Syst. Uebers. p. 61. no. 216; Brehm, Habesch, p. 215. no. 72.
—— *divaricatus*, Finsch & Hartl. Vögel Ostafr. p. 323. no. 150.

a. ♂. Undel Wells. May 27.
b. ♀. Undel Wells. May 27.
c. ♀. Senafé. May 22 (no. 902).

Both sexes (*a* and *b*), shot at Undel Wells, are alike, except that the female has the tail less furcated. The specimen *c* seems to be not quite old, because it has the under tail-coverts edged with white and of a more uniform dark black colour, without the steel-blue lustre. It agrees with *D. lugubris*, Ehrb., a species which cannot be separated from *D. divaricatus*, as already mentioned by the late Mr. Strickland (Proc. Zool. Soc. 1850, p. 217). The specimens *a* and *b* agree in every respect with specimens from Benguela in the Bremen Museum.

Long. al.	Rectr. inter.	Rectr. ext.	Culm.	Tars.	
4″ 9‴	3″ 7‴	4″ 1‴	c. 7‴	$9\frac{1}{2}$‴	*a.*
4 10	3 6	3 11	7	10	*b.*
4 6	3 6	3 9	$7\frac{1}{2}$	9	*c.*—*O. F.*

[Iris crimson.

Off the plains, among the hills, I found this bird rather common, always in pairs. It is very bold, driving Crows and Kites away from the neighbourhood of its nest. It feeds much after the manner of the Flycatchers, sitting on the top branch of a dead tree and making a dash straight up in the air at any passing insect, hovering a second or two, and then returning to its perch.—*W. J.*]

Fam. LANIIDÆ.

98. Lanius fallax, sp. nov. (Plate XXV.)

a. ♂. Rairo. August 13 (no. 1454).
b. ♀. Rairo. August 13 (no. 67).
c. ♀. Rairo. August 14 (no. 38).
d. ♀. Ain. August 17 (no. 92).

Supra dilute cinereus; area latissima utrinque a rostro per oculum ducta nigra, supra minus distincta, albo marginata; subtus totus albus, pectore et abdomine conspicue cinerascente lavatis; remigibus nigricanti-fuscis, a basi ad medium fere pure albis, minoribus limbo apicali albo; scapularibus fuscis apicibus albo marginatis, pogonio interno versus basin sensim albiore; subalaribus albis; rectricibus mediis fusco-nigris, limbo apicali tenui albo, extima fere tota alba, scapo latius fusco; secunda fusca, macula terminali majóre alba; rostro nigricante, mandibulæ dimidio basali albo; pedibus plumbeis.

Male. All the upper parts, including the rump and upper tail-coverts, delicate ashy grey; a very narrow frontal margin and a broad stripe, which covers the lorum, eye, and region of the ear black, margined above by an indistinct narrow whitish line; cheeks, chin, and throat white, all the remaining underparts of a light ashy grey, much lighter than the back; vent and under tail-coverts white, the same as the under quill-coverts, which are washed faintly with grey; primaries brownish black, on the basal half of both webs nearly white, forming a conspicuous white speculum; secondaries brownish black, on the basal half of the inner web whitish, and tipped broadly with white; quill-coverts brownish black, some newly developed secondaries have the basal half white, the same as the primaries; the longest of the shoulder-coverts whitish, but almost covered by the lesser shoulder-coverts; the tail-feathers black, tipped with white, narrowest on the two middle ones, increasing in breadth externally; the outmost tail-feather white, with the shaft blackish; the second feather margined with white on the outer web. Bill blackish horn-brown; the basal half of the mandible pale horn-colour; legs dark horn-brown.

The three females are similar, but want the narrow black frontal margin; the bill is paler; two specimens show the middle of the breast tinged faintly with isabelline colour.

All the specimens are in change of plumage. In moulting the female shows the back washed faintly with pale brown, indistinctly barred with darker lines.

Long. tota.	Al.	Rectr. med.	Rectr. ext.	Culm.	Tars.	
8″	4″ 0‴	3″ 10‴	3″	8″	13‴	♂.
—	3 11	3 8	2	7½	12	♀.
—	4 1	4 0	—	7½	13	♀.
—	4 2	3 7	—	7½	13	♀.

Being unable to refer this Shrike with certainty to any of the allied species, I must consider it to be new. It comes nearest to *L. lahtora*, Sykes, which occurs also on the shores of the Red Sea, but differs in the pale greyish tint of the under parts, which are decidedly white in *L. lahtora*. Otherwise there is scarcely any difference. The greyish tint of the belly, which all the specimens in Mr. Jesse's collection exhibit, shows its relation to *L. algeriensis*, Less.; but in this species the grey tone is much darker, the upper parts are dark ashy grey, and the outermost tail-feather is black with a broad white apical spot. *L. pallidirostris*, Cass., also an allied species, has the bill pale horn-colour, the under parts white. *L. pallens* is distinguished at once by the white rump.

I believe I am not mistaken in referring the *L. algeriensis* in the list of the birds collected by Mr. Daubeny (Sclater, Contrib. to Ornith. 1852, p. 125; Heugl. Fauna d. Roth. Meer. no. 127) at Mokkolla, near Massowa, to this species.

L. algeriensis, noticed by Mr. Strickland (Proc. Zool. Soc. 1850, p. 217) from Cordofahn, is certainly not this species, but very probably *L. pallidirostris*, Cass.—*O. F.*

[Iris brown; legs blue-grey.

I procured four specimens, all more or less moulting: three were from Rairo, the fourth was shot a few miles from Ain, on the plain towards Mai Wallet. I believe I shot two specimens of this Shrike at Koomaylee, but was too unwell to preserve them; this was in the middle of March.—*W. J.*]

99. Lanius collurio, L.

Enneoctonus collurio, Rüpp. Syst. Uebers. p. 62. no. 221; Heugl. Syst. Uebers. no. 318; *id.* Fauna d. Roth. Meer. no. 130.

Lanius collurio, Finsch & Hartl. Vögel Ostafr. p. 331. no. 154.

a. ♀. Senafé, April 25th (no. 467).

[Iris brown; beak brown; legs and feet brown.

The only specimen procured or observed.—*W. J.*]

100. Lanius senator, Linn.

Lanius senator, Linn. S. N. ed. x. p. 94.

Lanius rufus (Briss.), Rüpp. Syst. Uebers. p. 62. no. 217; Heugl. Syst. Uebers. no. 317; *id.* Fauna d. Roth. Meer. no. 131.

—— *paradoxus*, Brehm, Journ. f. Orn. 1854, p. 75 (Anm.); Heugl. Syst. Uebers. no. 321.

—— *rutilans* (Temm.): Hartl. West Afr. p. 103.

a. Adult.

b. ♂. Young. Amba. August 21st (no. M).

I at first mistook the specimens in Mr. Jesse's collection for the *L. paradoxus*, Brehm, because they showed the tail-feathers, inclusive of the two middle ones, on the basal third white on both webs, this being the distinguishing character of that species. After having examined a larger series of skins I find that this is not a character of specific value; for a female from the Hercynian Mountains agrees in that respect, whereas the male from the same locality has the two middle tail-feathers, as usual, of a uniform black. There is in general a great variation amongst specimens of this Shrike, according to age and season.

The old male (*a*) in Mr. Jesse's collection agrees in every respect with a German specimen, except in having the two middle tail-feathers white at the base, as already mentioned; the upper tail-coverts are also white throughout, whereas in the German specimens these feathers are pointed with black.

The specimen *b* is a young one, having changed its first plumage: the head and hinder part of the neck are pale rufous, with obsolete dark cross lines; back brown; rump greyish brown; hind part of the rump and upper tail-coverts pale isabelline white, like the shoulders, which are tinged with brown on the centre of each feather and the outer margin of the quill-coverts and tertiaries; quills dark brown, with a white speculum, as in the old bird; lores and an indistinct supercilium, like the whole undersurface, white, washed with isabelline fulvous on the flanks; ear-spot dark brown; tail-feathers as in the old one, but the ground-colour brown, not black. Bill pale horn-brown, in the adult black, with the basal portion of the mandible pale.

A careful comparison has also convinced me that the West-African *L. rutilans*, Temm., said to differ in its lighter tints, and in having the shoulders and quill-coverts margined externally with pale brown or white, is by no means separable. All the specimens which show these differences are in imperfect plumage, and bear more or less remains of the immature plumage.

An old male from the Gold Coast (type of *L. badius*, Hartlaub) is quite similar to a German specimen; but the rufous colour on the head is darker, and the white speculum on the primaries is scarcely visible, being represented on the outer web by pale rufous, just as in young birds. Another male from the Casamanse is as darkly coloured above as European specimens, but exhibits light brown margins on the quill-coverts; the under parts are strongly washed with cinnamomeous fulvous, and marked with obscure cross lines, which are apparently the remains of a younger dress; the two middle tail-feathers are also white on the base, but only on the outer web. A female from the Casamanse river agrees with a European female in every respect, except in having pale margins on the quill-coverts, which are only partially exhibited in the European bird. Both these have the back much lighter than in the male, and the under parts tinged with pale ochreous-fulvous; in the African bird the black feathers on the forehead have the rufous margins more visible. Another female from the Casamanse has the back rather paler brown, the forehead more mixed with white, forming an indistinct supercilium; the light margins on the coverts are less visible, and scarcely more developed than in European specimens; the under surface is white, as in the male, faintly tinged with ochre-yellow.

Ignorance of these variations, which Naumann has pointed out, has caused some of them to be taken for specific characters, and species have been founded on them—such as *L. pectoralis*, Müller (Journ. f. Orn. 1855, p. 450. no. 583), and *L. jardinei*, Müller (ib. no. 584). A *Lanius* from Tigreh, described by Von Heuglin (Journ. f. Orn. 1861, p. 195. no. 34) as probably different, belongs also to *L. senator*.

It may be remarked that Levaillant's "*Piegrièche rousse*" (tab. 63) refers to our European bird, as has been already pointed out by Professor Sundevall.

I append the measurements of several specimens from Europe and Africa to prove that there is no difference in size.

Long. al.	Caud.	Culm.	Tars.	
3″ 6‴	2″ 9‴	c. 6‴	10‴ .	. ad. Bogos.
3 8	2 10	6	10 .	. jun. Bogos.
3 10	3 0	6	10 .	. ♂. Germany.
3 8	2 9	5½	9½ .	. ♀. Germany.
3 7–3″ 9‴	2 6–2″ 10‴	5½–6‴	9‴–10‴	West Africa (4 spec.).—*O. F.*

[Iris brown.

One other immature male specimen from Amba.—*W. J.*]

101. Lanius nubicus, Licht.

Lanius personatus, Temm.; Rüpp. Syst. Uebers. p. 62. no. 218.
Leucometopon nubicus, Heugl. Fauna d. Roth. Meer. no. 129.
Collurio nubicus, Hartl. W. Afr. p. 103.

a. ♂. Ain. August 17th (no. 98).
b. ♂. Gelamet. August 11th (no. 4).

The Bogos country seems to be a new locality for this widely distributed species. Von Heuglin mentions it only from North Arabia.—*O. F.*

[Iris brown.

In Dr. O. Finsch's note on this species he mentions Bogos as a new locality; I may therefore observe that Gelamet is not thirty miles from the coast plain, and is of a much lower elevation than Bogos. Gelamet belongs properly, I believe, to Ḫamazan. Ain, where the second specimen was procured, is, of course, lower still. I do not remember to have observed this species on the Anseba.—*W. J.*]

102. Lanius fiscus, Cab.

Lanius fiscus, Cab. Mus. Hein. i. p. 74.
Laniarius collaris, Rüpp. (*nec* L.) Syst. Uebers. p. 62. no. 230.
Telophorus collaris, (Lath.) Heugl. Syst. Uebers. no. 325.
Collurio smithii, Brehm, Habesch, p. 215. no. 73.

a. ♂. Senafé. April 25 (no. 465).
b. ♂. Bejook. July 13 (no. 782).
c. ♂. Bejook. July 13 (no. 1957).
d. ♀. Bejook. July 13 (no. 1194).

I agree with Dr. Cabanis in separating the north-eastern bird from the southern *L. collaris*, Lath., but must remark that the only difference consists in the tail-feathers being considerably narrower, and in the somewhat smaller size; the colouring in both species is exactly similar.

Both females in the collection of Mr. Jesse have the feathers of the flanks rusty-coloured.

Long. al.	Caud.	Culm.	Tars.	
3″ 4‴–3″ 7‴	4″–4″ 4‴	6‴	10‴–11‴ . .	. *L. fiscus.*
3 9 –3 10	4 –4 1	6½	12 –13 . .	. *L. collaris.*

L. smithii, enumerated by Dr. Brehm in his 'Ergebnisse einer Reise nach Habesch,' is certainly this species. The true *L. smithii*, Fraser, known only from West Africa, is very closely allied, but distinguished at once by the deep black colour of the upper parts.—*O. F.*

[Iris brown; beak black; legs and feet black.

Very plentiful about Senafé and Bejook. Sits perched, like the generality of this family, on some bush or dead branch, so as to see well around.—*W. J.*]

103. NILAUS BRUBRU (Lath.).

Nilaus brubru, Rüpp. Syst. Uebers. p. 62. no. 223; Heugl. Syst. Uebers. no. 322; *id.* Fauna d. Roth. Meer. no. 122; Finsch & Hartl. Vögel Ostafr. p. 333. no. 155.

a. ♂. Waliko. July 20 (no. 1973).
b. ♂. Waliko. July 23 (no. 1081).

[Iris brown; beak black; legs and feet slate-blue.

I only procured two specimens of this species, both at Waliko. Mr. W. T. Blanford also obtained it, one specimen (a female, if my memory be true), from Ailet. The female has the plumage lighter and less marked.—*W. J.*]

104. TELEPHONUS ERYTHROPTERUS (Shaw).

Laniarius erythropterus, Rüpp. Syst. Uebers. p. 62. no. 228; Heugl. Syst. Uebers. no. 324; *id.* Fauna d. Roth. Meer. no. 133.

Telephonus erythropterus, Brehm, Habesch, p. 215. no. 76; Finsch & Hartl. Vögel Ostafr. p. 336. no. 157.

a. ♂. Bejook. July 16 (no. 1950).
b. ♂. Bejook. July 17 (no. 1109).
c. ♂. Bejook. July 18 (no. 1876).

Long. al.	Caud.	Culm.	Tars.
2″ 11‴–3″ 1‴	3″ 2‴–3″ 5‴	9‴	13–13½‴.

There is no difference between specimens from North-eastern and Western Africa.—*O. F.*

[Iris brown; beak black; legs and feet grey (bluish).

Rather plentiful about Bejook; also observed between Rayrayguddy and Senafé. In habits, much more shy than the other Shrikes, never exposing itself, but threading the bushes more like a Warbler. I notice in this species, as well as others of the Laniidæ collected, that the little hook at the end of the upper mandible is in some cases wanting, the upper not overhanging the lower mandible; possibly this is the effect of age, though I have not remarked any corresponding difference in the plumage. Not observed in the coast plains.—*W. J.*]

105. LANIARIUS GAMBENSIS, Licht.

Dryoscopus gambensis, Hartl. W. Afr. p. 110.
—— *cubla,* Rüpp. Syst. Uebers. p. 62. no. 226; Heugl. Syst. Uebers. no. 329.
Malaconotus malzacii, Heugl. Syst. Uebers. no. 334; Brehm, Habesch, p. 215. no. 75.

a. ♂? Bejook. July 16 (no. 1283).
b. ♂. Bejook. July 16 (no. 1850).
c. ♂. Bejook. July 18 (no. 759).
d. ♀. Waliko. July 20 (no. 1757).
e. ♂. Waliko. August 2 (no. 1102).
f. ♂. Maragaz. July 27 (no. 861).
g. ♀. Maragaz. July 27 (no. 985).

Long. al.	Caud.	Culm.	Tars.	
3″ 5‴–3″ 7‴	2″ 8‴–2″ 11‴	$7\frac{1}{2}$‴	10‴ . . .	♂.
3 4 –3 5	2 9	$7\frac{1}{2}$	— . . .	♀.

All writers on North-east African Ornithology have mistaken this species for the *L. cubla* of Levaillant, which does not occur in that portion of Africa. Both species are much alike; but *L. gambensis* has the rump tinged with grey, and is always larger. I have compared numerous specimens from Western and North-eastern Africa, and find them quite similar. Von Heuglin's undescribed *Malaconotus malzacii* from the Bahr el Abiad, of which I have inspected the type in the Vienna Museum, is undoubtedly a female of *L. gambensis.—O. F.*

[Iris orange-red; beak black, or slate-blue; legs and feet dark blue-grey.

I only met with this bird on the river Anseba, at Waliko, Bejook, and Maragaz, where it was plentiful. Contents of stomach, coleoptera. If no. 1283 is a male, it is doubtless a young bird.—*W. J.*]

106. LANIARIUS ÆTHIOPICUS (Vieill.).

Telophorus æthiopicus, Rüpp. Syst. Uebers. pp. 50 et 62. no. 222. t. 23; Heugl. Syst. Uebers. no. 323; *id.* Fauna d. Roth. Meer. no. 134; Brehm, Habesch, p. 215. no. 74.
Laniarius æthiopicus, Finsch & Hartl. Vögel Ostafr. p. 343. no. 160.

a. Sooroo. April 5 (no. 680).
b. ♀. Waliko. August 4 (no. 734).

[Iris brown; beak black; legs and feet slate-colour.

Common from Senafé to the plain of Koomaylee, also from the Anseba to Ain, in pairs. It differs from the true Shrikes in its habit of sneaking among the lower branches of bushes, and is frequently seen on the ground. It has two notes—each, I fancy, peculiar to one sex; but I am not sure; anyhow the one appears always to answer the other. One note consists of two bell-like whistles, repeated consecutively at intervals, not unlike that of the Bell-bird of Brazil; the answer is a grating noise, sometimes resembling rapid cracking of sticks. Indeed, in the jungle I have more than once turned to see what might be coming.—*W. J.*]

107. Laniarius cruentus (Hemp. & Ehrb.).

Laniarius cruentus, Hempr. & Ehrenb. Symb. Phys. av. t. iii.; Rüpp. Syst. Uebers. p. 62. no. 227; Heugl. Syst. Uebers. no. 330; *id.* Fauna d. Roth. Meer. no. 135; Brehm, Habesch, p. 215. no. 77; Finsch & Hartl. Vögel Ostafr. p. 354. no. 171.

a. ♂. River Amba. August 19.

b. ♂. Rairo. August 14.

Both specimens are males with the beautiful rose colouring on the breast, like fig. 2 on tab. iii. in the 'Symbolæ physicæ.'—*O. F.*

[Iris brown.

Two male specimens obtained, one at Amba. I had not seen it before; but Mr. W. T. Blanford told me it was one of the first birds he shot at Loulla.—*W. J.*]

Fam. CORVIDÆ.

108. Archicorax crassirostris (Rüpp.).

Corvus crassirostris, Rüpp. Neue Wirbelth. t. 8.

Corvultur crassirostris, Rüpp. Syst. Uebers. p. 75. no. 242; Heugl. Syst. Uebers. no. 346; *id.* Fauna des Roth. Meer. no. 136.

Archicorax crassirostris, Finsch & Hartl. Vögel Ostafr. p. 370. no. 181.

a. ♂. Takonda Pass. April 21 (no. 456).

[The only specimen procured was sent to me in the flesh by a friend; eye too far gone to note colour of iris. I afterwards saw one of these birds at Facado, and heard that they were much commoner further south, on the road to Antalo. I did not see it in the Bogos country. Contents of stomach, dung.—*W. J.*]

109. Corvus affinis, Rüpp.

Corvus affinis, Rüpp. Neue Wirbelth. t. 10. f. 2; *id.* Syst. Uebers. p. 75. no. 239; Heugl. Syst. Uebers. no. 343; *id.* Fauna d. Roth. Meer. no. 142; Brehm, Habesch, p. 216. no. 79; Finsch & Hartl. Vögel Ostafr. p. 372. no. 183.

a. ♂. Senafé. April (no. 410).

Long. al.	Caud.	Culm.	Rost. a rict.	Tars.	Dig. med.
15″	5″ 10‴	1″ 10‴	2″ 3‴	2″ 7‴	1″ 7‴.—*O. F.*

[Common from Koomaylee to Addigerat from March to May.—*W. J.*]

110. Corvus scapulatus, Daud.

Corvus leuconotus, Sws. B. W. Afr. i. pl. 5.

—— *scapulatus,* Rüpp. Syst. Uebers. p. 75. no. 238; Heugl. Syst. Uebers. no. 245; *id.* Faun. des Roth. Meer. no. 137.

—— *phæocephalus,* Cab. Mus. Hein. i. p. 232.

Corax scapulatus, Brehm, Habesch, p. 216. no. 80.
Corvus scapulatus, Finsch & Hartl. Vögel Ostafr. p. 374. no. 185.

a. ♂. Koomaylee. March 19 (no. 144).
b. ♂. Rairo. August 13 (no. 1452).
c. ♂. Rairo. August 13 (no. 1178).
d. ♀. Rairo. August 13 (no. 1370).
e. ♀. Rairo. August 13 (no. 1479).

The fine series in Mr. Jesse's collection plainly shows that *C. phæocephalus*, Cab., is not a good species, but the immature *C. scapulatus*. A male specimen from Rairo has the throat with dark umber-brown feathers strongly intermixed, and presents therefore undoubtedly an intermediate form between *C. phæocephalus* and *C. scapulatus*. Other specimens in Mr. Jesse's collection are not distinguishable from western specimens. The white collar on the hind neck varies much in extension.—*O. F.*

[Iris dark brown; beak black; legs and feet black.

Rather plentiful in March at Koomaylee, but not nearly so much so as *C. affinis*. Five specimens were procured one day in August at Rairo. I saw it between Ain and Massua; but did not see any specimen of *C. affinis* during that month. I do not remember seeing *C. scapulatus* anywhere in the highlands.—*W. J.*]

Fam. STURNIDÆ.

111. Pholidauges leucogaster (Gml.).

Lamprotornis leucogaster, Rüpp. Syst. Uebers. p. 75. no. 245; Heugl. Syst. Uebers. no. 349.
Pholidauges leucogaster, Fauna des Roth. Meer. no. 151; Brehm, Habesch, p. 217. no. 85; Finsch & Hartl. Ostafr. p. 376. no. 186.

a. ♀. Sooroo. May 29.
b. ♂. Undel Wells. May 27.
c. ♂. Undel Wells. May 27.
d. ♂. Undel Wells. May 27.
e. ♂. Undel Wells. May 29.
f. ♀. Senafé. April 4 (no. 480).
g. ♂. Senafé Rock. April 14 (no. 164).
h. ♂. Senafé. April 14 (no. 163).
i. ♀. Senafé. May 22 (no. 1107).
k. ♂. Monbar-Haratt-b', August 15.
l. ♂. Rairo. August 14 (no. 53).
m. ♀. Rairo. August 15 (no. 91).
n. ♂. Rairo. August 16 (no. 12).

Dr. Rüppell and von Heuglin maintain that the sexes in this species are alike, and that the spotted specimens are young birds. This opinion seems to be not quite correct; for all the splendid blue specimens with white under surfaces (nine in number) in Mr. Jesse's collection are marked "male," the spotted ones (four) "females." These notices are of more value, as Mr. Jesse has determined the sexes by anatomical dissection.—*O. F.*

[Iris lightish brown; beak black; legs and feet black.

The series of ten specimens before me were procured at the following localities, the two earliest dating 14th April, 1868: Sooroo, Undel Wells, Senafé (Abyssinia), Rairo, and Monbar-Haratt-b' (Hamazan). Up to about the beginning of April these birds were not to be seen, and only began to be plentiful towards the end of May. The female resembles the common Thrush (*Turdus musicus*) in plumage.

Those shot at Rairo and Monbar-Haratt-b' were killed in August.—*W. J.*]

112. Notauges chrysogaster (Gml.).

Lamprotornis rufiventris, Rüpp. Neue Wirbelth. t. 11. f. 1; *id.* Syst. Uebers. p. 75. no. 247; Heugl. Syst. Uebers. no. 351.
Notauges chrysogaster, Heugl. Fauna des Roth. M. no. 148.
Lamprocolius rufiventris, Brehm, Habesch, p. 216. no. 84.

a. ♀. Eylet. June 24 (no. 1255).
b. ♀. Eylet. June 24 (no. 446).
c. ♂. Eylet. June 25 (no. 1290).
d. ♂. Waliko. July 24 (no. 1423).
e. ♂. Waliko. July 24 (no. 935).

[Iris white; beak black; legs and feet black.

This bird I first met with during the journey to Bogos, at Eylet, and again on the river Anseba; it occurs in flocks, is a noisy bird, and is not unlike the common Starling (*S. vulgaris*) in its habits. Towards the end of the season, or rather of my stay in the Bogos country, these birds were infested with vermin[1], and were so disfigured as to be useless as specimens. Contents of stomach, principally coleoptera.—*W. J.*]

113. Lamprotornis purpuroptera, Rüpp.

Lamprotornis purpuropterus, Rüpp. Syst. Uebers. pp. 64 et 75. no. 251. t. 25.
—— *æneocephalus* et *L. Burchelli*, Heugl. Syst. Uebers. nos. 355, 356.
—— *æneus*, Brehm, Habesch, p. 216. no. 82.
—— *purpuroptera*, Hartl. Journ. f. Orn. 1859, p. 11.

a. ♂. Bejook. July 13 (no. 1669).
b. Bejook. July 13 (no. 1997).
c. ♀. Waliko. July 23 (no. 1208).
d. ♂. Waliko. July 24 (no. 1738).

The sexes are alike; but the females are a good deal smaller in size.

[1] Lice and ticks, some of the latter quite an eighth of an inch square.—*W. J.*

Long. tot.	Al.	Caud.	Culm.	Tars.	
c. 14″	6″ 6‴	7″ 6‴	$8\frac{1}{2}$‴	20‴	. . . . ♂.
—	6 4	7 0	$7\frac{1}{2}$	16	. . . . ♂.
c. 10	5 4	6 0	$8\frac{1}{2}$	16	. . . . ♀.
—	5 3	5 5	7	16	. . . . ♀.—*O. F.*

[Iris yellowish white.

I did not meet with this species but on the Anseba river.—*W. J.*]

114. LAMPROCOLIUS CHALYBEUS (Hempr. & Ehrb.).

Lamprotornis chalybæus, Rüpp. Syst. Uebers. p. 75. no. 248; Heugl. Syst. Uebers.. no. 352; *id.* Fauna des Roth. Meer. no. 146; Brehm, Habesch, p. 216. no. 83; Hartl. Journ. f. Orn. 1859, p. 21.

—— *abyssinicus,* Hartl. Journ. f. Orn. 1859, p. 21.

a. ♂. Senafé. April 14 (no. 168).
b. ♂. Senafé. April 12 (no. 147).
c. ♂. Maragaz. July 29.

The female is not so brilliantly coloured, more of a dull bronze-green, and has the blue shine on the vent and rump less distinct; the blue ear-spot is scarcely visible, the black end-spots of the tectrices are wanting. The males are larger, and vary also in the extension of the steel-blue spot on the ears. On such specimens Dr. Hartlaub founded his *L. abyssinicus,* which does not merit specific distinction.

Long. al.	Caud.	Culm.	Tars.	
5″ 2‴–5″ 7‴	3″ 1‴–3″ 6‴	$7\frac{1}{2}$‴–8‴	15‴	♂.
5 1	3 1	7	15	♀.
5 5 –5 6	3 6 –3 7	8	15	♂. *L. abyssinicus,* Hartl. Mus. Brem.
5 2 –5 4	3 . 4	7 –8	14 –15‴	♂. *L. chalybeus.* Mus. Brem.
4 8 –4 10	2 10 –3	8	14	♀. *L. chalybeus.* Mus. Brem—*O. F.*

[Iris orange; beak black; legs and feet black.

In April these birds were in pairs, later (from May to August) they were in flocks. I did not meet with this species, except in the passes and on the highlands, at any time. —*W. J.*]

115. AMYDRUS RUEPPELLII, Verr.

Lamprotornis morio, Rüpp. Syst. Uebers. p. 71. no. 252; Heugl. Syst. Uebers. no. 357.

Amydrus rüppellii, Verr., Hartl. Monogr. Journ. f. Orn. 1859, p. 31; Finsch & Hartl. Vögel Ostafr. p. 382. no. 191.

a. ♀. Rayrayguddy (no. 463).

Long. al.	Caud.	Culm.	Tars.
6″	6″	12‴	16‴

A. blythii, Hartl. (J. f. Orn. 1859, p. 32), seems not to be different.—*O. F.*

[I only obtained one specimen, but saw plenty. Not seen out of the passes, and most common about the rocks on Senafé plateau.—*W. J.*]

116. AMYDRUS TENUIROSTRIS (Rüpp.).

Lamprotornis tenuirostris, Rüpp. Neue Wirbelth. pl. 10. f. 1; *id.* Syst. Uebers. p. 75. no. 253; Heugl. Syst. Uebers. no 358.
Oligomydrus tenuirostris, Hartl. Journ. f. Orn. 1859, p. 34.

a. Addigerat. May 4 (no. 991).

Von Heuglin's *Oligomydrus sturninus* (J. f. O. 1863, p. 15) is the young of this species. I have compared the type specimens from Begemeder.—*O. F.*

[Iris brown; beak black; legs and feet black.

The only specimen I procured. I cannot say whether this species is common or not, as at a distance it may be easily confounded with *A. rueppellii* and *A. albirostris*, owing to its general appearance.—*W. J.*]

117. AMYDRUS ALBIROSTRIS (Rüpp.).

Ptilonorhynchus albirostris, Rüpp. Neue Wirbelth. t. 9. f. 1; *id.* Syst. Uebers. p. 75. no. 244; Heugl. Syst. Uebers. no. 348; Brehm, Habesch, p. 216. no. 81.
Pilorhinus albirostris, Hartl. Journ. f. Orn. 1859, p. 30.

a. ♂. Rayrayguddy. May 27.

[Beak yellowish white.

The only specimen. Not observed elsewhere.—*W. J.*]

118. BUPHAGA ERYTHRORHYNCHA (Stanl.).

Buphaga erythrorhyncha, Rüpp. Syst. Uebers. p. 76. no. 254; Heugl. Syst. Uebers. no. 359; *id.* Fauna d. Roth. Meer. no. 154; Brehm, Habesch, p. 217. no. 86; Finsch & Hartl. Vögel Ostafr. p. 384. no. 192.

a. ♂. Eylet. June 24 (no. 1278).
b. ♂. Eylet. June 26 (no. 1878).
c. ♂. Eylet. June 26 (no. 148).
d. Eylet. June 26 (no. 1266).
e. ♂. Maragaz. July 29 (no 652).

[Iris lemon-yellow, skin round the eye (eyelid) the same; beak orange-yellow; legs and feet dark grey.

Very universally distributed both in the highlands and in the plain. Runs over animals (cattle) like a Woodpecker, over and under with equal facility. Feeds on vermin. Toes not reversible. Contents of stomach ticks and blood.—*W. J.*]

Fam. PLOCEIDÆ.

119. TEXTOR ALECTO, Temm.

Textor alecto, Rüpp. Syst. Uebers. p. 76. no. 257; Heugl. Syst. Uebers. no. 363; Brehm, Habesch, p. 217. no. 89.

a. ♀. Waliko. July 19 (no. 717).
b. ♀. Waliko. July 21 (no. 1157).
c. ♂. Waliko. July 23 (no. 1960).

[Iris brown; beak light horn-colour at the tip, base thickly covered with a white rough coating, apparently not horn, and rather soft; legs and feet dirty grey.

I only procured and observed this bird on the Anseba; it was not very plentiful. Mr. W. T. Blanford shot one without the white rough covering at the base of the beak, possibly a young bird. Those seen were in company with a flock of *Lamprocolius chalybeus*. Perhaps the peculiarity about the base of both mandibles may be better described as excrescences.—*W. J.*]

120. HYPHANTORNIS ABYSSINICUS (Gm.).

Loxia abyssinica, Gm. S. N. i. p. 860.
Ploceus larvatus, Rüpp. Neue Wirbelth. t. 32. f. 1 (♂); *id.* Syst. Uebers. p. 76. no. 260.
—— *flavoviridis,* Rüpp. Syst. Uebers. pp. 69 et 76. no. 259, t. 29 (♀).
—— *larvatus* et *H. flavoviridis,* Heugl. Syst. Uebers. nos. 368 et 365; *id.* Fauna d. Roth. Meer. no. 159.
Hyphantornis abyssinicus, Finsch & Hartl. Vögel Ostafr. p. 388.

a. ♀. Goon Goona. May 8 (no. 1795).
b. ♂. Goon Goona. May 9 (no. 802).
c. ♂. Goon Goona. May 19 (no. 1195).

Long. al.	Caud.	Culm.	Tars.	
3″ 5‴–3″ 6‴	2″ 1‴	9‴–10‴	10‴	. . . . ♂, ♀.

The female agrees in every respect with *H. flavoviridis*, which is described and figured by Dr. Rüppell as a different species. Von Heuglin was of the same opinion, and maintained even in his 'Fauna des Rothen Meeres,' that he met this species breeding in colonies, but never found amongst them a black-capped male. Now he has altered this opinion, and declares *H. flavoviridis* to be only the winter dress of *H. larvatus*. It must be remarked that the females are scarcely or not at all separable from those of *H. melanocephalus*, Gmel. (*H. textor* auct.), a species which also occurs in North-east Africa.

The *H. flavoviridis* of Dr. Brehm's list (p. 217. no. 88) cannot be this species; for the length of the wing (p. 336) is given as only 2 inches.—*O. F.*

[Iris brown.

I only obtained three specimens of this species. Specimens *a* and *b* were shot on two consecutive days, within a hundred yards of the same place, thus leading one to infer reasonably that Dr. Rüppell's *H. flavoviridis* and *H. larvatus* are one and the same species. At the time I procured the above two specimens I only saw one or two others. The remaining specimen, a male, in not quite so bright plumage, was shot in the same neighbourhood, on the 19th May, by a friend.—*W. J.*]

121. Hyphantornis galbula (Rüpp.).

Ploceus galbula, Rüpp. Neue Wirbelth. t. 32. f. 2; *id.* Syst. Uebers. p. 76. no. 261; Heugl. Syst. Uebers. no. 367; *id.* Fauna d. Roth. Meer. no. 156.

Hyphantornis galbula, Brehm, Habesch, p. 217. no. 87; Finsch & Hartl. Vögel Ostafr. p. 398.

a. ♂. Koomaylee. March 23 (no. 184).
b. ♀. Koomaylee. March 23 (no. 122).
c. ♂. Undel Wells. May 28.
d. ♀. Ailet. June 29 (no. 1842).
e. ♂. Bejook. July 16 (no. 1644).
f. ♂. Bejook. July 16 (no. 1453).
g. ♀.

Long. al.	Caud.	Culm.	Tars.	
2″ 7‴–2″ 8‴	1″ 6½‴–1″ 9‴	6½‴	9½‴	. . . ♂.
2 5 –2 7	„	„	„	. . . ♀.

The females resemble those of *H. larvatus.*

Head and upper parts olive-greyish, the feathers on the hind neck and back with obsolete brownish shaft-stripes; rump and upper tail-coverts olive-yellow; supercilium, sides of the head, chin, throat, and breast pale olive-yellow; vent, sides, and under tail-coverts whitish; quills dark brown, margined externally with olive-yellow, on the inner web more broadly with pale yellow; quill-coverts brown, margined with pale brownish yellow; under quill-coverts of the same colour; tail brown, with olive yellow margins. Maxilla pale horn-brown, like the legs; mandibula pale horn-yellow.—*O. F.*

[Iris dark brown; beak black; legs and feet pinkish.

Widely distributed from the plains to the highlands. At Koomaylee, close to camp, in March, they were building, but after a few days left the neighbourhood. I afterwards saw this species building at Bejook in July, and that in the middle of the month; still the nests were not finished; thus I did not obtain eggs. The nest is built of grass, shaped like a cricket-ball, and of about the same size, with a short spout turning downwards. Seen in colonies.—*W. J.*]

122. Hyphantornis luteolus (Licht.).

Ploceus personatus, Vieill.

Fringilla (*Acanthus*) *chrysomelas*, Heugl. Syst. Uebers. no. 418.

Hyphantornis chrysomelas, Heugl. Journ. f. Orn. 1862, p. 25.

—— *personatus* et *H. luteolus*, Hartl. W. Afr. p. 123.

a. ♂. Bejook. July 17 (no. 1750).
b. ♀. Gabena Weldt Gonfallon. August 6 (no. 977).

The female wants the black on the face; the whole upper parts are olive-green, inclining to olive-yellow on the head; superciliaries, cheeks, and the under surface greenish yellow.

Long. al.	Caud.	Culm.	Tars.	
2″ 2‴–2″ 3‴	1″ 5‴	5½‴	7½‴	. . . North-east Africa.
2 1 –2 2	1 5	5½ –6‴	8	. . . West Africa.

The north-eastern specimens, which von Heuglin formerly separated as distinct (*H. chrysomelas*), are similar to western ones. The only difference is that the north-eastern birds show the orange-yellow tint on the sides of the neck and breast very faintly; but that is certainly only in consequence of the season. A western specimen from Ashantee agrees in that point with north-eastern ones. A larger series would probably prove that there is not even a difference of race.—*O. F.*

[Iris burnt sienna; beak almost black; legs and feet bluish grey.

This was a rare bird, as far as my observations went; I never saw more than half a dozen during my stay on the Anseba, and never met with it elsewhere. Mr. W. T. Blanford, I think, obtained only one specimen, also on the Anseba. No. 977 (♀), from Gabena Weldt Gonfallon, close to Bejook, I shot going from the nest, and obtained the eggs, together with another nest in the same tree, two eggs in one and one in the other. I only obtained two birds.—*W. J.*]

123. Ploceus æthiopicus, Sundev.

Ploceus sanguinirostris, var. *æthiopicus*, Sund. Öfv. 1850, p. 126; Finsch & Hartl. Vögel Ostafr. p. 409.

Coccothraustes sanguinirostris, Heugl. Syst. Uebers. no. 387.

Quelea sanguinirostris orientalis, Heugl. Journ. f. Orn. 1867, p. 391.

a. ♂. Eylet. June 29 (no. 1866).
b. ♂. Eylet. June 29 (no. 1254).
c. ♀. Eylet. June 29 (no. 1416).
d. ♀. Eylet. June 29 (no. 1247).
e. ♀. Maragaz. July 27 (no. 1089).
f. ♂. Bejook. July 16 (no. 1979).
g. ♀. Bejook. July 18 (no. 1244).
h. ♂. Bejook. July 18 (no. 625).

Long. al.	Caud.	Culm.	Tars.	
2″ 6‴–2″ 7‴	15‴	7‴	8½	. . . . ♂.
2 6 –2 8	„	7	„	. . . . ♀.

The north-eastern form seems to merit specific separation, as has already been pointed out by Professor Sundevall. The males always want the black margin on the front, which is invariably present in the southern and western *Pl. sanguinirostris*; the head is ochre-fulvous, like the belly, without the rose-tinge more or less visible in *Pl. sanguinirostris*. It is therefore in every case easy to distinguish *Pl. æthiopicus* when old and in full dress. The females and young ones, however, are scarcely, or, to speak more exactly, not at all distinguishable from those of the true *Pl. sanguinirostris.* It may be remarked that the western form (*Pl. occidentalis*, Hartl.) is the same as the southern, not being constantly smaller, as Professor Sundevall and Dr. Hartlaub suggest.—*O. F.*

[Iris brown, orbit orange-red; beak deep orange-red verging on crimson; legs and feet reddish pink.

In the female the above colours were much paler. I met with this species first at Eylet, Mr. W. T. Blanford giving me the first I ever had, I being ill at the time. Observed more or less up the pass to the Anseba, there in plenty, as indeed at Eylet, in flocks. I never saw this species elsewhere during my stay in Abyssinia, or rather Tigré; for Abyssinia proper I never reached, Addigerat being on the border. One evening on the Anseba, after a heavy spate, I saw a number of small birds hawking a swarm of flying ants just escaped from the nest, and on shooting several found them to be of this species. They were not quite so handy at this work as regular insectivorous birds, but still clever enough to make a meal.

Nos. 1866, 1254, 1979, and 625, mature males, have the cheeks, throat, and chin black, or nearly so, and the head and nape buff-colour; 1089 has but the faintest signs of black on the cheek, none on the chin, and the head and breast are of a much deeper or redder buff; 1244 and 1247 (♀) have head and nape dark-brownish grey, and the cheeks a little paler, throat and chin pale buff; 1416 agrees with the two former in the head, nape, and cheeks, but has black spots under the chin. Thus this series would seem to be paradoxical, as I know the sexes were rightly determined. Perhaps this species varies much?—*W. J.*]

124. Penthetria flaviscapulata (Rüpp.).

Coliupasser flaviscapulatus, Rüpp. Neue Wirbelth. p. 98.
Fringilla macrocerca, Licht. Verz. Doubl. p. 24; Brown, Illust. t. xi.
C. macrurus, Rüpp. (nec Gmel.) Syst. Uebers. p. 77. no. 272; Heugl. Syst. Uebers. no. 392.
Penthetria macrocerca, Cab. Mus. Hein. i. p. 176.

a. ♀. Goon Goona. May 4 (no. 1920).
b. ♀. Goon Goona. May 9 (no. 1150).
c. ♂. Goon Goona. May 4 (no. 955).
d. ♂. Facado. May 2 (no. 1288).
e. ♂. Between Facado and Addigerat. May 4 (no. 1258).
f. ♂. Addigerat. May 4 (no. 1756).

Long. al.	Caud.	Culm.	Tars.	Dig. med.	
3″ 3‴–3″ 6‴	2″ 1‴–2″ 7‴	$6\frac{1}{2}$‴–7‴	$10\frac{1}{2}$‴–11‴	8‴	♂.
2 10	2 0	$5\frac{1}{2}$–6	9	$6\frac{1}{2}$	♀.

All the males in Mr. Jesse's collection are in the winter dress, quite similar to the females, but having the lesser upper wing-coverts along the humerus bright yellow.

The remiges are also black, edged externally with pale whitish brown. The bill varies much in coloration. In one male the bill is totally black; in another only the maxilla is black, the mandibula pale brownish; in a third male the bill is pale horny brown. The females are considerably less in size than the males.

[Iris brown; beak dark brown; legs and feet dark brown.

Beak in the female lighter. Met with in flocks. Did not come across this species anywhere else during my stay in the country.—*W. J.*]

125. Vidua verreauxi, Cass.

Vidua verreauxi, Cassin, Proc. Acad. Phil. p. 56 (1850, June); Finsch & Hartl. Vögel Ostafr. p. 426.
—— *sphaënura* (Verr.), Bp. Consp. i. p. 449 (1850, July).
—— *paradisea,* Rüpp. Syst. Uebers. p. 77. no. 270; Heugl. Syst. Uebers. no. 390.
Steganura paradisea, var. *australis,* Heugl. Fauna d. Roth. Meer. no. 161; Brehm, Habesch, p. 217. no. 91.

a. ♂. Koomaylee. May 25 (no. 1522).

Long. al.	Caud.	Culm.	Tars.	
2″ 11‴	8½″	4½‴	8‴	
2 10	—	4	7½	*paradisea.* Damaraland.

An old male in full dress, having the collar on the nape ochre-fulvous, not cinnamomeous brown, as in the true *V. paradisea,* Linn.

[This specimen was given to me as a skin by Capt. Street, A.F.F.; he obtained several of the birds about Koomaylee in March. I saw some of them in the flesh in his tent, but none alive. He spoke of them as frequenting carcasses, probably feeding on maggots. The sex I am not answerable for.—*W. J.*]

126. Vidua principalis (Linn.).

Vidua erythrorhyncha (Sws.), Rüpp. Syst. Uebers. p. 77. no. 271; Heugl. Syst. Uebers. no. 391.
—— *principalis,* Heugl. Fauna d. Roth. Meer. no. 160; Brehm, Habesch, p. 217. no. 90; Finsch & Hartl. Vögel Ostafr. p. 428.

a. ♂. Bejook. July 14 (no. 1816).
b. ♂. Bejook. July 16.
c. ♂. Bejook. July 18 (no. 1188).
d. ♂. Bejook. July 18 (no. 841).

Long. al.	Caud.	Culm.	Tars.	
2″ 7‴	7″ 4‴–11″ 0‴	4‴	8‴	
2 7 –2″ 10‴	6 6 –7 9	4	7½	. . . Angola.
2 6	—	4	7	. . . Gambia.
2 9	4 7	4	7½	. . . Damaraland.

All the specimens in Mr. Jesse's collection are males in full dress, and have the base of the mentum (angulus mentalis) black, agreeing in that respect with specimens from the Gambia and from the Damara country (Andersson's collection). Whether the white-chinned specimens form a different species is questionable. In a collection of birds from Benguela, made by Dr. Welwitsch, I saw white-chinned specimens, but also specimens which showed in the extreme angle of the chin some black feathers. Very likely this difference is only a sign of age or season. Otherwise there is not the slightest difference, either in size or coloration; young birds are in every respect inseparable.

Linnæus's *Emberiza principalis* (Syst. Nat. p. 313) refers to the white-chinned form, which was renamed by Dr. Hartlaub *V. decora* (Ibis, 1862, p. 340).—*O. F.*

[Iris dark brown; beak orange; legs and feet black.

The only four specimens I procured were in July, and single birds at Kokai at the end of June. I saw a small flock. I did not meet with this bird anywhere else during my stay in the country.—*W. J.*]

Fam. FRINGILLIDÆ.

127. Habropyga rhodopyga (Sundev.).

Estrelda rhodopyga, Sund. Öfvr. Akad. Förh. 1850, p. 126.
—— *rhodoptera* (! laps. cal.), Bp. Consp. p. 459.
Habropyga frenata, Ehrb. Cab. Mus. Hein. i. p. 169.
Estrelda leucotis, Heugl. Journ. f. Orn. 1862, p. 29.
—— *frenata*, Heugl. Journ. f. Orn. 1868, p. 8.

a. ♀. Bejook. July 17 (no. 829).

Long. al.	Caud.	Culm.	Tars.
1″ 10‴	1″ 6‴	$3\frac{1}{2}$‴	6‴

A rare species. Von Heuglin obtained a single pair in the vicinity of Keren, in the Bogos country, and named them *Estrelda leucotis*. I have inspected the type specimens. Drs. Hemprich and Ehrenberg collected the species in Abyssinia and Nubia; Professor Hedenborg in Sennaar.—*O. F.*

[Beak nearly black; legs blue-grey.

The only specimen procured of this species.—*W. J.*]

128. Uræginthus phœnicotis (Sws.).

Estrilda bengalus (! L.), Rüpp. Syst. Uebers. p. 77. no. 275; Heugl. Syst. Uebers. no. 396.
Uræginthus phœnicotis, Heugl. Fauna d. Roth. Meer. no. 166.
Pytelia phœnicotis, Finsch & Hartl. Vögel Ostaf. p. 447.

a. ♂. Senafé. May 22 (no. 943).
b. ♀. Senafé. May 22 (no. 939).
c. ♀. Senafé. May 22 (no. 1725).
d. Senafé. May 22 (no. 1684).
e. ♂. Senafé. May 25.
f. Goon Goona. May 9.

g. ♀. Bejook. July 16 (no. 1500).
h. ♀. Bejook. July 16 (no. 1789).

Long. al.	Caud.	Culm.	Tars.	
1″ 11½‴–2½″	2″ 1‴–2″ 3‴	4½‴–5‴	7‴ . . .	♂, ♀.

All the female specimens want the carmine ear-spot; the brown colour of the hind neck reaches to the sides of the jugulum. The sexes are similar in size.

Southern specimens from the Damara country in the Bremen Museum agree in every respect.—*O. F.*

[Iris salmon-pink; beak crimson, tip black.

This, the first specimen of this species, I obtained in May at Goon Goona, five others at Senafé in the same month, and two at Bejook (Anseba), July 16, 1868. I did not meet with the species anywhere else.—*W. J.*]

129. Pytelia minima (Vieill.).

Estrelda minima, Rüpp. Syst. Uebers. p. 77. no. 276; Heugl. Syst. Uebers. no. 397.
Lagonosticta minima, Heugl. Fauna d. Roth. Meer. no. 165; Brehm, Habesch, p. 217. no. 92.
Pytelia minima, Finsch & Hartl. Vögel Ostafr. p. 444.

a. ♂. Maragaz. July 27 (no. 514).
b. ♀. Maragaz. July 27 (no. 1299).
c. ♂. Bejook. July 15 (no. 1686).
d. ♀. Bejook. July 15 (no. 1056).

Long. al.	Caud.	Culm.	Tars.	
1″ 10‴–1″ 11‴	1″ 4‴	c. 4‴	c. 7‴ . . .	♂, ♀.—*O. F.*

[Iris pale burnt sienna; beak deep crimson, tip black.

Did not procure or observe this species, except on the Anseba; four specimens in all.—*W. J.*]

130. Pytelia citerior, Strickl.

Pytelia citerior, Contr. to Ornith. 1852, p. 151.
Estrilda elegans, Rüpp. Syst. Uebers. p. 77. no. 278; Heugl. Syst. Uebers. no. 400.
Pytelia citerior, Heugl. Fauna d. Roth. Meer. no. 162.
Zonogastris citerior, Heugl. Journ. f. Orn. 1868, p. 19.

a. ♂. Bejook. July 17 (no 1176).
b. ♂. Rairo. August 13 (no. 11).

Long. al.	Caud.	Culm.	Tars.
2″ 2‴	1″ 7‴–1″ 9‴	5‴–6‴	7‴–7½‴

The late Mr. Strickland has pointed out the differences between the north-eastern form, which he calls *P. citerior*, and the southern *P. melba*, Linn., the latter being chiefly distinguished by the less extension of the red on the front, and having the belly and sides spotted with white, whereas in *P. citerior* the belly shows narrow transversal lines. Having no southern specimens for comparison, I can only remark that the specimens in Mr. Jesse's collection agree better with the description given by

Mr. Strickland of the southern *P. melba* than with that of his *P. citerior*. In the male, no. 11 (*b*), the white spots on the breast and sides are very distinct, less distinct in the specimen *a*, which shows the under parts with more transverse lines, like a specimen from West Africa in the Bremen Museum. It seems, therefore, doubtful whether *P. citerior* is distinct from *P. melba*.—*O. F.*

[Iris pale sienna; beak pale coral; legs and feet grey.

I only met with this species in the highlands on the Anseba, and at Rairo on the Lebka. Mr. W. T. Blanford, I believe, shot one one day with me in the plain of Koomaylee.—*W. J.*]

131. Spermestes cantans (Linn.).

Estrilda cantans, Rüpp. Syst. Uebers. p. 77. no. 279.
Coccothraustes cantans, Heugl. Syst. Uebers. no. 389.
Uroloncha cantans, Heugl. Fauna d. Roth. Meer. no. 164; Finsch & Hartl. Vögel Ostafr. p. 435. no. 228.

a, a. ♂, ♀. River Amba. August 19.
b. ♀. Amba. August 19.
c. ♂. Bejook. July 15 (no. 1741).
d. Waliko. July 20 (no. 1856).

Both sexes are alike.—*O. F.*

[Iris pale brown; beak slate-colour.

Not met with while with the expedition, but procured at Amba, in the plain, August 19, 1868.

I saw the nest of this species at Waliko, and shot the bird as it came out, but there were no eggs: this was on the 20th of July 1868. The nest is very large, say 1 ft. by 9 in. by 9 in., and is composed of fine grasses, the ends sticking out, not woven together as in that of the Weaver-bird. In form it resembles that of the Water-Ousel (*Cinclus aquaticus*), having a hole at one end; it was situated in a mimosa bush about eight feet from the ground.—*W. J.*]

132. Xanthodina dentata, Sundev.

Xanthodina dentata, Sundev. Öfers. Akad. Förh. 1850, p. 127.
Passer lunatus, Heugl. Syst. Uebers. no. 427.
Xanthodina dentata, Heugl. Journ. f. Orn. 1868, p. 81.
Petronia albigularis, Brehm, Nauman. 1856, p. 377.
Xanthodina albigularis, Heugl. Journ. f. Orn. 1868, p. 82.

a. ♂. Bejook. July 18 (no. 661).
b. ♂. Waliko. July 21 (no. 1032).
c. ♂. Waliko. July 24 (no. 1130).
d. ♀. Gelamet. August 10 (no. 63).

Long. al.	Caud.	Culm.	Tars.	
2″ 10	1″ 5‴–1″ 6½‴	4¾‴–5¼‴	7½‴	♂.
2 9	1 6½	5¼	7½	♀.

Dr. Von Heuglin, in his 'Synopsis der Vögel N.-O. Africas,' suggests that *X. albigularis*, Brehm, may be nothing else than the younger stage of *X. dentata*, as it differs only in the absence of the yellow spot in the centre of the throat. The specimens in the collection of Mr. Jesse confirm this opinion with more certainty. All are in plumage like *X. albigularis*, having the middle of the chin and throat white, except the male, no. 1032, which shows one or two pale yellowish feathers on the throat, just developing, proving that a change in the plumage is going on. *X. dentata* agrees in coloration with the southern *X. flavigula*, Sundev., differing only in the considerably smaller size.—*O. F.*

[Iris pale brown; beak, lower mandible pink, upper darker, nearly black; legs and feet blue-grey.

I procured specimens from Bejook and Waliko, Anseba river, and Gelamet on the Lebka; it was also plentiful at Rairo.—*W. J.*]

133. Xanthodina pyrgita, Heugl.

Xanthodina pyrgita, Heugl. Journ. f. Orn. 1862, p. 30; *id. ib.* 1868, p. 80.

a. ♂. Kokai. July 13 (no. 839).

Agrees with the description given by Dr. Von Heuglin. I have examined the type specimen from Keren. Allied to the South-African *X. flavigula*, Sundev., which is distinguished at once by the broad pale superciliary stripe and larger size.

Long. al.	Caud.	Culm.	Tars.	
3″ 0‴	2″ 5‴	5½‴	8‴ . . .	*X. pyrgita.*
3 5	2 4	5½	8½ . . .	*X. flavigula.* Damaraland.—*O. F.*

[Iris brown.

The only specimen I procured; nor did I observe it elsewhere, though I may possibly have passed it over.—*W. J.*]

134. Passer swainsoni (Rüpp.).

Pyrgita swainsonii, Rüpp. Neue Wirbelth. t. 33. f. 2; *id.* Syst. Uebers. p. 78. no. 295; Heugl. Syst. Uebers. no. 428.

—— *simplex,* Heugl. Fauna d. Roth. Meer. no. 169; Brehm, Habesch, p. 218. no. 95.

—— *swainsoni,* Finsch & Hartl. Vögel Ostafr. p. 450. no. 239.

a. ♂. Senafé. May 25.
b. ♀. Senafé. May 25 (no. 143).
c. ♀. Senafé. May 25.
d. ♂. Eylet. June 29 (no. 1235).
e. ♀. Kokai. July 12 (no. 1226).

Long. al.	Caud.	Culm.	Tars.
3″ 2‴–3″ 3‴	2″ 3‴–2″ 6‴	5¼‴	9‴.

Both sexes are alike; the females in general paler. An indistinct white cross band on the wing.

Synonymous are *P. simplex*, Sws. (*nec* Licht.), from West, and *P. diffusa*, Smith, from Southern Africa.—*O. F.*

[Iris dark brown; beak nearly black; legs and feet brown.

Obtained at Senafé, Eylet, and Kokai, 25th May, 29th June, 12th July, 1868.—*W. J.*]

135. Crithagra xanthopygia (Rüpp.).

Serinus xanthopygius, Rüpp. Neue Wirbelth. t. 35. f. 1; *id.* Syst. Uebers. p. 76. no. 288.
Fringilla xanthopygia, Heugl. Syst. Uebers. no. 410.
Poliospiza uropygialis, Heugl. Fauna d. Roth. Meer. no. 174.
Serinus xanthopygius, Heugl. Journ. f. Orn. 1868, p. 90.

a. ♂. Kokai. August 10 (no. 95).

[I only procured this one specimen between Kokai and Gelamet at the time I saw three others, but did not observe this species anywhere else during my journey.—*W. J.*]

136. Crithagra striolata (Rüpp.).

Pyrrhula striolata, Rüpp. Neue Wirbelth. t. 37. f. 1; *id.* Syst. Uebers. p. 79. no. 317; Heugl. Syst. Uebers. no. 453; Brehm, Habesch, p. 218. no. 102.
Serinus striolatus, Heugl. Journ. f. Orn. 1868, p. 94.

a. ♂. Senafé. April 24 (no. 427).

Congeneric with *Cr. sulphurata*, Sws., and nearest to *Cr. albigularis*, Smith; both from South Africa.—*O. F.*

[Iris brown; beak horn-colour; legs and feet horn-colour.

The only specimen seen during my stay in the country.—*W. J.*]

137. Emberiza flaviventris (Vieill.).

Emberiza flavigastra (!), Rüpp. Atlas, t. 25; Syst. Uebers. p. 78. no. 298; Heugl. Syst. Uebers. no. 432; *id.* Journ. f. Orn. 1868, p. 75; Finsch & Hartl. Vögel Ostafr. p. 458. no. 245.

a. ♂. Senafé. May 22 (no. 598).
b. ♂. Rairo. August 13 (no. 16).
c. ♂. Rairo. August 13 (no. 1769).
d. ♀. Rairo. August 13 (no. 542).
e. ♀. Rairo. August 14 (no. 81).
f. ♀. Rairo. August 14 (no. 866).

Long. al.	Caud.	Culm.	Tars.	
2″ 9‴–3″ 0‴	2″ 4‴–2″ 7‴	5‴	7‴ 8‴	
3 0 –3 4	2 6 –2 9	5	7 8½	. . . South Africa.

The north-eastern *E. flavigaster*, Rüpp., is inseparable from the southern *E. flavi-*

ventris, which is said to be distinguished by its larger size. The measurements given above will prove that in this respect an exact separation is impossible.

Young birds in the collection of Mr. Jesse have a fulvous-brown stripe along the head instead of a white one, and dark shaft-stripes on the back.—*O. F.*

[Iris brown; beak, upper mandible darkish horn-colour, lower mandible pinkish; legs and feet yellowish grey.

One specimen procured at Senafé, 22nd May 1868; two others (♂ & ♀), shot together (1769 & 542) on 13th August, have the general plumage much lighter and the marking less distinct; both heads brownish, instead of black, with white stripes, that of the male darkest. That these were birds of the year I doubt, though possibly they may have been bred the season previously. I did not meet with this species in the plains.—*W. J.*]

138. Emberiza septemstriata, Rüpp.

Emberiza septemstriata, Rüpp. Neue Wirbelth. t. 30. f. 2; *id.* Syst. Uebers. p. 78. no. 299; Heugl. Syst. Uebers. no. 435.

Fringillaria septemstriata, Heugl. Fauna des Roth. Meer. no. 176; Brehm, Habesch, p. 218. no. 96.
—— *tahapisi*, Smith.

Polymitra capistrata, Cab. Mus. Hein. i. p. 129.

a. ♂. Sahati. June 24 (no. 1830).
b. ♂. Sahati. June 24 (no. 1243*).
c. ♂. Eylet. June 26 (no. 788).
d. ♂. Ain. July 6 (no. 881).
e. ♂. Ain. July 6.
f. ♂. Ain. July 16 (no. 59).
g. ♀. Ain. July 16.
h. ♂. Maragaz. July 27 (no. 1041).
i. ♂. Maragaz. July 28 (no. 1029).
k. ♂. Between Waliko and Bejook. July 20 (no. 989.

There is no difference between specimens from the north-east and south of the continent. The latter Dr. Cabanis has separated s. n. *capistrata*, although they were already named beforehand *Fr. tahapisi* by Dr. Smith. Dr. Cabanis distinguishes *E. capistrata* as having the cinnamomeous margins on the quills less visible or nearly wanting; but in the large series of Mr. Jesse are specimens which agree in this respect, and prove that this character is only a difference of age, and therefore without specific value.

I have examined the type specimens of *Fr. capistrata* from Caffirland in the Berlin Museum and in the Museum Heineanum.—*O. F.*

[Iris brown; beak, upper mandible dark horn—lower mandible, base yellow, tip horn-colour; legs and feet dirty yellowish white.

Met with this species first at Sahate in flocks; it was plentiful right up to the Anseba.—*W. J.*]

Fam. ALAUDIDÆ.

139. GALERITA CRISTATA (L.).

Galerita cristata, Rüpp. Syst. Uebers. p. 78. no. 309; Heugl. Syst. Uebers. no. 443; *id.* Fauna des Roth. Meer. no. 179; *id.* Journ. f. Ornith. 1868, p. 223.
—— *abyssinica,* Bp. Consp. p. 245; Brehm, Habesch, p. 218. no. 98.
—— *senegalensis,* Hartl. W. Afr. p. 153.
—— *cristata,* Finsch & Hartl. Vögel Ostafr. p. 460. no. 246.

a. ♂. Senafé. August 24 (no. 154).
b. ♂. Amba. August 18 (no. 96).
c. ♂. Amba. August 21.
d. ♀. Massuah. August 23 (no. H).

A careful comparison of these birds with European specimens has convinced me that there is no specific difference, and that the African Crested Lark varies as much as our European one. The male *c* agrees in every respect with a German specimen, also the female *d*; the male *b* has a rather shorter and straighter bill, a broader moustache-stripe, whereas in the male *a* the ground-colour of the under surface is rather washed with ferruginous, the upper parts are also darker brown. Specimens from the highlands of Abyssinia (Bremen Museum) are identical. Von Heuglin, who also unites with *G. cristata* the *G. lutea* of Brehm, an apparently distinct species, is wrong in saying that the African Crested Lark is always smaller in size, as the following table of measurements will show at once:—

Long. al.	Caud.	Culm.	Tars.	Dig. intern.	Dig. post.	cum ung.	
3″ 8‴	2″ 0‴	6‴	10½‴	6½‴	c. 4‴	c. 5‴	. . . *a.*
3 8	2 1	6½	11	—	4	4½	. . . *b.*
4 0	2 1	7½	11½	7	4	5½	. . . *c.*
3 7	2 0	7	12	7	4	5	. . . *d.*
3 8–10	2 1	6½	11	6½	4	5	. . . Germany.—*O. F.*

[Iris brown; beak horn-colour; legs and feet flesh-colour.

Procured or observed at Zoulla, in March; Senafé, April; Amba and Massowah, in August; so that it seems well distributed at all periods of the year.—*W. J.*]

140. AMMOMANES DESERTI (Licht.).

Ammomanes deserti, Licht. Verz. Doubl. 1823, p. 28.
Alauda isabellina, Temm. Pl. Col. 244. f. 2.
Melanocorypha isabellina, Rüpp. Syst. Uebers. p. 78. no. 307; Heugl. Syst. Uebers. no. 441.
Ammomanes deserti, Cab. Mus. Hein. i. p. 125; Brehm, Habesch, p. 218. no. 99.

a. ♂. Koomaylee. June 3.
b. ♂. Amba. August 18 (no. 37).
c. ♂. Amba. August 19.
d. Amba. August 21 (G).
e. ♂. Amba. August 21 (K).

The specimen *a* has the back pale fulvous, whereas the other specimens have a greyish-isabel tinge on the back, and are in general brighter in colour. All these specimens, shot in the month of August, are in moult, and show more or less obsolete dark spots on the throat.

Long. al.	Caud.	Culm.	Tars.
3″ 6‴–3″ 8‴	2″ 1‴–2″ 2‴	$5\frac{1}{2}$‴–$6\frac{1}{2}$‴	10‴

A nearly allied species is *A. cinctura*, Gould (=*pallida*, Ehrb.), distinguished by the brighter cinnamon-colour of the upper parts and the black apical spot of the tail-feathers. A specimen from the Cape Verde Islands (Dohrn) agrees with an Algerian one, but is brighter above, and has the jugulum tinged strongly with fulvous, whereas in the Algerian specimen those parts show only a faint fulvous tinge.—*O. F.*

[Legs and feet rufous grey.

One specimen obtained at Koomaylee on June 3rd, 1868; not plentiful there, more so at Amba in August.—*W. J.*]

141. Alæmon jessei, sp. nov.

Certhilauda desertorum, Heugl. Ibis, 1859, p. 343.

Alæmon desertorum, Heugl. Fauna d. Roth. Meer. no. 183; *id.* Journ. f. Orn. 1868, p. 231 (spec. ex Arabia); Finsch & Hartl. Vögel Ostafr. p. 465. no. 248, et p. 869.

a. ♂. Zoulla. June 9.
b. ♂. Zoulla. June 9.
c. ♂. Zoulla. June 9.
d. ♀. Zoulla. June 9.

Supra pallide griseo-brunnescens, plumis medio distinctius fuscis; regione parotica striolaque mystacali brevi, lata, fuscis; gula, loris, superciliis et capitis lateribus infra oculos albis; pectore in fundo albo maculis rotundatis fuscis confertim guttato; abdomine albo; remigibus majoribus fuscis, basibus pogonii interni albis, minoribus fuscis basi et apice late albis; scapularibus dorso concoloribus; tectricibus alarum pallide fuscis, pallidius marginatis; subalaribus albis; rectricibus duabus intermediis pallide fuscis, sequentibus fusco-nigricantibus, extima pogonio externo alba; rostro pallide brunnescente, tomiis et basi albidis; pedibus dilute griseis.

The surface of the head and all the upper parts pale greyish brown, each feather somewhat darker brown in the centre; the feathers on the head with more distinct dark-brown shaft-stripes; lores and a conspicuous superciliary stripe white, like the sides of the head, chin, and upper throat; on the ears a blackish spot, extending to the tempora; from the angle of the mouth descends a broad blackish moustache-stripe; before the eye a small blackish spot; the under parts white, washed strongly with pale brown on the sides; the feathers on the throat marked with small blackish-brown spots, those of the jugulum and breast with large cordiform spots of the same colour, primaries brownish black, the first, second, and third white on the basal third of the inner web, on the remainder as well as on the secondaries the white extended nearly to the basal half on both webs; the seventh to the ninth primaries tipped with white; the secondaries brownish black with a broad white apical margin, and narrow pale brownish margins on the outer web; the innermost, which are prolonged secondaries (tertiariis *auct.*), pale greyish brown, the same as the upper quill-coverts, with narrow paler margins; the coverts of the primaries dark brown, those of the secondaries of the same colour, but tipped on the end with white; the under wing-coverts white; the two middle tail-feathers greyish brown, somewhat darker than the back, with paler margins externally; the remainder of the tail-feathers brownish black; the outermost white on the outer web. Bill pale horn-grey; edges of commissure whitish; legs pale greyish yellow.

The description is taken from the specimen *a*, an undoubtedly old male. The two other males agree exactly, except the *c*, which is considerably smaller in size. The female, *d*, is similar, but shows the dark spots on the breast a little smaller.

Long. tota.	Al.	Caud.	Culm.	Tars.	Dig. med.	
c. $8\frac{1}{2}''$	$4''$ $10'''$	$3''$ $5'''$	$10\frac{1}{2}'''$	$14\frac{1}{2}'''$	$6\frac{1}{2}'''$	. . . ♂. *a.*
—	4 7	3 2	$12\frac{1}{2}$	15	7	. . . ♂. *b.*
—	4 0	2 8	$9\frac{1}{2}$	14	6	. . . ♂. *c.*
—	4 3	2 10	10	14	$5\frac{1}{2}$	. . . ♀. *d.*

Differs from the allied *A. desertorum*, Stanl. (*A. bifasciata*, Temm.), in being above decidedly pale greyish brown, not pale ferruginous or isabelline, in having the middle of the secondaries (to a breadth of from 10–12''') black, whereas in *A. desertorum* the secondaries are white with a black cross band of about only from 4–5''' in breadth, and chiefly in having the jugulum and breast marked with large cordiform spots, there being in *A. desertorum* some narrow dark spots visible only on the jugulum, and these being sometimes wanting altogether.

Dr. von Heuglin has undoubtedly confounded this species with the true *A. desertorum*; for he remarks that the specimens collected by him along the shores of the Red Sea are darker. A specimen from Arabia in the Berlin Museum (collected by Hemprich and Ehrenberg), which Von Heuglin considers to be the young bird, belongs clearly also to *A. jessei*.

I name the species after my friend Mr. William Jesse, the zealous zoologist to the Abyssinian expedition, who has enriched in so many respects our knowledge of the avifauna of the Abyssinian coast-lands.—*O. F.*

[I only observed this species at Zoulla and between Ain and Amba; at the latter place I could not shoot any. They run with great swiftness; and their flight is singular, not unlike that of a Ring-Plover.—*W. J.*]

142. Coraphites melanauchen, Cab. (Plate XXVI.)

Coraphites melanauchen, Cab. Mus. Hein. i. p. 124; Heugl. Journ. f. Orn. 1868, p. 219; Finsch & Hartl. Vögel Ostafr. p. 469.
? *Pyrrhulalauda crucigera,* Rüpp. Syst. Uebers. p. 79. no. 313; Heugl. Syst. Uebers. no. 449.
Coraphites nigriceps, Heugl. Fauna d. Roth. Meer. no. 185.
Pyrrhullauda crucigera, Brehm, Habesch, p. 219. no. 101.

a–e. ♂. Massowah. August 23.
f, g. ♀. Massowah. August 23.
h. ♂. River Amba. August 18.

A well-marked species, distinguished from the nearly allied *C. nigriceps*, Gould, at once by the large black spot on the hind neck, which in all the male specimens in Mr. Jesse's collection is well defined; the white on the forehead is also more restricted, and the outer web of the first tail-feather white. The female wants the black neck-spot; the head, hind neck, and ear-region is isabelline brown, like the back; the sides of the neck, lores, and under parts whitish, washed with pale brown on the sides and breast; feathers of the jugulum and breast with brownish shaft-stripes; otherwise similar to the male.

Dr. Cabanis remarks (Journ. f. Orn. 1868, p. 219, note) that *C. nigriceps*, Gould, is not the same as *C. frontalis*, Licht. (Bp. Consp. p. 512), and that my *C. modesta* (Journ. f. Orn. 1864, p. 413), from the Canaries, is the female of *C. nigriceps*. I have not had an opportunity of comparing specimens from the west and north-east, but must declare that a skin from the Cape Verde Islands (collected by Dr. Dohrn), and therefore the true *C. nigriceps*, Gould, agrees in every respect with the descriptions given by Bonaparte and Heuglin of *C. frontalis*. As regards my *C. modesta*, based upon a single female specimen, it seems that this species is nearer to *C. melanauchen* than to *C. nigriceps*.—*O. F.*

[Common all over the plains from Zoulla to Massowah, but nowhere further inland. Seen from early in March to late in August, probably stops all the year in the plains. —*W. J.*]

Fam. MUSOPHAGIDÆ.

143. Colius macrourus (Linn.).

Colius senegalensis, Rüpp. Syst. Uebers. p. 79. no. 318; Heugl. Syst. Uebers. no. 454.

a. ♂. Takonda. May 17 (no. 1412).
b. ♂. Kokai. July 9 (no. 1207).
c. ♂. Mahaber. July 9 (no. 1304).
d. ♂. Mahaber. July 9 (no. 1559).
e. ♂. Mahaber. July 9 (no. 1207).
f. Rairo. August 14.
g. ♂. Rairo. August 16 (no. 20).

[Iris brown, skin round the eye dirty crimson; beak, upper mandible dark crimson base, next a blue line, then tip black, lower mandible black; legs and feet dirty mauve, toes reversible.

No. 1412, the first, was obtained as a skin. I afterwards procured six specimens, from which I drew my notes. Localities: Kokai, Mahaber, 9th July; Rairo 14th August, 1868; found in flocks. Contents of stomach fruit and berries. In no. 1412 the contents of the stomach were mimosa-seeds. Not observed in any other locality by me.—*W. J.*]

144. Colius leucotis, Rüpp.

Colius leucotis, Rüpp. Syst. Uebers. p. 79. no. 319; Heugl. Syst. Uebers. no. 455; Finsch & Hartl. Vögel Ostafr. p. 472. no. 253.

—— *leuconotus*, Brehm, Habesch, p. 219. no. 103.

a. ♀. Dolo. May 16 (no. 662).
b. ♀. Bejook. July 16 (no. 1674).
c. ♀. Bejook. July 16 (no. 764).
d. ♀. Bejook. July 17 (no. 1124).
e. ♀. Bejook. July 17 (no. 1527).
f. ♂ Bejook. July 18 (no. 1893).

The ear-spot is not distinctly white, as the specific name denotes, but pale brownish. —*O. F.*

[Iris pale cobalt; beak, upper mandible dark horn-colour with a light patch at the base, lower mandible flesh-colour; legs and feet coral-red.

I obtained every specimen but one at Bejook, where they were plentiful; they are very active, climbing like parrots and clinging like Tits (*Parus*), and keep themselves well concealed. No. 662 was given me by Mr. W. T. Blanford, and was obtained by him at Dolo, in Tigré, at an elevation of 7000 feet. I did not meet with this species elsewhere.—*W. J.*].

145. Corythaix leucotis, Rüpp.

Corythaix leucotis, Rüpp. Neue Wirbelth. t. 3.

Turacus leucotis, Rüpp. Syst. Uebers. p. 80. no. 326; Heugl. Syst. Uebers. no. 463; Brehm, Habesch, p. 219. no. 104.

a. ♂. Taconda Pass. April 21 (no. 195).
b. ♂. Taconda Pass. April 21 (no. 476).
c. ♀. Taconda Pass. April 21 (no. 692).
d. ♂. Waliko. August 2 (no. 609).
e. ♂. Bejook. July 18 (no. 133).
f. ♂. Bejook. July 18 (no. 1994).

[Iris brown; beak scarlet, and skin round the eye the same; legs and feet very nearly black.

Did not observe this species lower down the passes to Senafé than Rayrayguddy. Localities: Senafé (behind the rock in the valley beneath), not plentiful; Anseba, common. Flight very light and noiseless; call rather noisy; runs up and down lateral branches like a Parrot, "hand over hand." Contents of stomach fruit.—*W. J.*]

146. Schizorhis zonura, Rüpp.

Chizærhis zonura, Rüpp. Neue Wirbelth. t. 4; *id.* Syst. Uebers. p. 80. no. 327; Heugl. Syst. Uebers. no. 465; Brehm, Habesch, p. 219. no. 105.

a. ♂. Senafé. May 22 (no. 604).
b. ♂. Senafé. May 22 (no. 1183).
c. ♂. Senafé. May 22 (no. 793).
d. ♀. Senafé. May 22 (no. 1309).
e. ♀. Senafé. May 22 (no. 1975).
f. ♀. Maragaz. July 29 (no. 1351).
g. ♀. Waliko. July 23 (no. 1859).
h. ♂. Waliko. August 2.
i. ♂. Bejook. July 18 (no. 649).

[Iris brown; beak greenish yellow; legs and feet dark grey.

I met with this bird only at Senafé, in the valleys, and on the Anseba. In August I shot well-fledged young, able to fly. They are excessively noisy, especially when two alight on the same tree; the note resembles a derisive roar of laughter more than any thing else I can think of. Contents of stomach fruit.—*W. J.*]

Fam. BUCEROTIDÆ.

147. Buceros nasutus (L.).

Toccus nasutus, Rüpp. Syst. Uebers. p. 79. no. 323; Heugl. Syst. Uebers. no. 459.
—— *pœcilorhynchus*, Lafr.; Heugl. Syst. Uebers. no. 462; Heugl. Fauna d. Roth. Meer. no. 189; Brehm, Habesch, p. 219. no. 106.
Buceros nasutus, Finsch & Hartl. Vögel Ostafr. p. 486. no. 263.

a. ♀. Ain. July 7 (no. 1949).
b. ♀. Ain. July 7 (no. 502).
c. ♂. Between Ain and Mohaber. July 7 (no. 1171).
d. ♂. Mohaber. July 8.
e. ♂. Mohaber. July 8 (no. 1818).
f. ♀. Mohaber. July 8 (no. 1133).

There cannot be any doubt that *B. pœcilorhynchus* is the female of this species, although von Heuglin maintains the contrary, and thinks the latter distinct. All the females in the collection of Mr. Jesse agree with the so-called *B. pœcilorhynchus*, whereas the black-billed ones are males. Many specimens from Damaraland, which I inspected, in the collection of the late Mr. Andersson gave similar results.—*O. F.*

[Iris brown; beak black at base, with three diagonal stripes of white at the base of the lower mandible, base of upper mandible a large white patch, end of beak dirty red; legs and feet nearly black.

Beak of male longer than that of female, and entirely black except a white patch on the base of the upper mandible much smaller than in the female.

Found from Ain to the Anseba; note so variable as to induce me to expect some fresh bird, a source of constant trouble and disappointment. I have seen this bird hawking insects in a very awkward manner; it is also a fruit-eater. Did not meet with this species while with the troops.—*W. J.*]

148. Buceros erythrorhynchus, Temm.

Toccus erythrorhynchus, Rüpp. Syst. Uebers. p. 79. no. 322; Heugl. Syst. Uebers. no. 458; *id.* Fauna d. Roth. Meer. no. 190; Brehm, Habesch, p. 220. no. 108.

Buceros erythrorhynchus, Finsch & Hartl. Vögel Ostafr. p. 491. no. 266.

a. Rayrayguddy. May.

[The only specimen procured; others seen in the vicinity of Senafé.—*W. J.*]

149. Buceros flavirostris, Rüpp.

Buceros flavirostris, Rüpp. Neue Wirbelth. t. 2. f. 2; *id.* Syst. Uebers. p. 79. no. 324; Heugl. Syst. Uebers. no. 461; *id.* Fauna d. Roth. Meer. no. 191; Finsch & Hartl. Vögel. Ostafr. p. 490. no. 265.

Toccus elegans, Hartl. Proc. Zool. Soc. 1865, p. 86, t. 4.

a. ♂. Undel Wells. April 6.

b. ♂. Between Sooroo and Undel Wells. April 5 (no. 581).

c. Rayrayguddy.

d. ♀. Between Sooroo and Undel Wells. April 6 (no. 422).

In some specimens there is a black longitudinal stripe on the upper mandible; in other specimens the bill is uniform orange-yellow tipped with black. In the white markings on the wings and the black tail-bands there is also a great variation, also in the extent of the white apical spots on the tectrices, which are sometimes margined with black. The incorrectness of the figure in Rüppell's 'Neue Wirbelthiere,' and the shortness of his description, were the causes of Dr. Hartlaub's publishing the western *T. elegans* as a new species. I have examined the type specimens in Frankfort since, and the fine series in Mr. Jesse's collection, and am convinced that both species are one and the same.—*O. F.*

[Iris yellowish white, eyelid formed like a horny shade capable of projection over the eye, eye-lashes strong bristles; beak bright yellow, base almost orange, lower edge of lower mandible black-brown, from fork of lower mandible to the tip black-brown; legs black.

Immediately under the throat a space of bare skin, the upper half of which had a slightly bluish tint, the remainder flesh-colour.

The female of this species is a fourth less than the male, with a smaller beak; the skin under the chin is black instead of coloured. The anatomical structure of this bird is singular; each muscle stands well separated from the others; and between the skin and the body is an open space, the first not adhering to the latter, as in most birds, but attached by a number of threads or ligaments. It appears possible that this vacant space can be filled with air, especially as the flight of this bird is singularly light. These peculiarities apply also to *Bucorax abyssinicus*, and, I believe, to others of the family. Contents of stomach seeds and stones of fruit and small coleoptera. Did not meet with this bird higher up than Rayrayguddy.—*W. J.*]

150. Buceros limbatus, Rüpp.

Buceros limbatus, Rüpp. Neue Wirbelth. t. 2. f. 1; *id.* Syst. Uebers. p. 79. no. 325; Heugl. Syst. Uebers. no. 460; Brehm, Habesch, p. 220. no. 107.

a. ♀. Senafé. May 25.
b. Senafé. May 25.

[Iris brown.

I only obtained two specimens of this species near Senafé, towards Rayrayguddy, and, being at the time much engaged with preparations for returning to Zoulla, had no time to make further notes. I never obtained or saw this bird afterwards in Bogos or elsewhere.—*W. J.*]

151. Tmetoceros abyssinicus (Gmel.).

Tragopan abyssinicus, Rüpp. Syst. Uebers. p. 79. no. 320; Heugl. Syst. Uebers. no. 456.
Bucorax abyssinicus, Brehm, Habesch, p. 220. no. 109.
Tmetoceros abyssinicus, Finsch & Hartl. Vögel Ostafr. p. 480. no. 259.

a. ♂. Facado. May 2 (no. 517).
b. ♀. Facado. May 2 (no. 1268).

The female has the casque more developed than the male.

Long. al.	Caud.	Culm.	Rostr. ad rict.	Long. gal.	Altit. gal.	Tars.	Dig. inter.	
19″	13″	5″ 4‴	7″ 6‴	3‴	2″ 0‴	5″ 0‴	2″ 4‴	. . ♀.
22	13½	5 10	8 6	1½	2 1	5 4	—	. . ♂.—*O. F.*

[Iris brown; eyelid horny, lashes bristles; beak black, surmounted at base by a hollow casque, which appears as though broken off, leaving the hollow part exposed; a little way down the hollow portion of the casque there is a membrane across, somewhat similar to the inside of a reed-joint; skin round the eye blue and black; under throat blue with some red, in the female the same, save the red.

I found this bird at Senafé and Facado in May; Bejook on the Anseba, July, and also saw one as low down, and near the coast, as Ain in August; I never saw them regularly in the plain. It is useless to give a description of the habits of this bird, as Antinori has already done so with great accuracy, omitting, however, the bird's note, which is very peculiar, sounding like a note from a bassoon. It is difficult to judge of the whereabouts of the bird by it, as it now sounds far, now near, as though some ventriloquist was at work. I cannot help associating the membrane in the casque with the note, though I do not know if there be any communication between the throat and the casque; a section of the head and casque, however, would decide this. I have seen this bird on trees, though seldom; it feeds principally on grubs and insects, which it digs up with its pickaxe-like beak. I rarely saw more than two together.—*W. J.*]

SCANSORES.

Fam. PSITTACIDÆ.

152. Palæornis torquatus (Bodd.).

Palæornis cubicularis, Rüpp. Syst. Uebers. p. 95. no. 335; Heugl. Syst. Uebers. no. 473.
—— *torquatus,* Heugl. Fauna d. Roth. Meer. no. 192; Brehm, Habesch, p. 220. no. 110; Finsch, Papag. ii. p. 17; Finsch & Hartl. Vögel Ostafr. p. 871. no. 457.

a. ♂. Bejook. July 14.
b. ♀. Bejook. July 15 (no. 1806).
c. ♀. Bejook. July 16 (no. 1261).
d. ♀. Bejook. July 16.

[Iris yellowish white; beak deep crimson at base, tip black.
Common on the Anseba, did not meet with it anywhere else.—*W. J.*]

153. Pionias meyeri (Rüpp.).

Psittacus meyeri, Rüpp. Atlas, t. 11; *id.* Syst. Uebers. p. 94. no. 330.
Pionus meyeri, Heugl. Syst. Uebers. no. 468; *id.* Fauna d. Roth. Meer. no. 193.
Pionias meyeri, Finsch, Papag. ii. p. 494; Finsch & Hartl. Vögel Ostafr. p. 500. no. 270.

a. Kokai. July 9 (no. 1488).
b. ♂. Kokai. July 9 (no. 560).
c. ♂. Kokai. July 10 (no. 628).
d. ♀. Kokai. July 10 (no. 518).
e. ♀. Kokai. July 11.
f. ♂. Kokai. July 11 (no. 1436).
g. ♀. Kokai. July 12 (no. 1740).
h. ♀. Waliko. July 20 (no. 1191).

[Eye brown, with an outer ring of orange-red.
Only met with by me on the Anseba.—*W. J.*]

154. Psittacula tarantæ, Stanl.

Psittacula tarantæ, Rüpp. Syst. Uebers. p. 95. no. 334; Heugl. Syst. Uebers. no. 472; *id.* Fauna des Rothen Meer. no. 195; Finsch, Papag. ii. p. 634.

a. ♂. Rayrayguddy. April 27 (no. 1329).
b. ♂. Rayrayguddy. April 15 [sex?—*W. J.*].

[Eye brown; beak rose-colour; legs and feet blackish grey.
Only seen near Senafé by me, in small flocks of from six to eight.—*W. J.*]

Fam. CAPITONIDÆ.

155. Trachyphonus margaritatus, Rüpp.

Bucco margaritatus, Rüpp. Atlas, t. 20.
Tamatia erythropyga, Hempr. & Ehrb. Symb. Phys. t. 7.
Trachyphonus margaritatus, Rüpp. Syst. Uebers. p. 95. no. 342; Heugl. Syst. Uebers. no. 483; *id.* Fauna d. Roth. Meer. no. 197; Brehm, Habesch, p. 221. no. 112; Finsch & Hartl. Vögel Ostafr. p. 506. no. 276.

a. ♂. Koomaylee. March 19 (no. 111).
b. ♀. Kokai. July 11 (no. 1364).
c. ♂. Kokai. July 12 (no. 1450).
d. ♂. Bejook. July 18 (no. 1471).
e. Waliko. July 23.
f. ♀. Rairo. August 15 (no. 1394).

[Iris brown; beak dirty red, dark at the tip; legs and feet stone-grey.
Rather plentiful. Localities: Koomaylee, March; Kokai, Bejook, Waliko, Rairo, in July and August.—*W. J.*]

156. Pogonorynchus abyssinicus (Lath.).

Bucco saltii, Stanl.
Pogonias brucei, Rüpp. Neue Wirbelth. t. 20. 1.
Laimodon brucei, Rüpp. Syst. Uebers. p. 95. no. 338; Heugl. Syst. Uebers. no. 476.
Pogonias saltii, Brehm, Habesch, p. 220. no. 111.

a. ♀. Waliko. July 23 (no. 792).
b. ♀. Gabena Weldt Gonfallon. August 4.
c. ♂. Gabena Weldt Gonfallon. August 8.
d. ♂. Gabena Weldt Gonfallon. August 7 (no. 578).
e. ♂. Gabena Weldt Gonfallon. August 7 (no. 1875).
f. ♂. Bejook. July 17 (no. 702).

[Iris brown; beak black; legs and feet black.
Common on the river Anseba.—*W. J.*]

157. Pogonorhynchus undatus (Rüpp.).

Laimodon undatus, Rüpp. Neue Wirbelth. t. 20. 2; *id.* Syst. Uebers. p. 95. no. 339; Heugl. Syst. Uebers. no. 477.

a. ♂. Rayrayguddy. May 17 (no. 675).
b. ♂. Senafé. April 4 (no. 119).
c. ♂. Kokai. August 9 (no. 1578).

Long. al.	Caud.	Culm.	Tars.
2″ 11‴	1″ 7‴	$7\frac{1}{2}$‴	8‴.

Not observed in the Bogos country by Dr. von Heuglin.

[Iris white.

Not plentiful. Localities: Senafé, April, early; Rayrayguddy, May; Kokai (Anseba), August. Seen hawking insects like a Flycatcher, returning to its perch on a dead bough.—*W. J.*]

158. Pogonorynchus melanocephalus (Rüpp.).

Pogonias melanocephalus, Rüpp. Atlas, t. 28; *id.* Syst. Uebers. p. 95. no. 336.
—— *bifrenatus*, Hempr. & Ehrb. Symb. Phys. t. 8. f. 1.
Laimodon melanocephalus, Heugl. Syst. Uebers. no. 474.
Pogonias bifrenatus, Heugl. Fauna d. Roth. Meer. no. 196.

a. ♂. Rairo. August 13 (no. 973).

[The only specimen I procured or saw during my stay in the country.—*W. J.*]

159. Megalæma pusilla (Dumont).

Megalaima pusilla, Goffin, Mus. des Pays-Bas. (1863) p. 40.
Barbatula minuta, Hartl. W. Afr. p. 173.
—— *pusilla*, Heugl. Ibis, 1861, p. 124.

a. ♂. Kokai. July 13 (no. 576).
b. Kokai.
c. Waliko. July 21 (no. 1656).

Long. al.	Caud.	Culm.	Lat. rostr. ad basin.	Tars.	
2″ $1\frac{1}{2}$‴	1″ 2‴	c. 5‴	$3\frac{1}{4}$‴	$6\frac{1}{2}$‴	Kokai.
2 0	1 1	$4\frac{1}{2}$	3	6	♀. Kokai.
2 1	1 2	c. 5	$3\frac{1}{4}$	$6\frac{1}{2}$	Waliko.
2 0	1 3	$4\frac{2}{3}$	—	6	(Heuglin).
2 4	1 3	$5\frac{1}{4}$	c. 4	7	Natal.
2 4	1 2	5	—	—	*M. pusilla* (Goffin).

Von Heuglin has already mentioned this species as obtained once in a collection of birds from the Blue Nile, and has remarked on its being smaller than the measurements given by Hartlaub. The specimens in Mr. Jesse's collection confirm this fact, inasmuch as they have the wings a little shorter, also the bill, but the latter only comparatively. In comparing Mr. Jesse's specimens with an old male in full dress from

Natal (the only southern specimen which I have) I find, although the distribution of colours is quite the same, some differences also in the coloration, the spots on the occiput and hind neck being not so decidedly sulphur-yellow as in the Natal bird, but nearly white, only washed very faintly with yellow. The chin is also of a much paler sulphur-yellow in the northern specimens, like the other under parts; the orange-yellow margins on the quills and tectrices are rather obsolete; and the yellow supercilium, so visible in the southern bird, is very slightly tinged with yellowish, and nearly white. Many persons would think these differences sufficient to constitute a new species; but I am not able to do so, having certain reasons to believe that they are only the effects of age or season. All the specimens in Mr. Jesse's collection killed in the month of July are partially moulting, getting here and there new feathers, which are as bright as the corresponding feathers in the Natal specimen: on the chin, for instance, in one specimen are some feathers not quite developed, which are of as bright a sulphur-yellow as in the one from Natal. All the old feathers are more or less rubbed; therefore the plumage is in general paler. Now every experienced ornithologist knows that similar differences in colouring according to the season occur in many of our European birds, and will not be surprised to find the same rule in African birds. The only important distinction would be the smaller size; but there must be large series to decide whether this character is permanent or not. I, at least for the present, do not venture to base a specific separation upon these characters.

M. J. Verreaux, in his Monograph of the African Barbets, is certainly wrong in giving "Nubie" as a locality for *M. pusilla*; and it may be remarked that in most cases his "Nubie" must be construed Sennahr or Abyssinia.

The Bogos country is a new locality.—*O. F.*

[Iris brown; legs and feet, toes two back and two forward.

Only observed during the Bogos journey. Localities: Kokai (Lebka), Waliko, Anseba.—*W. J.*]

Fam. PICIDÆ.

160. Picus nubicus, Gmel. (nec Licht.).

Picus æthiopicus, Hempr. & Ehrb. Symb. Phys.

Dendromus æthiopicus, Rüpp. Syst. Uebers. pp. 90 et 95. no. 346, t. 36; Heugl. Syst. Uebers. no. 487; *id.* Fauna des Roth. Meer. no. 198.

Picus nubicus, Finsch & Hartl. Vögel Ostafr. p. 509. no. 278.

a. ♂. Undel Wells. May 27 (no. 3001).
b. ♀. Undel Wells. May 27.
c. ♀. Undel Wells. May 27 (no. 3000).
d. ♀. Undel Wells.
e. ♂. Ain. July 6 (no. 1424).
f. ♂. Maragaz. July 29 (no. 1665).

g. ♂. Gabena Weldt Gonfallon. August 7 (no. 1794).
h. ♀. Bejook. July 16 (no. 1729).
i. ♂. Bejook. July 18 (no. 1751).

Long. al.	Caud.	Culm.
4″ 1‴–4″ 4‴	2″ 2‴–2″ 7‴	8½‴–10‴

The old males quite agree with the figure in Rüppell's 'Uebersicht.' Two other males, probably younger ones, have the whole upper surface of the head black, as in the female, but without white spots; the base of the feathers is of a conspicuous dark grey; in some specimens there are some red feathers on the vertex. The female has the head black, spotted with white; the nape is red; the mystacal stripe is also black. In other females the white spots on the head are much smaller.—*O. F.*

[Eye pearl-grey, in some specimens pearl-pink.

Common. Contents of stomach larvæ and eggs of insects.—*W. J.*]

161. Picus hemprichi, Ehrb.

Dendrobates hemprichii, Rüpp. Syst. Uebers. pp. 88 et 95. no. 345, t. 35 (♂); Heugl. Syst. Uebers. no. 486; *id.* Fauna d. Roth. Meer. no. 200; Brehm, Habesch, p. 221. no. 113.
Picus hemprichii, Finsch & Hartl. Vögel Ostafr. p. 514. no. 281.

a. ♀. Eylet. June 30 (no. 1968).
b. ♂. Rairo. August 13 (no. 1590).
c. ♀. Rairo. August 13 (no. 614).
d. ♀. Rairo. August 14.

Long. al.	Caud.	Culm.	Tars.	
3″	1″ 7‴	7½‴	7‴	♂.
3 –3″ 1‴	1 4 –1″ 6‴	6½ –7‴	7	♀.

The females want the red on the occiput, having this part brownish black, and have the red on the upper tail-coverts paler.—*O. F.*

[Iris dark brick-red; beak horn-colour; legs and feet grey.

Rare. Localities: Eylet, June 30; Rairo, August 13.—*W. J.*]

Fam. CUCULIDÆ.

162. Centropus monachus, Rüpp.

Centropus monachus, Rüpp. Neue Wirbelth. t. 21. f. 2 (ad.).
—— *superciliosus*, Rüpp. Neue Wirbelth. t. 21. f. 1 (jun.).
—— *monachus* et *C. superciliosus*, Rüpp. Syst. Uebers. p. 96. nos. 352, 353; Heugl. Syst. Uebers. nos. 496, 497.
—— *superciliosus*, Heugl. Fauna des Roth. Meer. no. 203; Brehm, Habesch, p. 221. no. 115.
—— *monachus*, Finsch & Hartl. Vögel Ostafr. p. 528 (note).

a. ♂. Goon Goona. May 8 (no. 141).

b. ♀. Ain. July 7 (no. 1898).
c. ♀. Between Mahaber and Kokai. July 9 (no. 919).

Long. al.	Caud.	Culm.	Tars.	
7″ 5‴	8″ 4‴	14‴	1″ 8‴	. . . . ♂.
6 0	7 6	12½	1 5	. . . . ♀.
5 9	7 4	12	1 6	. . . . ♀.

The old male agrees exactly with Rüppell's figure (t. 21. f. 2), the females with that on tab. 21. f. 1. The latter seem to be immature, for some of the quills and tail-feathers are just developing. There is much variation in size and coloration amongst specimens of this genus, and the different species are not at all settled.—*O. F.*

[Iris crimson; beak black; legs and feet black.

The only specimen I ever saw.

Centropus superciliosus is common from Ain (Lebka) to Bejook (Anseba), but difficult to shoot owing to its sneaking among dense bushes. Note singularly lugubrious. Occurs also at Eylet. Insectivorous.

All specimens procured were alike in plumage; those of Mr. Blanford as well. I think this *must* be distinct from *C. monachus*.—*W. J.*]

163. Oxylophus afer, Leach.

Oxylophus ater, Rüpp. Syst. Uebers. p. 96. no. 355.
—— *afer,* Heugl. Syst. Uebers. no. 499.
Coccystes hypopinarus, Cab. & Heine, Mus. Hein. iv. p. 47.

a. ♂. Maragaz. July 29 (no. 1977).
b. Waliko. August 2 (no. 535).
c. ♂. Gabena Weldt Gonfallon. August 7 (no. 958).
d. ♂. Gabena Weldt Gonfallon. August 7 (no. 1074).
e. ♀. Gabena Weldt Gonfallon. August 8 (no. 1550).

Long. al.	Caud.	Culm.	
6″ 4‴–6″ 9‴	7″ 9‴–8″ 5‴	9‴–10‴.	
6 9 –6 10	8 3 –8 4	10½–11	. . . . Damaraland.

The female is similar to the male. In some specimens the dark shaft-stripes on the throat are much narrower.

I cannot agree with Dr. Cabanis in separating the southern form as a distinct species, since I have compared specimens from Damaraland with Abyssinian ones. The measurements of Mr. Jesse's specimens will prove that they are as large as southern ones, and that there is a great variety in size.

Von Heuglin does not notice this species from the Bogos country.—*O. F.*

[Iris brown; legs and feet bluish grey.

This bird was procured by me in the Anseba valley, and by W. T. Blanford at Kokai. Mr. Blanford extracted the egg, which is of a greenish-blue colour. Contents of stomach apparently small coleoptera and vegetable matter.—*W. J.*]

164. Oxylophus jacobinus, Bodd.

Oxylophus serratus, Strickl. P. Z. S. 1850, p. 219; Heugl. Syst. Uebers. no. 500.
Coccystes jacobinus et *C. pica* (Hempr. & Ehrb.); Cab. & Hein. Mus. Hein. iv. pp. 45, 46.

a. ♀. Waliko. August 3 (no. 470).

Long. al.	Caud.	Culm.	Tars.		
4″ 9‴	6″ 5‴	$8\frac{1}{2}$‴	12‴	. . . . ♀.	
5 7	6 6	8	$12\frac{1}{2}$	. . . . ♂.	Keren.
5 5	5 11	$8\frac{1}{2}$	12	. . . .	Pegu.

The north-eastern specimens agree with those from the Cape and India (Pegu, Bremen Mus.).

The African one is not larger, as Dr. Cabanis suggests.—*O. F.*

[The only specimen I saw.—*W. J.*]

165. Cuculus canorus, Linn.

Cuculus canorus, Rüpp. Syst. Uebers. p. 96. no. 356; Heugl. Syst. Uebers. no. 502; *id.* Fauna des Roth. Meer. no. 205.

a. ♂. Between Massowah and Ain. August 22.
b. ♂. Between Massowah and Ain. August 22.

Both specimens, in full dress, are similar in every respect to European ones.

It may be remarked that *C. chalybæus,* Heugl. (Journ. f. Orn. 1862, p. 34), from the Abyssinian coast, is certainly the *C. clamosus,* Lath. (Levaill. t. 204). The Bremen Museum possesses one of Heuglin's typical specimens, which shows no difference from southern ones.—*O. F.*

[Mr. Blanford procured this species in Bogos in July or August. I never heard the cry of the Cuckoo.—*W. J.*]

166. Chrysococcyx cupreus (Bodd.).

Chrysococcyx auratus, Rüpp. Syst. Uebers. p. 96. no. 358; Heugl. Syst. Uebers. no. 504.
Lamprococcyx cupreus, L. chrysochlorus, et *L. chrysites,* Heine, jun., Journ. f. Orn. 1863, p. 350.

a. ♂. Bejook. July 14 (no. 565).

M. Heine, jun., is certainly mistaken in dividing this species into three geographical species. After having examined numerous specimens from the north-east, west, and south, I cannot see any reason for separating them.—*O. F.*

[Iris orange, eyelid also.

The only one I saw. Contents of stomach larvæ.—*W. J.*]

167. Indicator sparrmani, Steph.

Indicator albirostris, Temm. Pl. Col. 367 (♂).
—— *flaviscapulatus,* Rüpp. Neue Wirbelth. p. 60.
—— *archipelagicus* (Temm.!), Rüpp. Syst. Uebers. p. 96. no. 349.

Indicator archipelagicus et *I. albirostris,* Heugl. Syst. Uebers. nos. 491 et 492.
—— *pallidirostris,* Heugl. Journ. f. Orn. 1864, p. 265.

♀. Maragaz. July 27 (no. 1774).

The female differs from the old male in being above somewhat duller brown, and in wanting the black chin and throat as well as the white ear-spot; the whole under surface is dirty white, tinged faintly with pale brownish; the dark shaft-stripes on the sides are narrower than in the male; the white margins of the upper quill-coverts are wanting, the yellow on the humerus less developed; the bill brownish horn-colour, not yellowish white; otherwise the female is similar to the male.

Long. tota.	Al.	Caud.	Culm.	Tars.
c. 6″	4″ 2‴	2″ 5‴	5¼‴	7

Indicator archipelagicus, Temm., from Borneo, to which Rüppell and Heuglin refer this bird, is a very different species. I have compared specimens of Heuglin's *I. archipelagicus*, from Galabat, in the Vienna Museum, with Cape specimens of *I. sparrmani*, and could not find any permanent difference. An old male from the Bariland, in the Vienna Museum, forwarded by a Catholic missionary, has the chin and throat black and a white ear-spot, like old birds from the Cape and Senegambia (Brem. Mus.). Heuglin's *I. pallidirostris*, of which I have compared the type specimens from Wau and Bongo, is this species in a younger stage, having the black on the chin not yet developed, the ears dirty white, and the jugulum and breast tinged with yellow. The six Indicators of North-east Africa, mentioned by von Heuglin (Journ. f. Orn. 1864, p. 265), must be reduced to four—namely, *I. major*, Steph. (=*I. barianus*, Heugl. Syst. Uebers, no. 493; I have compared the type specimen in the Vienna Museum), *I. sparrmani*, Steph., *I. minor*, Steph., and *I. conirostris*, Cass. (=*pachyrhynchus*, Heugl.), the last being very probably equal to *I. minor*.—*O. F.*

[Eye pale burnt-sienna; legs and feet dark grey.

Contents of stomach fragments of insects and wax. I shot another specimen, which had guided us by its cry to honey, and paid dearly for it, or rather my naked servants did; for on trying to take the honey after killing the bird, the bees turned out to be "stingers," and I had to run away, leaving my specimen behind. One of my men was so badly stung as to be obliged to ride home. I did not meet with this bird elsewhere.—*W. J.*]

168. Indicator minor, Steph.

Le petit Indicateur, Levaill. Ois. d'Afr. t. 242.
Indicator diadematus, Rüpp. Neue Wirbelth. p. 61.
—— *minor,* Rüpp. Syst. Uebers. p. 96. no. 350; Heugl. Syst. Uebers. no. 494; *id.* Fauna des Roth. Meer. no. 202; Brehm, Habesch, p. 221. no. 114; Finsch & Hartl. Vögel Ostafr. p. 515. no. 282.

♂. Waliko. July 30 (no. 533).

The specimen agrees very well with a South-African specimen in the Bremen Museum.

Long. tota.	Al.	Caud.	Culm.	Tars.
c. 5″	3″ 4‴	2″	4‴	6‴

A very nearly allied, probably not different, species is *I. conirostris*, Cass., of which *I. pachyrhynchus*, Heugl. (Journ. f. Orn. 1864, p. 266), is merely a synonym.—*O. F.*

[This specimen was given me by Mr. W. T. Blanford. I did not myself see one. —*W. J.*]

Fam. COLUMBÆ.

169. Treron waalia (Gm.).

Vinago abyssinica, Rüpp. Syst. Uebers. p. 100. no. 360.
Geopelia humeralis (Wagl.), Heugl. Syst. Uebers. no. 510.
Treron abyssinica, Brehm, Habesch, p. 221. no. 116.
—— *waalia,* Finsch & Hartl. Vögel Ostafr. p. 533. no. 288.

a. ♀. Rayrayguddy. May 16 (no. 2004).
b. ♂. Near Senafé. May 21 (no. 610).

Long. tota.	Al.	Caud.	Culm.	Tars.	Dig. med.	
c. 11½″	6″ 8‴	3″ 7‴	7‴	11‴	12‴ . . .	♂
—	6 6	3 5	c. 7	c. 11	— . . .	♀

The female similar to the male, but the yellow on the belly lighter.—*O. F.*

[Iris blue, with an outer ring of salmon-pink; beak bluish grey, red at base; legs and feet pinkish yellow, toes blue.

Found up the pass from Undel Wells to Senafé.—*W. J.*]

170. Columba guineensis, Briss.

Columba guinea, Rüpp. Syst. Uebers. p. 100. no. 363.
Palumbus guineus, Heugl. Syst. Uebers. no. 508.
Stictœnas guinea, Brehm, Habesch, p. 222. no. 118.
Columba guineensis, Finsch & Hartl. Vögel Ostafr. p. 539. no. 291.

a. ♂. Senafé. April 15 (no. 107).
b. ♂. Kokai. July 12 (no. 1716).

[Iris white, with outer ring of light brown, fleshy skin round the eye dark crimson; legs and feet pink.

Common about Senafé in April, seen in large flocks on the cultivated lands; other localities, Gelamet and Kokai, July.—*W. J.*]

171. Columba albitorques, Rüpp.

Columba albitorques, Rüpp. Neue Wirbelth. t. 22. f. 1; *id.* Syst. Uebers. p. 100. no. 364.
Palumbus albitorques, Heugl. Syst. Uebers. no. 509.

a. ♀. Senafé. May 24 (no. 694).

[Iris brown; legs and feet red.

Plentiful down from Senafé to Rayrayguddy.—*W. J.*]

172. Columba lugens, Rüpp.

Columba lugens, Rüpp. Neue Wirbelth. t. 22. f. 2.
Turtur lugens, Rupp. Syst. Uebers. p. 100. no. 368; Heugl. Syst. Uebers. no. 516.

a. Taconda Pass. April 24 (no. 199).

[Iris salmon-pink, skin round eye crimson; legs and feet pink. No further notes.—*W. J.*]

173. Turtur albiventris, Gray.

Turtur semitorquatus, Sws. (*nec* Rüpp.).
—— *risorius,* Rüpp. Syst. Uebers. p. 100. no. 366; Heugl. Syst. Uebers. no. 513; Brehm, Habesch, p. 222. no. 121; Finsch & Hartl. Vögel Ostafr. p. 546. no. 294.

a. ♂. Koomaylee. June 3.
b. ♀. Koomaylee. June 3.
c. ♀. Koomaylee. June 3.

Long. al.	Caud.	Culm.	Tars.	
5″ 8‴	3″ 7‴	7‴	9‴ . . .	♂.
5 7	3 4	c. 7	9 . . .	♂.
5 5	3 2	$6\frac{1}{4}$	9 . . .	♀.

I take the specimens in Mr. Jesse's collection for the above-named species, although they seem to differ a little from western specimens. *T. capicola,* Sund., from South Africa differs in being generally somewhat darker, especially on the under quill-coverts, which are more grey than greyish white. In *T. albiventris* the head also wants the ashy tint, and is of a delicate vinaceous like the breast. The north-eastern specimens resemble, therefore, in every respect Levaillant's "*Tourterelle blonde à collier*" (tab. 268), which Bonaparte refers to the Indian *T. risorius*—the latter species being, however, quite different in having the crissum and under tail-coverts ashy instead of white.

The African species of the genus *Turtur* are not at all well understood, and the distinction of them is difficult. They vary considerably in the intensity of the colouring in different localities; but without having large series one is unable to say whether these differences are specific or not. The slight differences of the North-eastern examples of this bird I have mentioned already. In specimens of it from Damaraland the vinaceous colour of the belly is washed with a delicate grey, the top of the head is pale ashy, like the under wing-coverts[1].

There is also an individual variation from age and season. The female has the rump almost brown like the back, the same as the upper quill-coverts, which show only a few greyish margins; whereas in the male the rump is ashy, mixed with brownish feathers, the same as the quill-coverts.—*O. F.*

Common in the plains, and up the pass as far as Sooroon. In June seen in large flocks.—*W. J.*]

[1] This is our *T. damarensis,* Finsch & Hartl. Vögel Ostafr. p. 550.

174. TURTUR SENEGALENSIS (Linn.).

Turtur senegalensis, Rüpp. Syst. Uebers. p. 100. no. 367; Heugl. Syst. Uebers. no. 515; *id.* Fauna d. Rothen Meer. no. 209; Brehm, Habesch, p. 222. no. 119; Finsch & Hartl. Vögel Ostafr. p. 551. no. 296.

a. ♂. Koomaylee. June 6.

Domesticated along the shores of the Red Sea (Heuglin) (W., E., S.).—*O. F.*

[Common in March and April at Koomaylee; in June, July, and August they had moved further up the hills.—*W. J.*]

175. CHALCOPELIA AFRA (L.)

Peristera chalcospilos, Wagl.; Rüpp. Syst. Uebers. pp. 98 et 100. no. 372, t. 38; Heugl. Syst. Uebers. no. 511.

Chalcopelia afra, Heugl. Fauna des Rothen Meer. no. 211; Brehm, Habesch, p. 222. no. 122; Finsch & Hartl. Vögel Ostafr. p. 254. no. 297.

a. ♂. Ain. August 16 (no. 74).
b. ♂. Mohaber. July 8 (no. 812).
c. ♀. Between Gelamet and Kokai. August 10 (no. 32).
d. ♂. Kokai. August 10 (no. 34).
e. ♀. Maragaz. July 28 (no. 817).
f. ♀. Waliko. August 2 (no. 1798).

Long. al.	Caud.
3″ 11‴–4″ 4‴	3″ 7‴–3″ 11‴

The females have the spots on the tertiaries of a brilliant amethyst-blue; in the males they are of the same colour, but change on the outer margins into metallic green.

The specific distinctness of this bird from the South-African *Ch. chalcospilos,* which differs only in having metallic-green wing-spots, is not at all certain.—*O. F.*

[Iris brown; legs and feet pink.

Localities: Anseba Valley to Ain and Eylet; at this latter place they were plentiful. —*W. J.*]

176. ŒNA CAPENSIS (Linn.).

Œna capensis, Rüpp. Syst. Uebers. p. 100. no. 371.

Ectopistes capensis, Heugl. Syst. Uebers. no. 519.

Œna capensis, Heugl. Fauna d. Roth. Meer. no. 212; Brehm, Habesch, p. 222. no. 123; Finsch & Hartl. Vögel Ostafr. p. 257. no. 298.

a. ♂. Koomaylee. June 3.
b. ♂. Koomaylee. June 4.
c. ♂. Koomaylee. June 4.
d. ♀. Koomaylee. June 4.
e. ♀. Ain. August 16 (no. 2).

[Legs and feet dark purple.

At Koomaylee, on the plains, I saw very few in March and April; by the end of June they were to be found in great numbers.—*W. J.*]

GALLINÆ.

Fam. PTEROCLIDÆ.

177. Pterocles exustus, Temm.

Pterocles exustus, Rüpp. Syst. Uebers. p. 106. no. 384; Heugl. Syst. Uebers. no. 537; *id.* Fauna d. Rothen Meer. no. 222.
—— *senegalensis,* Licht. (*nec* Sws.).

a. ♀. Mai Wallet. August 18.

The specimen agrees very well with the figure in the Pl. Col. 360.—*O. F.*

[The only specimen procured by me.—*W. J.*]

178. Pterocles lichtensteini, Temm.

Pterocles lichtensteini, Finsch & Hartl. Vögel Ostafr. p. 563; Rüpp. Syst. Uebers. p. 106. no. 387: Heugl. Syst. Uebers. no. 539; *id.* Fauna d. Roth. Meer. no. 224.
—— *quadricinctus,* Brehm, Habesch, p. 223. no. 130.

a. ♀. Koomaylee. June 3.
b. ♂. Sahati. June 23 (no. 139).
c. ♂. River Amba. August 19.
d. ♀. River Amba. August 19.
e. River Amba. August 19.
f. ♂. River Amba. August 19.

[Skin round the eye chrome-yellow; legs and feet chrome-yellow.

Very plentiful from the shore to the lower range of hills at Koomaylee, also Sahati, Eylet, and Amba.—*W. J.*]

Fam. MELEAGRIDÆ.

179. Numida ptiloryncha, Licht.

Numida ptiloryncha, Rüpp. Syst. Uebers. pp. 102 et 105. no. 373, t. 39; Heugl. Syst. Uebers. no. 520; *id.* Fauna d. Rothen Meer. no. 213; Brehm, Habesch, p. 222. no. 124; Finsch & Hartl. Vögel Ostafr. p. 570. no. 304.

a. ♀. Koomaylee. April 22 (no. 115).
b. Senafé. May.
c. Senafé. May.
d. ♂. Araflé. June 6.

The female is similar to the male; it has also the horny appendices on the base of the bill. Dr. Brehm affirms that they are wanting in the female.—*O. F.*

[Alluding to Dr. Brehm's assertion that the female does not possess the horny excrescences, I can state that on several occasions I opened birds havings eggs so far advanced that I had them beaten up and fried; these birds all had the excrescences, but in some cases smaller than in others. I shot this bird on the plains and among the rocks of Senafé, and also literally on the sands of the bay at ebb tide. I am sorry now that I did not examine the stomachs of those shot on the shore.—*W. J.*]

Fam. TETRAONIDÆ.

180. Francolinus rubricollis, Rüpp. (*nec* Lath.).

Francolinus rubricollis, Rüpp. Atlas, t. 30.
Pternistes rubricollis, Rüpp. p. 106. no. 382; Heugl. Syst. Uebers. no. 531; *id.* Fauna d. Roth. Meer. no. 216; Brehm, Habesch, p. 223. no. 128.
Francolinus rubricollis, Finsch & Hartl. Vögel Ostafr. p. 576. no. 308.
—— *leucoscepus*, G. R. Gray.

a. ♂. Koomaylee. June 4.
b. ♀. Koomaylee. June 4.
c. ♂. Sahati. June 23 (no. 458).
d. ♀. Sahati. June 23 (no. 1231).
e. ♂. Between Rairo and Monbar Harratt-b'. August 14.
f. ♂. Rairo. August 14 (no. 904).

[Iris brown; skin under throat orange-red; throat chrome-yellow; legs and feet brown.

This species does not go far into the hills.—*W. J.*]

181. Francolinus rueppelli, Gray.

Perdix clappertoni, Rüpp. Atlas, t. 9.
Francolinus rüppelli, G. R. Gray; Rüpp. Syst. Uebers. p. 106. no. 379; Heugl. Syst. Uebers. no. 527; Brehm, Habesch, p. 223. no. 126.

a. ♂. Senafé. May 15 (no. 1168).
b. ♀. Senafé. May 15 (no. 1168).
c. ♀. Kokai. July 11 (no. 1292).
d. ♀. Bejook. July 16 (no. 1697).
e. ♀. Maragaz. July 30 (no. 1654).
f. ♂. Waliko. July 23 (no. 1810).
g. ♂. Waliko. July 24 (no. 1220).
h. ♀. Waliko. July 24 (no. 1834).
i. ♂. Waliko. July 24 (no. 1891).
k. ♂. Waliko. August 3 (no. 1121).
l. ♀. Waliko. August 4 (no. 1240).
m. ♂. Waliko. August 4 (no. 1201).

Differs from the nearly allied *Fr. clappertoni*, Gray, in the markings of the feathers on the jugulum and breast. These are in this species brown, paler on the centre, with a narrow whitish margin, which is separated internally by a blackish arrow-shaped line running parallel with the exterior margin; whereas in *Fr. clappertoni* the whitish outer margin is much broader, leaving a much narrower dark brown centre. All the specimens in Mr. Jesse's collection show these peculiarities.—*O. F.*

[Iris brown; skin round eye bright scarlet; legs and feet black in front and scarlet behind, soles of feet scarlet.

Localities: Senafé, Kokai, and the Anseba valley, nowhere else; its cry is a screech like that of the Barn-Owl at times. Obtained from May to August.—*W. J.*]

182. Francolinus erkelii, Rüpp.

Francolinus erkelii, Rüpp. Neue Wirbelth. t. 6; *id.* Syst. Uebers. p. 106. no. 378; Heugl. Syst. Uebers. no. 526; *id.* Fauna des Roth. Meer. no. 215; Brehm, Habesch, p. 223. no. 125.

a. ♀. Senafé. April 15 (no. 150).
b. ♀. Senafé. May (no. 116).
c. ♂. Maragaz. July 30 (no. 1814).

[Iris brown; beak black with white tip; legs and feet stone-grey.

A strictly highland species. Localities: Undel Wells, Senafé, and Anseba valley. Cry of the male very like that of the Common Pheasant.—*W. J.*]

183. Francolinus gutturalis, Rüpp.

Francolinus gutturalis, Rüpp. Syst. Uebers. pp. 103 et 106. no. 380, t. 40; Heugl. Syst. Uebers. no. 529; *id.* Fauna d. Rothen Meer. no. 214; Brehm, Habesch, p. 223. no. 127; Finsch & Hartl. Vögel Ostafr. p. 584. no. 313.

a. ♀. Senafé. April 27 (no. 404).
b. ♂. Senafé.
c. ♂. Senafé. May (no. 130).
d. ♀. Senafé. May.
e. Senafé. May (no. 432).
f. ♂. Bejook. July 13 (no. 1159).
g. ♂. Bejook. July 13 (no. 1717).

[Iris brown; legs and feet yellowish-grey.

A highland form. Localities: Senafé and Anseba valley. Cry resembling that of the Grey Partridge (*Perdix cinerea*) of England.

All the Francolins vary much in quality for the table, sometimes being too nauseous to be eaten: when this is the case I have found that they have been feeding on insects.

Among the Francolins the male is heavier than the female.—*W. J.*]

GRALLATORES.

Fam. OTIDÆ.

184. Otis arabs, Linn.

Otis arabs, Rüpp. Atlas, tab. 16, *id.* Syst. Uebers. p. 110. t. 391.
Eupodotis arabs, Heugl. Syst. Uebers. no. 551; *id.* Fauna des Roth. Meer. no. 226; Brehm, Habesch, p. 224. no. 132.

a. ♀. Azoos. July 2 (no. 664).
b. ♂. Ain. July 5 (no. 1053).

Long. al.	Caud.	Culm.	Rostr. a rict.	Tars.	Dig. med.	
22½″	12″	3″ 0‴	4″ 1‴	6″ 4‴	2″ 2‴	. . . ♂.
18½	8½	2 9	3 7	6 2	2 1	. . . ♂.

The female is smaller in size, but in colour similar, except as regards the dark markings on the tail-feathers, which are less decided, and on some feathers restricted to the outer web.—*O. F.*

[Iris yellowish stone-colour; beak pale horn-colour; legs and feet whitish yellow.

Localities: Ain, Azoos, Koomaylee, and Zoulla. I also saw its tracks between Gelamet and Rairo. The male is much larger than the female. I found them either in pairs or solitary.—*W. J.*]

Fam. CHARADRIIDÆ.

185. Œdicnemus crepitans, L.

Œdicnemus crepitans, Rüpp. Syst. Uebers. p. 116. no. 395; Heugl. Syst. Uebers. no. 553; *id.* Fauna des Rothen Meer. no. 229; Finsch & Hartl. Vögel Ostafr. p. 619. no. 325.

a. ♀. Zoulla. March 11 (no. 171).
b. ♂. River Amba. August 21.
c. River Amba. August 21.

[Iris bright lemon-colour; beak yellow at base, tipped with black; legs and feet greenish yellow.

Localities: Zoulla and Amba.—*W. J.*]

186. Œdicnemus affinis, Rüpp.

Œdicnemus affinis, Rüpp. Syst. Uebers. pp. 111 et 117. no. 396, t. 42; Heugl. Syst. Uebers. no. 554; *id.* Fauna des Rothen Meer. no. 230; Brehm, Habesch, p. 224. no. 133; Finsch & Hartl. Vögel Ostafr. p. 626. no. 328.

a. ♂. Gabena Weldt Gonfallon. August 6 (no. 667).

[Iris brown; beak halfway from base chrome-yellow, rest black; legs and feet chrome-yellow.

These notes of iris and legs will be found to disagree with Rüppell's description; so I can only suppose mine to have been taken from a young bird. I only saw this one specimen.—*W. J.*]

187. Dromas ardeola, Paykull.

Dromas ardeola, Rüpp. Syst. Uebers. p. 121. no. 439; Heugl. Syst. Uebers. no. 624; *id.* Fauna d. Roth. Meer. no. 261; Finsch & Hartl. Vögel Ostafr. p. 627. no. 329.

a. ♀. Suakin. September 1.

b. ♂. juv. Suakin. September 1.

[Iris nearly black.

I procured three specimens at Suakin, one a young bird: of one of these I made a skeleton. At Zoulla, in March, I shot eight; but they were, unfortunately, all spoiled. I observed this bird at Zoulla in June, but not so numerous, also at Massowah.—*W. J.*]

188. Cursorius chalcopterus, Temm.

Cursorius chalcopterus, Heugl. Syst. Uebers. no. 557.

—— *superciliosus,* Heugl. Journ. f. Orn. 1865, p. 98; Finsch & Hartl. Vögel Ostafr. p. 629. no. 330.

a. ♂. Waliko. August 2 (no. 1090).

Von Heuglin's *C. superciliosus,* of which I have examined the type specimen, is this species in immature plumage. Similar specimens from Damaraland I have seen in the collection of the late Mr. Andersson.—*O. F.*

[Iris brown; beak black, gape and base of lower mandible coral-colour; legs and feet pink.

The only specimen I ever saw.—*W. J.*]

189. Glareola pratincola, L.

Glareola pratincola et *G. limbata,* Rüpp. Syst. Uebers. p. 113 et 117. no. 400 et 401, t. 43; Heugl. Syst. Uebers. no. 560 et 561; *id.* Fauna d. Roth. Meer. no. 233 et 233; Finsch & Hartl. Vögel Ostafr. p. 630. no. 331.

a. ♀. Gabena Weldt Gonfallon. August 7 (no. 1585).

Distributed over the whole of Africa. *Gl. limbata,* Rüpp., is not separable from the European bird.—*O. F.*

[Iris brown; beak black; legs and feet pinkish-brown.

The only specimen I procured; Mr. Blanford procured two at Rairo. I never saw this species on the plains or along the shore.—*W. J.*]

190. Hoplopterus spinosus, Linn.

Hoplopterus spinosus, Rüpp. Syst. Uebers. p. 117. no. 407; Heugl. Syst. Uebers. no. 572; Brehm, Habesch, p. 224. no. 134.

a. ♀. River Amba. August 21.

[Beak black; legs and feet black.

The only specimen I saw.—*W. J.*]

191. Sarciophorus pileatus (L.).

Sarciophorus pileatus, Rüpp. Syst. Uebers. p. 118. no. 408; Heugl. Syst. Uebers. no. 572; *id.* Fauna des Roth. Meer. no. 235; Brehm, Habesch, p. 224. no. 135.

a. ♂. Koomaylee Plain. June 4.
b. ♀. Eylet. June 25 (no. 493).
c. ♀. Eylet. June 25 (no. 1224).

[Iris yellow; beak, base rose-colour, tip black, two red wattles at base of upper mandible; legs and feet purple-pink.

Localities: Eylet and Koomaylee.—*W. J.*]

192. Lobivanellus albicapillus, Vieill.

Lobivanellas senegalensis, Rüpp. Syst. Uebers. p. 117. no. 406; Heugl. Syst. Uebers. no. 569.
Lobivanellus albicapillus, Finsch & Hartl. Vögel Ostafr. p. 642. no. 338.

a. ♀. Kokai. August 10 (no. 67).
b. ♂. Gabena Weldt Gonfallon. August 6 (no. 471).
c. ♀. Gabena Weldt Gonfallon. August 6 (no. 1616).

[Iris pale grey, verging on white on the outer edge; beak yellow at the tip, upper mandible black, top lobe of wattle dirty crimson, lower lobe chrome-yellow; legs and feet chrome-yellow.

I only observed this species on the Anseba and at Kokai.—*W. J.*]

193. Charadrius fluviatilis, Bechst.

Hiaticula minor, Rüpp. Syst. Uebers. p. 118. no. 413.
Ægialites minor et *Æ. auritus,* Heugl. Syst. Uebers. nos. 578 et 579.
—— *minor,* Heugl. Fauna d. Roth. Meer. no. 238.
Charadrius fluviatilis, Finsch & Hartl. Vögel Ostafr. p. 659. no. 347.

a. ♂. River Amba. August 21.

[Not obtained elsewhere.—*W. J.*]

194. Charadrius tricollaris, Vieill.

Charadrius bitorquatus, Licht.
Hiaticula indica, Rüpp. Syst. Uebers. p. 118. no. 412.
Ægialites indicus et *Æ. cinereicollis,* Heugl. Syst. Uebers. nos. 581 et 582.
—— *cinereicollis,* Heugl. Fauna des Roth. Meer. no. 242.
Charadrius tricollaris, Finsch & Hartl. Vögel Ostafr. p. 655. no. 345.

a. ♂. Eylet. June 26 (no. 1827).
b. ♀. Eylet. June 26 (no. 1853).
c. ♂. Eylet. June 29 (no. 1854).

The specimens agree with South-African specimens from the Cape and Damaraland. Heuglin's *Æ. cinereicollis,* of which I have compared the typical specimen, is not different.—*O. F.*

[Iris stone-grey, eyelid orange; beak orange at base, black at tip; legs and feet pale pink.

Not observed elsewhere.—*W. J.*]

195. Charadrius geoffroyi, Wagl.

Charadrius geoffroyi, Wagl. Syst. Av.; Finsch & Hartl. Vögel Ostafr. p. 648. no. 341.
Hiaticula geoffroyi, Rüpp. Syst. Uebers. p. 118. no. 415.
Ægialites geoffroyi, Heugl. Syst. Uebers. no. 583; *id.* Fauna des Roth. Meer. no. 243.
—— *columbinus,* Hempr. & Ehrb. no. 241.

a. ♂. Zoulla. March 12 (no. 138).
b. ♂. Massuah. June 24.
c. ♂. Massuah. August 24.
d. Massuah. August 24.

[Iris brown, nearly black; beak black; legs and feet black.

Localities: Zoulla, March; Massuah, June and August.—*W. J.*]

196. Charadrius pecuarius, Temm.

Hiaticula pecuaria, Rüpp. Syst. Uebers. p. 118. no. 414.
Ægialites longipes et *pecuarius,* Heugl. Syst. Uebers. nos. 584, 585.

♂. Zoulla. June 3.

Long. al.	Caud.	Culm.	Tars.
3″ 11‴	1″ 7‴	$6\frac{1}{2}$‴	$12\frac{1}{2}$‴

Agrees very well with specimens from Damaraland.

Dr. Rüppell notices this species only from Egypt; it seems not to have been observed on the Red Sea—*O. F.*

[The only specimen procured; seen in small flocks of four or five.—*W. J.*]

Fam. ARDEIDÆ.

197. Ardea gularis, Bosc.

Ardea schistacea, Hempr. & Ehrb. Symb. Phys. t. vi.
Egretta gularis, Rüpp. Syst. Uebers. p. 121. no. 428 *a.*
—— *schistacea* et *A. ardesiaca,* Heugl. Syst. Uebers. nos. 603 et 606.
Herodias schistacea, Brehm, Habesch, p. 225. no. 142; Finsch & Hartl. Vögel Ostafr. p. 691. no. 364.

a. ♀. Massuah. August 24.

[Not uncommon about the coast.—*W. J.*]

198. Ardea atricapilla, Afz.

Buphus griseus, Heugl. Syst. Uebers. no. 611.
Butorides atricapillus, Heugl. Fauna des Roth. Meer. no. 254.
Ardea atricapilla, Finsch & Hartl. Vögel Ostafr. p. 701. no. 368.

a. ♀. Massuah. August 24.

b. Massuah. August 24.
c. ♀. Ain. August 16 (no. 83).

[Iris lemon-yellow; legs and feet greenish yellow.

I procured two immature birds at Massuah.—*W. J.*]

Fam. CICONIIDÆ.

199. Ciconia abdimii, Licht.

Sphenorhynchus abdimii, Hempr. & Ehrb. Symb. Phys. t. v; Rüpp. Atlas. t. 8; *id.* Syst. Uebers. p. 122. no. 443; Heugl. Syst. Uebers. no. 628; Brehm, Habesch, p. 226. no. 145; Finsch & Hartl. Vögel Ostafr. p. 721. no. 377.

a. ♀. Undel Wells. April 7 (no. 418).
b. ♂. Senafé. May 8 (no. 1933).
c. Bejook. July 29.

[Iris brown; beak dirty green, tip red; a fleshy skin round base of beak, eye, cheek, ear, and chin flesh-colour, on the forehead and round the eye in front crimson; rest of the skin blue, except the chin, which is crimson: skin of the neck red; legs dirty white, knees and feet dirty red, skin under the wing-bone pink; tongue very short.

Contents of stomach beetles. At Koomaylee these birds (a small flock of five or six) frequented the carrion carcasses, possibly with a view to feed on the maggots, with which the road even was *alive.*—*W. J.*]

Fam. TANTALIDÆ.

200. Scopus umbretta, L.

Scopus umbretta, Rüpp. Syst. Uebers. p. 121. no. 435; Heugl. Syst. Uebers. no. 618; *id.* Fauna des Roth. Meer. no. 262; Brehm, Habesch, p. 226. no. 146; Finsch & Hartl. Vögel Ostafr. p. 727. no. 328.

a. ♂. Senafé. April 17 (no. 852).
b. ♂. Taconda. April 21 (no. 430).
c. ♀. Kooseret. July 2 (no. 767).
d. ♂. Ain. July 6 (no. 1698).

[Iris brown; beak black; legs and feet black.

Localities: Senafé, April; Taconda, April; Ain and Kooseret, July. Contents of stomach larvæ of water-insects.—*W. J.*]

201. Ibis carunculata, Rüpp.

Ibis carunculata, Rüpp. Neue Wirbelth. t. 19. f. 1; *id.* Syst. Uebers. p. 122. no. 448; Heugl. Syst. Uebers. no. 634; *id.* Fauna des Roth. Meer. no. 265.

a. ♂. Senafé. April 23 (no. 453).

b. Facado. May 2.
c. Facado. May 2.

Localities: Senafé, Goongoona, and Facado. Feeds on the insects found in cow-dung.—*W. J.*]

Fam. SCOLOPACIDÆ.

202. Numenius phæopus (Lath.).

Numenius phæopus, Rüpp. Syst. Uebers. p. 125. no. 453; Heugl. Syst. Uebers. no. 640; Finsch & Hartl. Vögel Ostafr. p. 739. no. 388.

a. ♀. Massuah. August 24.

[Not uncommon on the coast.—*W. J.*]

203. Totanus calidris, Bechst.

Totanus calidris, Rüpp. Syst. Uebers. p. 126. no. 459; Heugl. Syst. Uebers. no. 644; *id.* Fauna des Roth. Meer. no. 270; Brehm, Habesch, p. 227. no. 151.

a. ♂. Zoulla. March 12 (no. 126).
b. ♂. Zoulla. March 12 (no. 112).
c. ♀. Massuah. August 24.

[Common, in pairs generally. Note the same as in England.—*W. J.*]

204. Totanus ochropus (Linn.).

Totanus ochropus, Rüpp. Syst. Uebers. no. 126. no. 460; Heugl. Syst. Uebers. no. 646; *id.* Fauna des Roth. Meer. no. 271; Brehm, Habesch, p. 227. no. 152.

a. Zoulla. June 6 (no. 173).
b. ♂. Senafé. April 15 (no. 1817).

[Distributed from the plains to the highlands of Tigré and Bogos.—*W. J.*]

205. Totanus stagnatilis, Bechst.

Totanus stagnatilis, Rüpp. Syst. Uebers. p. 126. no. 456; Heugl. Syst. Uebers. no. 643.

a. ♀. Zoulla. March 13 (no. 113).

[Eye black; beak black; legs and feet pale greenish stone-colour.
The only specimen procured.—*W. J.*]

206. Actitis hypoleucos (Linn.).

Actitis hypoleucos, Rüpp. Syst. Uebers. p. 126. no. 458; Heugl. Syst. Uebers. no. 647; *id.* Fauna des Roth. Meer. no. 272; Brehm, Habesch, p. 227. no. 153; Finsch & Hartl. Vögel Ostafr. p. 752. no. 393.

a. ♂. Senafé. April 15 (no. 419).
b. ♀. Ain. August 17.

c. ♀. Ain. August 17 (no. 88).
d. Ain. August 17 (no. 39).
e. ♂. Maragaz. July 27 (no. 496).
f. ♀. Waliko. July 23 (no. 637).

[Well distributed from the plains to the highlands of Tigré and Bogos.—*W. J.*]

207. Himantopus autumnalis (Hasselqu.).

Himantopus vulgaris, Rüpp. Syst. Uebers. p. 126, no. 462; Heugl. Syst. Uebers. no. 656.
Himantopus autumnalis, Finsch & Hartl. Vögel Ostafr. p. 758.

a. ♀. Senafé. April 27 (no. 433).

Not noticed from Abyssinia by Dr. Rüppell and von Heuglin; the latter says, goes as far to the south as Cordofahn.—*O. F.*

[Iris dark brown; beak black; legs and feet red.

The only specimen which came under my notice.—*W. J.*]

Fam. RALLIDÆ.

208. Rallus rougeti, Guér.

Rallus rougeti, Guérin, Rev. Zool. 1844, p. 322.
—— *abyssinicus,* Rüpp. Syst. Uebers. p. 127. no. 478, t. 46; Heugl. Syst. Uebers. no. 670.

a. ♀. Lake Ashangi. May.

[Given me by Mr. W. T. Blanford; killed by him at Lake Ashangi.—*W. J.*]

209. Gallinula chloropus (Linn.).

Gallinula chloropus, Rüpp. Syst. Uebers. p. 128. no. 479; Heugl. Syst. Uebers. no. 671; *id.* Fauna des Roth. Meer. no. 281; Finsch & Hartl. Vögel Ostafr. p. 787. no. 408.

a. ♂. Senafé. May (no. 1556).

Von Heuglin had already noticed this species from Abyssinia.—*O. F.*

[Iris brown.

I shot one other specimen at Goongoona: in no. 1556 the wing had a *very* small spur. Did not see this bird elsewhere.—*W. J.*]

NATATORES.

Fam. ANATIDÆ.

210. Chenalopex ægyptiaca (Linn.).

Chenalopex ægyptiaca, Rüpp. Syst. Uebers. p. 137. no. 487; Heugl. Syst. Uebers. no. 682; *id.* Fauna des Roth. Meer. no. 285; Brehm, Habesch, p. 228. no. 159; Finsch & Hartl. Vögel Ostafr. p. 803. no. 415.

a. ♂. Maragaz. July 28 (no. 705).
b. ♀. Maragaz. July 28.
c. ♂. Waliko. July 25 (no. 699).
d. Waliko. July 25.

Long. al.	Caud.	Culm.	Tars.	Dig. med.	
15″–15½″	4½″ 5‴	22‴–23‴	3″ 4‴	2″ 6‴–2″ 9‴	. . . . ♂.
14	4 4	—	3 0	2 6	. . . . ♀.

The female is similar to the males, but has the chestnut patch of feathers on the breast less developed.—*O. F.*

[Iris reddish yellow; legs pink, toes black.

Common in flocks on Goore plain, near Senafé. One female shot on the Anseba, 28th July, had a completely formed egg inside, which I unfortunately broke. These birds were then in pairs along the river-side.—*W. J.*]

211. Rhynchaspis clypeata (Linn.).

Spatula clypeata, Rüpp. Syst. Uebers. p. 138. no. 496.
Rhynchaspis clypeata, Heugl. Syst. Uebers. no. 699.
Spatula clypeata, Heugl. Fauna d. Roth. Meer. no. 289.

a. ♂. Senafé. April 12 (no. 462).
b. ♀. Senafé. April 12 (no. 500).

Von Heuglin notices this Duck as a permanent inhabitant of Abyssinia.—*O. F.*

[Iris yellow; beak dirty green; female, beak lighter, under mandible red; legs and feet orange.

I only saw one small flock at Senafé, none elsewhere.—*W. J.*]

Fam. COLYMBIDÆ.

212. Podiceps minor, Lath.

Podiceps minor, Rüpp. Syst. Uebers. p. 138. no. 502; Heugl. Syst. Uebers. no. 709; *id.* Fauna d. Roth. Meer. no. 292; Finsch & Hartl. Vögel Ostafr. p. 811. no. 421.

a. ♂. Senafé. April 13 (no. 415).

Long. al.	Caud.	Tars.	Dig. ext.
3″ 10‴	9‴	15‴	18‴.

A full-dressed female, with the sides of the head and the neck chestnut, the same as in European specimens. Drs. Hemprich & Ehrenberg collected this very widely distributed species in Arabia..—*O. F.*

[The only specimen I saw.—*W. J.*]

Fam. LARIDÆ.

213. Larus leucophæus, Licht.

Larus leucophæus, Heugl. Fauna des Roth. Meer. no. 298; Finsch & Hartl. Vögel Ostafr. p. 818. no. 426.

a. Zoulla. June 8.

Long. al.	Caud.	Culm.	Rost. a rict.	Tars.	Tib.	Dig. med.
16″ 8‴	6″ 4‴	2″ 3‴	3″ 3‴	2″ 7‴	1″ 5‴	2″ 1″.

The whole plumage rubbed and faded, therefore the colours ill defined; the white apical spot on the primaries worn off; tail-feathers white, on the apical half blackish brown. Whether this species is really specifically different from *L. argentatus* I am not able to say.—*O. F.*

[The only specimen procured.—*W. J.*]

214. Larus leucophthalmus, Licht.

Larus leucophthalmus, Rüpp. Syst. Uebers. p. 139. no. 507; Heugl. Syst. Uebers. no. 720; *id.* Fauna des Rothen Meer. no. 300; Brehm, Habesch, p. 228. no. 161; Finsch & Hartl. Vögel Ostafr. p. 821. no. 428.

a. Zoulla. June 7.
b. ♀. Zoulla. June 8.
c. ♀. Zoulla. June 8.
d. ♀. Zoulla. June 8.
e. ♀. Zoulla. June 8.
f. ♀. Zoulla. June 8.
g. Zoulla. June 8.
h. Zoulla. June 13.
i. Zoulla. June 13.

Long. al.	Caud.	Culm.	Tars.	Tib.	Dig. med.
11″–12″	4″–4″ 6‴	20‴–22‴	19‴–23‴	10‴–11‴	16‴–18‴.

The coloration of the tail varies from black to white; the bill from dark red to black; the extension of the black on the head and throat varies also very much.—*O. F.*

[Iris brown; beak dark crimson, tip black, extreme point white; legs and feet chrome-yellow.

Out of nine specimens I have five females noted; the sex of the remainder is not noted.—*W. J.*]

215. Larus hemprichii, Bp. (Plate XXVII.)

Larus hemprichii, Heugl. Fauna des Roth. Meer. no. 299; Brehm, Habesch, p. 228. no. 160; Finsch & Hartl. Vögel Ostafr. p. 823. no. 429.

a. ♀. Zoulla. March 18 (no. 132).
b. Zoulla. June 8.
c. Zoulla. June 8.

Long. al.	Caud.	Culm.	Rostr. a rict.	Tars.	Tib.	Dig. med.
11″ 10‴–13″	4″ 4‴–4″ 10‴	20‴–23‴	25‴–30″	24‴–25‴	10‴–15‴	17‴–19‴.—*O. F.*

[Iris dark brown; beak greenish-yellow at base, including the nostril, to within a quarter of an inch of the end black, tip orange, dying away to greenish-yellow at the extreme point; legs and feet dirty greenish-yellow.

Obtained in March and June.—*W. J.*]

216. Sterna media, Horsf.

Sterna affinis, Rüpp. (*nec* Horsf.) Atlas, t. 14; *id.* Syst. Uebers. p. 139. no. 518; Heugl. Syst. Uebers. no. 740; *id.* Fauna des Rothen Meer. no. 309; Brehm, Habesch, p. 229. no. 165.
—— *media,* Finsch & Hartl. Vögel Ostafr. p. 830. no. 433.

a. ♂. Zoulla. June 7.
b. ♂. Zoulla. June 7.
c–f. Zoulla. June 7.
g. Zoulla. June 8.
h. Zoulla. June 13.

Long. al.	Culm.
10″ 5‴–10″ 11‴	21″–25‴

The specimens *h* and *a* agree with the figure given in Dr. Rüppell's Atlas; other specimens have the front white, the vertex white with black shaft-stripes, the occiput and nape black; another specimen (*g*) has the front and forehead white mixed with black.—*O. F.*

[Iris almost black; beak orange; legs and feet black.

A series procured of mature and immature birds.—*W. J.*]

217. Sterna macroptera, Blasius.

Sterna macroptera, Blasius, Journ. f. Orn. 1866, p. 76.
—— *senegalensis,* Schleg. Mus. P. B. Sternæ, p. 16.
—— *dougalli,* Layard, B. S. Afr. p. 369.

a. Zoulla. August 17.

Long. al.	Rectr. ext.	Rectr. intern.	Culm.	Tars.	Dig. med.	
9″ 0‴	4″ 5‴	2″ 4‴	16‴	9″	$7\frac{1}{2}$‴	
8 10	5 0	2 8	15	9	8	. . . Table Bay.

The specimen agrees exactly with the description of Professor Blasius, who had an example from the Cape in the so-called winter dress, having only the vertex, occiput, and nape black, the sinciput and lores white, as also the sides of the head and all the under parts. The upper parts are ashy, the primaries brownish black, along the margin of the inner web broadly white; the shafts white; the tail-feathers delicate ashy, at the base of the inner web white; the outermost tail-feather on the outer web dark greyish brown; the smallest quill-coverts along the cubitus also greyish brown. Bill black, the base of the mandible tinted with reddish brown; legs reddish brown.

A similar specimen I got once in a collection of Mr. Layard from Table Bay, s. n. *St. dougalli*. It is undoubtedly the species noticed under this title in his 'Birds of South Africa,' being very common in Table Bay. Mr. Layard unfortunately does not describe African specimens, but copies his description from the true *St. dougalli* in M'Gillivray's 'British Birds.'

St. senegalensis, from the Gold Coast, in the Leyden Museum, where I have compared the specimens, belongs also to *St. macroptera*. The true *St. senegalensis*, Sws., has the bill and feet red.

This species has not been recorded from the Red Sea. *St. senegalensis*, Heugl. (Ibis, 1859, p. 351), refers to *St. albigena*, Licht.—*O. F.*

218. STERNA MINUTA, L.

Sternula minuta, Rüpp. Syst. Uebers. p. 140. no. 521; Heugl. Syst. Uebers. no. 731; *id.* Fauna des Roth. Meer. no. 316.

a. ♂. Zoulla. June 9.

An old male in full dress; quite agreeing with European ones. Bill reddish, with black apical third.

Long. al.	Rectr. ext.	Culm.	Tars.
6″ 9‴	2″ 4‴	13‴	7‴.—*O. F.*

[Beak yellow, tip black; legs and feet yellow.
Only one procured. *W. J.*]

219. STERNA ——, sp.?

♂. Zoulla. June 7 (no. 14).

Long. al.	Rectr. ext.	Rectr. intern.	Rostr.	Tars.	Dig. med.	
6″ 0‴	1″ 10‴	1″ 6‴	$11\frac{1}{2}$‴	$7\frac{1}{2}$‴	$5\frac{1}{2}$‴	
6 3	2 4	1 7	$12\frac{1}{2}$	$6\frac{1}{2}$	5	. . . . *balænarum.*

Front, forehead, lores, sides of the head, and all the under parts, including the under wing-coverts, white; vertex mixed with greyish-brown feathers; temporal, occiput, nape, and a spot before the eye brownish black; the upper parts, including the upper tail-coverts, delicate ashy grey; the smallest wing-coverts along the cubitus brownish; primaries dark greyish brown, on the inner web broadly margined with white nearly to the apical third; shafts of the primaries dark blackish brown, beneath white; tail-feathers ashy grey, on the basal half of the inner web white; the outermost tail-feather wholly white. Bill black; legs horn-brown; nails black.

The specimen is moulting, and apparently a young bird: I abstain therefore from declaring it to be new, although I am unable to refer it to any of the known species. It agrees in most respects with the winter dress of *St. minuta*, but differs in having the bill black and the legs dark. Can these differences be the consequences of age or season?

The black-billed, and nearly allied, *St. balænarum*, Strickl. (of which the Bremen Museum possesses a fine specimen from Walvisch Bay), has the shafts of the quills above and beneath all white.—*O. F.*

[Iris brown; beak black; legs black.

The only one procured.—*W. J.*]

220. STERNA PANAYA, Gml.

Sterna fuliginosa, Heugl. Ibis, 1859, p. 350.

—— *panaya*, Heugl. Fauna des Roth. Meer. no. 313; Finsch & Hartl. Ornith. Central-Polyn. p. 228; *id.* Vögel Ostafr. p. 833. no. 435.

a. Massuah. August 24.

Long. al.	Rectr. ext.	Rectr. int.	Culm.
8″ 3‴	4″ 2‴	2″ 9‴	1″ 6‴

An old bird in full dress. This species has been often erroneously confounded with *St. fuliginosa*. In the Berlin Museum are examples of both species from the Arabian coast of the Red Sea, labelled *St. fuliginosa*, Licht.

Von Heuglin's *Anous tenuirostris*, from the Guano island Bur-da-rebschi, is the true *A. stolidus*.—*O. F.*

[Beak black; legs and feet black.

Only one procured. *W. J.*]

221. HYDROCHELIDON FISSIPES (Linn.).

Hydrochelidon nigra, Rüpp. Syst. Uebers. p. 139. no. 514; Heugl. Syst. Uebers. no. 738; *id.* Fauna d. Rothen Meer. no. 315; Brehm, Habesch, p. 228. no. 167.

a. Zoulla. June 13.

[Beak black; legs and feet red.

The only one procured.—*W. J.*]

APPENDIX I.

Report to the Council upon his Proceedings in Connexion with the Abyssinian Expedition. By WILLIAM JESSE, *C.M.Z.S., Zoologist to the Abyssinian Expedition*[1].

GENTLEMEN.—It is with pleasure that I find myself in a position to lay before you a sketch of my proceedings during my recent journey with the late expedition in Abyssinia.

I should first like to state that, my late arrival on the scene of action having prevented me from accomplishing any thing like the work I wished to carry out, I eagerly

[1] Reprinted from P. Z. S. 1869 (p. 111 *et seqq.*), in order to show the exact route followed by Mr. Jesse. See also the map herewith, Pl. XXIII.—P. L. S.

seized upon an opportunity which presented itself, after the close of the campaign, of supplying the deficiencies thus occasioned.

I heard from Mr. W. T. Blanford, Geographer to the Expdition, that he, Capt. Mokeler (political officer), and Mr. Munzinger (H.B.M. Consul at Massowah) contemplated an excursion into the Bogos country; and I therefore wrote to the Consul begging his permission to make one of the party. This permission I subsequently received, and under these auspices found means to fulfil my mission more completely than I had anticipated.

On the 27th of January, 1868, I left England, and on the 24th of February we cast anchor in Annesley Bay. My arrangements on shore not being completed, I obtained a boat and crew from the Captain and started with a party to the head of the bay. I spent a couple of days here, examining the surrounding country and shooting. I procured specimens of the Naked-necked Francolin of the plains, one species of Hornbill, and a variety of other birds, the most important of which were eight specimens of the *Dromas ardeola*. These latter I especially wished to bring home, both as skeletons and in spirits. Unfortunately I could not carry out this intention, as, instead of returning safely in about two hours' trip to the 'Great Victoria,' we were nearly wrecked on the opposite shore; and the energies of our crew and selves were so severely tried by wind and rain that we with difficulty, and utterly exhausted, reached the fleet at the end of twenty-four hours. My specimens being spoiled, this was rather a discouraging commencement of my duties. I may here remark that I did not again obtain specimens of this bird until on my voyage home, at Suakim.

On the 27th I landed at Zoulla, and reported myself to General Stuart, there awaiting orders from the Commander-in-Chief. In a few days I received an intimation from his Excellency that I should find ample scope for my researches in the neighbourhood of Zoulla; it was, however, at that time impossible to prosecute them with any result, on account of the country being utterly devastated of wood and grass, offering but small opportunities for the zoologist. I obtained a few specimens, when an attack of sickness put an end to my endeavours, and compelled me to go on board the hospital ship. After some days I returned ashore; but in the course of a few hours I had a relapse, which induced me to leave the plain and move up towards the highlands. I was also disappointed in not meeting at Zoulla with the taxidermists Lieut. R. C. Beavan had given me reason to expect would be there; but before quitting the place I was fortunate enough to find a man who eventually proved of use to me in this department.

The country lying between the sea and the foot of the hills at Koomaylee was of the most barren description—to the seaward sandy, and nearer the hills broken ground, bearing, at the period of which I speak, but few traces of vegetation beyond those of low thorny mimosas and a stunted species of cypress. The plain is intersected by dry watercourses, running from the hills towards the sea. The presence of salt in the soil is to be detected from the sea even up to Koomaylee. Along the seashore are belts of mangroves, affording shelter for many species of waterfowl. About an hour's ride from Zoulla towards the head of the bay are some hot springs, near a large grove of tamarisks. It was at this place I found spoor and dung of Elephants, three species of Antelope, and one of Bustard. The tenants of these barren districts, as far as I could ascertain, are Elephants (during the wet season), three species of Antelope, Wart-Hogs, a small Hare, one species of Hyena (probably the spotted), one of Jackal (probably *Canis anthus*), a Jungle-Cat (supposed to be identical with the Syrian Cat, of which I obtained a female and cubs), also a Jerboa-like Rodent. Scorpions are here numerous and large. For further details I shall refer to my collections at a later date. The character of the fauna of the plains is migratory, changing almost monthly from the hills to the plains, and *vice versâ*.

Proceeding up the passes, the only object worthy of special notice was the curious Rodent named by Mr. Blyth *Pectinator spekii*, the existence of which was made known to me by Mr. Blanford, and of which I obtained specimens. I should have procured more examples had not my taxidermist fallen ill with fever, and my own health continued far from good.

On arriving at Senafé I made that place my headquarters; and health rapidly improving, I set to work in the surrounding neighbourhood. Here, on one of my excursions, a companion who had separated from me was robbed of one of my rifles, and returned to camp stripped. Unfortunately, this happening out of my reach, I lost the opportuuity of procuring a skeleton of one of the inhabitants for our investigation in England. From Senafé I made a short trip to Addigerat, adding somewhat to my collection.

The rapid and successful termination of the Abyssinian campaign brought my labours to an unexpected close; but I continued working until Lord Napier's return to Senafé obliged me to return.

I here found the list of birds numerically increased. About Senafé and Rayrayguddy the "Koodoo," or "Aggazin" (*Strepsiceros kudu*), was found in small herds, and a fine young buck came into my possession alive—a present to the Society from Dr. Knapp, surgeon to the 25th Bengal Native Infantry. Unfortunately, two consecutive attacks of dysentery reduced the animal to such a state of weakness that it was impossible to save it—a fact which I much regretted, as I believe at that time the Society did not possess a specimen alive in their gardens. The "Klipp-springer" Antelope existed in these regions; and the "Beni-e-Israel" Antelope I found in the valleys at the back of Senafé, as also the "Wart-Hog."

Two species of "Ground Squirrel," one striated, the other not, and one species of Ichneumon came under my notice up the passes.

On the hills in the neighbourhood of Senafé I found another species of Hare, about equal in size to a threequarter-grown English Leveret, and of the same colour. A small sandy, strong-haired Rat I also procured a specimen of, which was unavoidably lost.

On the return journey I spent a few days at Undel Wells, with the view of obtaining a more special knowledge of the fauna of that elevation, having reason to believe it differed materially from that of the higher and lower zones. I did not, however, obtain much satisfactory information until my subsequent trip, at a later date, into Northern Abyssinia.

I arrived with the rearguard at Zoulla, where, after having made some additions to my collection, I prepared seven cases to be sent to England. As I have before stated, I obtained permission from H.B.M. Consul at Massowah to join him, Capt. Mokeler, and Mr. Blanford in an expedition into the Bogos country, which, although already explored by Brehm and Heuglin, I thought worthy of attention. Had opportunity offered, I should, in accordance with my instructions and my own wishes, have visited the country towards lake Assal. During the third week in June we were occupied in preparing for our proposed trip. We sent our baggage and provisions round to Massowah by buggalow, and our animals by land. We ourselves started on board the 'General Havelock' for Massowah, where we had to remain a few days arranging our affairs.

On the 22nd of June we left Massowah for the mainland, assembling our caravan at about four miles distance, at Monkooloo, and started the next morning with thirty-eight camels, eight horses, and about thirty men. We halted at Sahati, *en route* for Ailet, and heard there of Lions, but found no traces of them, so proceeded to Ailet the following day. Our camp here was situated on the banks of a wild nullah, watered by a hot spring at no great distance. This place is noted but too truly for its man-eating Lions and Panthers. It is a legend in the village "that no man dies in his bed." During one or two days I accompanied Capt. Mokeler (Mr. Blanford being lame) in pursuit of a lioness, tracks of which we had seen close to our tent, but with no success, Capt. Mokeler only obtaining one shot, which was without effect.

On the 27th of June, after some premonitory symptoms, I received a sunstroke, which completely put an end to my researches. My friend Mr. Blanford was more fortunate, and laid a good foundation for his subsequent collection. On the 29th, at about 12 o'clock at night, I was awoke from a sick bed, along with my companions, by shrieks of the most fearful kind. It was pitch dark; and we rushed out of our tents with our arms in our hands, to find our followers in a state of most dire terror and confusion, filling the air with cries of "the Lion, the Lion;" and then a dusky form was seen to bound away over the thorn fence and disappear in the darkness. After having in some degree quieted the fears of our people, we called the roll, and found that one of my gun-bearers, a Shunkgalla of huge proportions, lay dead in the midst of us, his throat bearing but too terrible marks of the manner in which the poor fellow had perished. I may add that, only the night before, Mr. Blanford's butler had been severely wounded in the head by the claws of what we supposed to be a Panther. These brutes had passed by our camels, horses, milch-goats, and fires without harming any thing. In the morning, after a useless search for the brute of the preceding night, on which we naturally desired to wreak our vengeance, we buried the poor victim, covered him with a pile of stones, and left for Asoos. From here we started the same day, and halted at Kooserit.

On the 31st we left Kooserit, and, halting at Anagully, arrived in the evening at Kanzal, where I managed to stroll out, but I was still very ill. I fired at two Panthers without effect. At 6 P.M. on the 4th of July we started across the desert to Ain, on the river Lebka, which rises in the hills and flows across the plains to the sea. I stopped to look at a Bedouin village, consisting of about 100 mat huts. The inhabitants belonged to one of the nomad tribes which pasture their flocks during the wet season on the coast, moving up towards the highlands as the pasturage fails. We passed through the Ostrich-country, but we did not see any of these birds. During the night, the moon being up, we saw several herds of Antelopes.

We arrived at Ain at about 10 o'clock. In the afternoon I went out, and succeeded in procuring some specimens. This place is very prettily situated, forming quite an oasis in the desert. A bright stream runs through grass and high reedy jungle, bordered with tamarisks and other trees; a background of rugged barren hills, rising tier above tier, enhances the beauty of the scene.

On the 7th of July we left Ain for Mahabar; and when there I began to regain my health. Between Ain and Mahabar we found spoor of Elephants, evidently in a state of migration from the lowlands to the highlands. At Mahabar I added considerably to my collection, particularly by specimens of a small hawk, which I take to be the *Nisus sphenurus* of Rüppell. Mr. Blanford obtained several. The night before our arrival a native had been killed by a Lion. The animal left his track by the waterside, and it was taken up by Mr. Blanford and Capt. Mokeler without effect. I took up the track of a solitary Elephant with a like result. At 5 o'clock A.M. the next day we continued our march, halting at Gelamet for lunch, and arrived at 6 P.M. at Kokai, or the City of the Lions. Between Gelamet and Kokai the scenery improved greatly, exchanging rather stunted tamarinds and barren mimosas for the baba tree, or *Adansonia*, the cactus-like *Euphorbia*, and a dense jungle with a strong undergrowth of rank grass and aloes.

Here the climate was truly European, and, indeed, at night intensely cold. The fauna began to show the peculiarities which I had expected at Undel Wells, and in which I was disappointed; the transition was so sudden that on the first day I procured three species of Roller, a Parrot, and several other birds.

The next morning we found on inquiry that Elephants were in the neighbourhood; so, having supplied my taxidermist with materials for his day's work, I joined Capt. Mokeler and Mr. Blanford in an excursion in search of them.

I remained two days longer in this neighbourhood collecting with success, and then proceeded over the pass to Bejook on the river Anseba. Here I had a good week, securing many specimens I had hitherto failed to obtain. On the 14th of July we went out in pursuit of a Rhinoceros we had heard of the day before, and which Mr. Blanford and I had the good fortune to shoot. The next morning I went out with my attendants and a *posse comitatus* of natives, to bring in the skeleton, and on arriving at the place I witnessed a scene precisely similar to that described by Sir Samuel Baker as taking place over the carcass of a Hippopotamus:—women, old and young, the former hideous, scratching, screaming, and fighting over the entrails, pulling furiously at these or at one another's hair, it mattered not which so that possession of the prey was secured; the men jabbering like jackals, fighting with sticks and knives, one and all knee-deep in filth and blood; so that between them, in about four hours, the skeleton was utterly bared of meat and skin, leaving not an atom for the Vultures.

On the 18th we had the first earnest of the rainy season, which was ushered in by a terrific storm of rain and hail, some of the hailstones being as large as small walnuts. The Anseba, an affluent of the Barca, from a dry bed with an occasional waterhole became a splendid river, varying from 50 to 100 yards in width, and flowing between banks of dense jungle and fine forest-trees. The tracks of Elephants, Rhinoceroses, and Lions were plentiful along the banks, so much so as to give the appearance of a place frequented by giant rabbits. The valley here varied from fifteen to twenty miles in width, the jungle and forest limiting itself to about a couple of miles on each side. The remainder of the ground was stony and barren, rising gradually towards the hills, and intersected by numerous nullahs running into the Anseba. Here we came in for a glimpse, on two occasions, of another species of Antelope, slightly larger than the " Beni-e-Israel." Unfortunately I had but a momentary view of it, and never succeeded in obtaining a specimen. On the 19th we left Bejook for Waliko, seeing on the road plenty of spoor of Elephants and Rhinoceroses; from the dung of the latter I collected a few Coleoptera. While at Waliko, finding a great scarcity of birds, I followed up more closely the tracks of the Rhinoceros, passing through very dense jungle that is never penetrated by sun or air, by means of their paths, which are from 2 to 3 feet broad, and formed like galleries in a mine, about 4 feet high—and so entering their dens, which are very curious, having the appearance of immense arbours; they vary in size from 13 to 20 feet square, and have in some cases a smaller retreat adjoining.

On the 24th, Mr. Blanford and I went out birding, and came upon fresh tracks of two Lions; they had followed Elephants' spoor for over two miles. The herd consisted of three old ones and a young one. The next day we left for Maragaz, where Capt. Mokeler shot a doe Koodoo, and I procured a few birds, one species of *Indicator*. Mr. Blanford obtained a rare Kingfisher, of which I also secured a specimen the next day. I also shot a pair of fine Ground-Hornbills (*Bucorax abyssinicus*), which I prepared as skeletons. The rains having set in, and the term of our excursion drawing to a close, we left Maragaz on the 31st of July on our return journey. When I arrived at Waliko, to which place Capt. Mokeler had preceded us, I found that he had been charged by a herd of some twenty Elephants, and had been forced to make good his escape into a tree, after hard running, and having left a bullet in the head of a large bull. At a later date I found myself in the same disagreeable predicament, and under a like disagreeable necessity. At Waliko I found two species of crested Cuckoo and the English Cuckoo. I also obtained a Bateleur Eagle, two species of Tortoise, and a small Squirrel. I must here state that Waliko is not, as represented in the map, on the right side of the river, but on the left as you go down stream. From here we crossed over to Gabena Weld Gonfallon, or the river-plain, where Mr. Blanford and Capt. Mokeler killed a Rhinoceros. We returned by the old route to Kokai and Gelamet, and then branched off to Rairo; here we stopped two days collecting. On the 15th of August we moved on again to Mombar-Haratt-b', where we killed a Lioness, one out of four, the others running away. From this place we proceeded to Ain (where we reentered our former route), and quitted this on the 17th of August for Amba and Mai Wallet. Mr. Blanford and I stayed in Amba from the 19th to the 21st, trying to obtain specimens of the *Oryx beisa*. I unfortunately did not even see one; Mr. Blanford procured four specimens. We went from Amba to Massowah, which I left on the 27th for England.

I append a list of my collections, full information relative to which will appear at a later date:—

Skins of mammals, about	24
Skull of an aboriginal	1
Skull of African Elephant	1
Skeleton of Rhinoceros	1
Heads of Antelope	3
Skeletons of other mammals, about	8
Skins of birds, about	750
Birds and Mammals in spirit, about	20
Reptiles in spirit, about	6
Tortoises and Lizards, about	6
Fish, about	30
Crustacea, about	50
Lepidoptera, about	150
Coleoptera, about	200
Total number of specimens, about	1250

The following living specimens were also forwarded to the Zoological Society from Zoulla:—

Young Wild Cats[1]	2
Jerboa-like Land-Rats	2
Guinea-fowls	2

[1] These were the only specimens forwarded by Mr. Jesse that reached the Society alive. They were the young of *Felis maniculata*, Rüppell.—P. L. S.

APPENDIX II.

Supplemental Remarks on the Birds collected by Mr. Jesse.

By OTTO FINSCH, Ph.D., C.M.Z.S.

SINCE the foregoing pages were written nearly a year has passed, and during that interval the ornithology of this part of our globe has become enriched to an extraordinary extent by important contributions. I may mention that our work on the birds of East Africa, cited before, has been finished, and that von Heuglin's valuable publication on the ornithology of North-east Africa[1] made good progress. But of far greater interest to our present subject is the appearance of Mr. W. T. Blanford's 'Geology and Zoology of Abyssinia'[2]. The author, well known as a zealous and intelligent naturalist from his researches in India, accompanied the army, by permission of the Government of Bombay, from the beginning of December 1867 till it reached Magdala, and afterwards made, together with Mr. Jesse, the trip through the Bogos country. The ornithological portion of his most interesting book (pp. 285–443) proves that this branch of zoology was treated with especial care, and that his endeavours were successful in a high degree. Many valuable notes on habits, distribution, on the colours of the naked portions, eye[3], &c., testify the author's capacity for observing animals in a wild state; and we must also congratulate Mr. Blanford on the excellent and critical manner in which his work is executed.

The total number of species of birds collected by Mr. Blanford was 293, amongst which were 101 not obtained by Mr. Jesse; but we must not forget that Mr. Blanford arrived about two months earlier, that he traversed the highlands (the most interesting portion of Abyssinia so far as regards animal life) to a far greater extent than Mr. Jesse could do, and that the collection of the last-named naturalist contained, nevertheless, twenty-eight species not noticed by Mr. Blanford. These are the following:—*Vultur fulvus*, *Aquila imperialis*, *Bubo ascalaphus*, *Otus brachyotus*, *Strix flammea*, *Cypselus caffer*, *Cotyle fuligula*, *Trogon narina*, *Halcyon chloris*, *Hypolais olivetorum*, *Thamnobia albifrons*, *Saxicola stapazina*, *Cossypha gutturalis*, *Turdus pelios*, *Platystira senegalensis*, *Campephaga phœnicea*, *Amydrus tenuirostris*, *Cursorius chalco-*

[1] Ornithologie Nordost Africas, der Nilquellen u. Küsten-Gebiete des Rothen Meeres und des nördlichen Somal-Landes von M. Th. von Heuglin. Cassel: Theodor Fischer. This work is published in livraisons, of which thirteen have appeared, embracing the orders Accipitres and Passeres to the family Corvidæ, including 421 species.

[2] 'Observations on the Geology and Zoology of Abyssinia made during the progress of the British Expedition to that Country in 1867–68.' By W. T. Blanford. With Illustrations and Geological Map. London: Macmillan & Co. 1870.

[3] I cannot omit to remark that, singularly enough, in many cases the notes of the two naturalists relating to these subjects differ more or less. In some cases where the one says "iris brown," the other notices "iris red" or "yellow."

pterus, *Charadrius pecuarius*, *C. minor*, *Totanus stagnatilis*, *Himantopus autumnalis*, *Rhynchaspis clypeata*, *Larus leucophæus*, *Sterna minuta*, *S. macroptera*, *S.* ——, sp., and *Hydrochelidon fissipes.* Mr. Blanford's collection exceeds, therefore, that of Mr. Jesse by seventy-two species. Five species[1] are described as new, and seven are excellently figured in coloured plates.

Having altered my views in respect to some of the species in consequence of the better knowledge gained in preparing our great work since last year, it is necessary to append some corrections to the preceding paper. After having done so, I think it will be interesting to enumerate those species of Mr. Blanford's not collected by Mr. Jesse, in order to complete the list of birds obtained and observed during the Abyssinian expedition by the indefatigable naturalists attached to the British Army. The total number of species of birds amounts to 322, being nearly half of all the species supposed to occur in the whole of North-eastern Africa, a result which, when we consider the comparatively short stay, must surprise everybody who is acquainted with the difficulties of collecting in a tropical climate and under such circumstances.

Page 200. no. 3. Gypaetus barbatus.

Mr. Blanford's remark (*l. c.* p. 299) that the Abyssinian *Lammergeyer* is distinguished not only by the nudity of the basal portions of the tarsus, but also by its "very much smaller" size, seems to be, indeed, correct, as far as I can judge from a specimen from the Pyrenees in the Bremen collection, which has the wing 2′ $7\frac{1}{2}$″ long, and the tail 20″. Von Heuglin gives the length of the wing of *Gypaetos barbatus meridionalis* (!) in accordance with me as 27–28″, and that of the tail as 17–$18\frac{1}{2}$″.

P. 202. no. 7. Buteo augur.

In the Appendix to our "Vögel Ostafricas" (p. 853) I declared positively the identity of *B. auguralis*, Salvad. (Atti della Societ. Ital. di Scienze Nat. viii. 1866), with this species, after a careful comparison of the type specimens which Dr. Salvadori was kind enough to send us. It may be allowed me to correct this as a mistake; for, after receiving the type specimens of Rüppell's *B. augur* through the kindness of Mr. Erckel, of the Senckenbergian Museum, it was evident that the *B. augur* in the Bremen collection (described in our work, p. 58, "Ein jüngerer Vogel") was by no means the true *B. augur*, but Salvadori's *B. auguralis.* Von Heuglin (Ornithol. Nordost Africas, p. 93) has distinguished both species accurately, but thinks that *B. auguralis* is identical with *B. anceps*, Brehm (Naumannia, 1855, p. 6), the type of which he seems to have compared and described in the Berlin Museum. To judge from the description of Brehm, who does not say where his type was deposited, I strongly inclined to believe it might have been a specimen of *B. desertorum*; but von Heuglin assures me it

[1] The descriptions of these new species have been already published in the 'Annals and Magazine of Natural History' for November 1869, pp. 329 et 330.

is evidently a younger bird of *B. auguralis*. Not having seen the type specimen, and still feeling some doubts, I wrote several times to my friend Dr. Brehm in order to satisfy myself whether the description of his *B. anceps* was indeed based upon the specimen now in the Berlin Museum. I much regret to say that I have not received an answer from my friend, who, occupied with extensive popular publications, seems to have partially lost his interest for pursuits of a purely scientific kind. I therefore am unable to decide whether the species should be called *B. anceps*, or, as I suspect, *B. auguralis*. In any case this species, although allied to *B. augur*, is well distinguished, not only by its inferior size, but also by the very different coloration. The crop and breast are dark red-brown, the remaining underparts white with conspicuous dark cordiform spots; under tail-coverts and thighs uniformly white; the greater portion of the inner web of the secondaries is white, with five or six narrow, incomplete, dark cross bands, whereas in *B. augur* there are from nine to eleven complete dark cross bands.

Long. al.	Caud.	Rostr.	Tars.	Dig. med.	Ung.	
16″–17″	7″ 2‴–9″ 0‴	12‴ –13‴	3″ 0‴–3″ 6‴	17‴–20‴	9‴–10½‴	. . . *B. augur* (after five type spec. in the Senkb. Mus.)
13½–14½	6 4 –7 2	10½ –11	2 7 –2 9	15 –17	7 – 8	. . . *B. auguralis* (after two type spec. in Turin.)

P. 203. no. 8. MILVUS MIGRANS.

Mr. Blanford (*l. c.* p. 300) also records the occurrence of this species in Abyssinia, where it is "extremely common everywhere, both on the highlands and lowlands." Von Heuglin (Orn. N.-O. Afr. p. 98) is therefore evidently wrong in supposing it to be only a winter visitor in Egypt.

P. 216. no. 27. CYPSELUS AFFINIS.

Mr. Blanford, who met with this species in May breeding under rocks in the Sooroo Pass, is wrong in saying "Brehm states that this bird breeds on palms;" for Brehm does not say so positively, but only that it is probable (Habesch, p. 273).

P. 230. no. 55. NECTARINIA JARDINEI.

Mr. Blanford also obtained a single specimen of this rare Sun-bird from Captain Sturt; it was shot at an elevation of between 5000 and 6000 feet below Senafé. Von Heuglin never met with this species, and enumerates it in his work (Orn. N.-O. Afr. p. 227) only as having been informed of its occurrence privately by myself.

P. 231. no. 59. CAMAROPTERA BREVICAUDATA.

Mr. Blanford (*l. c.* p. 376) confirms the fact that the female is considerably smaller, as already noticed by Prof. Sundevall. As it is discovered that the "Olivert" of Levaillant (t. 125), *Sylvia brachyura*, Vieill., is not an *Eremomela*, but a true *Camaroptera*, Sundevall's name, *C. olivacea*, ought to be used instead of *brevicaudata* (*vide* Vögel Ost-Africas, Append. p. 862).

P. 232. no. 61. HYPOLAIS ELAËICA.

I suspect that this species will prove to be identical with *Sylvia rama*, Sykes (Proc. Zool. Soc. 1832, p. 89), but not having seen Indian specimens I cannot settle the question. *Sylvia opaca*, Licht., from Western Africa, is also scarcely separable. Von Heuglin describes this species as *Acrocephalus pallidus* (Hempr. & Ehrb. Orn. N.-O. Afr. p. 294).

P. 240. no. 80. ANTHUS SORDIDUS.

The Rev. H. B. Tristram (Ibis, 1869, p. 437), who has had an opportunity of inspecting the specimens brought home by Mr. Blanford, calls attention to the fact that specimens from South Africa and India (*Corydalla sordida*, Blyth) are as widely different as *A. gouldi* from Western Africa, and therefore fully confirms the opinion expressed by me long before. Mr. Blanford (p. 382) mentions that *A. sordidus* varies considerably in colour and size; but I do not feel quite sure whether he did not confound another species with it.

P. 244. no. 87. CRATEROPUS LIMBATUS must be united with *Cr. leucopygius*, no. 86.

Mr. Blanford (Geol. & Zool. Abyss. p. 371) also does not hesitate to treat them as identical.

P. 247. no. 93. PLATYSTIRA PRIRIT must stand as *Platystira affinis*, Wahlberg (Journ. f. Orn. 1857, p. 3); *Pl. pririt*, Blanf. p. 345. no. 94.

Having lately compared specimens from South Africa (the true *Pl. pririt*, Vieill.), I have convinced myself of the difference of this species, it being considerably larger, and the female quite differently coloured. The males described in our work (p. 315) from Damaraland and Gabon are unquestionably *Pl. affinis* (as corrected, p. 866), whereas the description of the female (extracted from Levaillant) belongs to the true *Pl. pririt*. Von Heuglin (Orn. N.-O. Afr. p. 449) has since separated the north-eastern form as new (sub nom. *Pl. orientalis*), and it is not impossible that they are specifically distinct; especially the females of the north-eastern form and the *Pl. affinis* seem to differ considerably. The female of the latter I know only from a careful description sent to us by the kindness of Professor Sundevall; but I have not seen a female from the north-east—the specimens with a chestnut guttural cross band (which von Heuglin keeps as females) being apparently young males, as stated by Mr. Jesse. The old males in Mr. Jesse's collection I could not distinguish from our southern and western specimens; and as von Heuglin also does not explain the differences, I am still uncertain whether the separation into two species will be right. To decide the question a large series from various localities is necessary.

P. 247. no. 94. PLATYSTIRA SENEGALENSIS.

This species is distinguished from *Pl. affinis,* besides a difference in the white markings of the tail-feathers, by having a broad well-marked white supercilium from the nostrils to the nape. In the old male the upper surface of the head is black, in younger males and females slate-coloured. A male in the Turin Museum, collected by Marchese Antinori, on the Bahr el Ghasal (type of his *Muscicapa torquata*, Catal. descr. p. 46), agrees in every respect with our Senegal specimen (as described, p. 318); another specimen, marked female, in Turin, collected by Dr. Bussa in North-east Africa, has a chestnut pectoral band like the specimen in Mr. Jesse's collection; but the upper surface of the head is dark grey, the white supercilium as strongly developed as in the old male.

P. 253. no. 102. LANIUS FISCUS must stand as *Lanius humeralis*, Stanl. in Salt's Trav. App. p. 51 (1814); Blanf. p. 338. no. 82.

P. 257. no. 111. PHOLIDAUGES LEUCOGASTER.

Mr. Blanford, who places this species in the Indian genus *Grandala* (p. 367. no. 142) (an opinion with which I cannot agree), confesses that the thrush-like-coloured specimens are females, so that there remains not the slightest doubt concerning this point.

P. 272. no. 139. GALERITA CRISTATA.

Of this widely distributed species we have given a full account in our 'Vögel Ostafrikas' (p. 460). *Alauda (G.) arenicola*, Blanf. (p. 387), seems to be, as far as I can judge, nothing else than a dark-coloured specimen of *G. cristata*. *G. lutea*, Brehm (Habesch, p. 218), will probably prove also to be *G. cristata*, but ought not to be confounded with *G. lutea*, Brehm, from Senahr and Cordofahn (Naumannia, 1858, p. 209), which apparently is a well-marked species.

P. 273. no. 141. ALÆMON JESSEI must be *A. desertorum*, Stanl.

Further researches have convinced me that this species is not separable from the true *A. desertorum*, as already noticed by the Rev. H. B. Tristram (Ibis, 1869, p. 435) and Mr. Blanford (p. 385), and corrected by myself in the Appendix to our new work (p. 869).

The comparison of the types of *Certhilauda doriæ*, Salvad., from Bender Abbas, in Persia, in the Museum of Turin, showed me at once its identity with my *A. jessei*. Neither the greyish-brown colour of the upper parts, nor the thickly spotted breast is a constant character; and amongst a larger series all intermediate forms will be shown. Specimens from Arabia in the Berlin Museum are still more spotted than the so-called *A. jessei*. The size, especially the length of bill, also varies very much. Of all these peculiarities I have given a full account in our work, where also the synonymy is accurately explained.

P. 279. no. 150. Buceros limbatus must stand as *Buceros hemprichii*, Ehrb. (1828).

Mr. Blanford has first pointed out that *B. hemprichii* is not the female of *B. nasutus* as Drs. Hartlaub and Cabanis suggest; and I agree with him, although I stated the contrary in our work (Vög. Ostafr. p. 487). After consulting the short description by Hemprich and Ehrenberg (Symb. Phys. fol. a a 3), I think there can be no doubt that Mr. Blanford is right, the length of bill being given as 4″ 7‴, which is only referable to the species published later by Rüppell as *limbatus*.

P. 284. no. 162. Centropus monachus.

Mr. Jesse has already expressed his doubts as to the identity of *C. monachus* and *C. superciliosus*; and Mr. Blanford (*l. c.* p. 315) positively declares their distinctness, *C. superciliosus* not being the female or younger state of *monachus*, as I erroneously suggested. Both species "were founded on fully adult specimens; and not only are they quite different in plumage, but their habitat is entirely distinct, *C. monachus* being only found in the temperate region of Abyssinia, while *C. superciliosus* is equally confined to the tropical and subtropical parts of the country." (Blanf.) Although I am still unable to distinguish *C. superciliosus* from the similar eye-striped specimens from Western and Eastern Africa, I yield to one who has observed these two birds in the wild state. Nos. 1898 and 919 (p. 285) therefore must stand as *Centropus superciliosus*, Rüpp.

P. 289. no 173. Turtur albiventris.

We have given a careful monograph of all the African members (six) of the genus *Turtur* in our last work. Specimens from Damaraland we have separated as *Turtur damarensis*, Finsch & Hartl. (p. 550), and those from the Cape as *Turtur capicola*, Sundev.

P. 297. no. 197. Ardea gularis.

Mr. Blanford remarks on this species:—"As shown by Mr. Blyth (Journ. As. Soc. Bengal, 1855), there can be no question of the identity of this species with the Indian form (*A. asha*, Syk.). I have compared my specimen carefully with those in the Calcutta Museum." Unfortunately I have not yet had an opportunity of examining specimens from the Indian continent; and I have considered these identical with *A. sacra*, Gml. This latter, of which I have seen a great many specimens from various parts of the Sunda Islands, the Moluccas, Australia, and the Pacific, is constantly different from the African *A. gularis* in having only a more or less narrow white line from the chin along the fore part of the neck, whereas in *A. gularis* the white is extended on the sides of the head and throat; besides, in *A. gularis* the naked portion of the tibia is constantly further extended (21–31‴, in *A. sacra* 12–18‴). By this latter character the white specimens of both species are also distinguishable.

P. 297. no 198. ARDEA ATRICAPILLA.

The Rev. H. B. Tristram concurs in Mr. Gurney's opinion (Ibis, 1869, p. 437) that *A. javanica*, Horsf., is inseparable from *A. atricapilla*, adopting the views of Dr. von Schrenk, who several years ago (Vögel des Amurlandes, pp. 437–447) maintained that all the members of the subgroup *Butorides* (*A. virescens*, Gmel., of North America, *A. scapularis*, Ill., of South America, and two species mentioned before) belong only to one species. Notwithstanding their near relationship, I must declare my own belief that they are different species, of as much value as many others. In respect to the Indian and African species, I find that *A. atricapilla* is always distinguishable from *A. javanica* in having the middle line along the fore part of the neck always tinged with fulvous, whereas in *A. javanica* this portion is uniformly greyish like the other parts of the neck and body. Occasionally a faint tinge of pale fulvous is seen in very old specimens of *A. javanica*. A full account of the differences of these two species will be found in our 'Ornithologie der Viti, Samoa and Tonga Inseln,' p. 210, and 'Vögel Ostafricas,' p. 703.

List of those Species of Birds collected by Mr. Blanford which were not obtained by Mr. Jesse.

VULTUR RÜPPELLI, Natt., p. 285. no. 1; Finsch & Hartl. Vögel Ostafr. p. 33, note.

Localities: Anseba valley, at 4000–4500 feet, Rairo 3000 feet, high plateaux of Wadela and Dalanta.

NEOPHRON PERCNOPTERUS (L.), p. 287. no. 2; Finsch & Hartl. Vögel Ostafr. p. 33. no. 2.

"From the sea-level up to 10,000 feet, and equally abundant near the camps on the Wadela plateau and on the shores of Annesley Bay."

FALCO SACER (? Gml.).

"Gelamet in the Lebka valley."

There is some doubt about the determination of this species.

TINNUNCULUS CENCHRIS (Naum.), p. 290. no. 8.

"Not rare on the Abyssinian highlands."

NISUS TACHIRO (Daud.), p. 291. no. 10; Finsch & Hartl. Vögel Ostafr. p. 78. no. 27.

"Goona-goona, near Senafé."

The union of *N. unduliventer*, Rüpp., with the South-African *N. tachiro*, as first pointed out by us, is confirmed by Mr. Blanford. The single skin collected by him is that of a very old male in superb plumage, and has been determined by M. J. Verreaux and Mr. Gurney. "A specimen of *N. tachiro*, from South Africa, in the British Museum, agrees well with that from Abyssinia." (Blanf.)

Sagittarius serpentarius (Miller); Finsch & Hartl. Vögel Ostafr. p. 93. no. 34. *Gypogeranus serpentarius*, Blanf. p. 297. no. 17.

"Seen only twice on the highlands."

Circus æruginosus (L.), p. 301. no. 21.

"Occasionally seen on the highlands."

Circus cineraceus (Mont.), p. 301. no. 23.

"In the Samhar, and abounded on the highlands in the winter and spring."

Bubo maculosus (Vieill.); Finsch & Hartl. Vögel Ostafr. p. 103. no. 40. *B. cinerascens*, Guér., Blanf. p. 302. no. 25.

"Only once met with this bird, near Antalo."

Contrary to the views of Messrs. J. Verreaux and Gurney, I do not take the north-eastern form to be specifically distinct from the southern *B. maculosus*.

Caprimulgus nubicus, Licht. p. 336. no. 78.

"A single specimen obtained near Zulla."

Having compared the types of Rüppell's *C. infuscatus* with *C. nubicus*, I can speak with certainty of their identity; but I must protest against the uniting of *C. tamaricis*, Tristr., as proposed by Mr. Blanford. This latter is a well-distinguished species, and nearest allied to *C. asiaticus*, Lath. (*vide* Vögel Ostafricas, p. 125. no. 49).

Caprimulgus tristigma, Rüpp. p. 337. no. 80.

"Near Antalo."

Cypselus æquatorialis, Müll. p. 334. no. 75.

"Not rare around Senafé in February and March."

Hirundo alpestris, Pall., p. 346. no. 97.

"At Koomaylee in February."

Hirundo melanocrissus, Rüpp., p. 346. no. 96.

"Seen at low or moderate elevations."

HIRUNDO RUSTICA, L., p. 347. no. 99; Finsch & Hartl. Vögel Ostafr. p. 134. no. 55.

"Common everywhere. This bird abounded on the shores of Annesley Bay in the middle of June." (Blanf.)

Von Heuglin also states this species to be resident along the Red Sea.

HIRUNDO FILIFERA, Steph.; Finsch & Hartl. Vögel Ostafr. p. 141. no. 58. *H. ruficeps*, Licht., Blanf. p. 348. no. 101.

Mr. Blanford obtained a single pair near Aguala, halfway between Adigrat and Antalo, and remarks, "The outer tail-feathers are very much shorter than is usual in Indian specimens, and I am far from convinced that the species are identical." The length of the outer tail-feathers is noticed as 4·6; this is only a little smaller than in Indian specimens.

CHELIDON URBICA (L.), p. 349. no. 103.

"A single specimen obtained at Koomaylee in February."

COTYLE CINCTA (Bodd.), p. 349. no. 104; Finsch & Hartl. Vögel Ostafr. p. 144. no. 59.

"On the shores of the Lake Ashangi in April, and about a fortnight later on the banks of a stream near Antalo."

COTYLE RUPESTRIS, Scop., p. 350. no. 105.

"A very common bird in the rocky passes, and found almost from the sea-level to 8000 feet." It is singular that Von Heuglin notices only *C. obsoleta*, Cab., from neighbouring localities in Abyssinia; and one would be inclined to believe Mr. Blanford had confounded the species, did he not say "a specimen from Senafé differs in no respect from others brought from Southern Europe."

The type specimens of *C. obsoleta* which I saw in the Museum Heineanum, I found difficult to distinguish from *C. rupestris.*

COTYLE MINOR, Cab., p. 350. no. 106; Finsch & Hartl. Vögel Ostafr. p. 147. no. 61.

"Seen in countless swarms on Lake Ashangi in April."

The three allied species *C. riparia*, *C. minor*, and *C. paludicola*, Vieill., are treated of in our work on the birds of East Africa, where we state that they occur nearly over the whole of Africa. Mr. Tristram (Ibis, 1869, p. 436) expresses his opinion that under the name of *C. palustris* have been confounded two species—one from the north, the other from the south. The northern bird, which Mr. Tristram obtained by the Dead Sea, and received from Egypt and Abyssinia, being larger than the southern bird, and having a large white spot on the inner web of each of the rectrices, except the outer and middle covering pair, is undoubtedly referable either to *C. obsoleta*, Cab., or

C. fuligula, and not to *C. paludibula*, Rüppell, who under this name confounded *C. riparia* and *C. minor*.

ALCEDO SEMITORQUATA, Sws., p. 325. no. 65; Finsch & Hartl. Vögel Ostafr. p. 859. no. 451.

"One specimen from Adigrat on the highlands of Tigré."

ALCEDO CRISTATA, L.; Finsch & Hartl. Vögel Ostafr. p. 167. no. 74, et p. 860. *Corythornis cyanostigma*, Blanf. p. 324. no. 64.

"Common near Agula and Dongolo."

Mr. Sharpe has lately become convinced that the true *A. cristata* of Linné is the Madagascar species, and that the African form must bear Rüppell's name (*cyanostigma*); but, as I have noticed already in our work, Linné's *A. cristata* ("habitat in India orientali") based upon Seba's figure and *Ispida philippensis cristata*, Brisson (Orn. iv. p. 483. t. 37. f. 3), must remain for ever obscure, as it is not to be referred satisfactorily to any known species.

CERYLE RUDIS (L.), p. 325. no. 66; Finsch & Hartl. Vögel Ostafr. p. 175. no. 78.

"Seen near Magdala and Dongolo, at about 7000 feet above the sea; a rare bird."

MEROPS NUBICUS, Gml., p. 321. no. 57; Finsch & Hartl. Vögel Ostafr. p. 182. no. 80.

"A large number were collected about one spot close to the hot spring of Atzfut, on the shores of Annesley Bay. Mr. Jesse also met with it only once, and in the same neighbourhood." (Blanf.)

CISTICOLA AYRESI, Hartl.; Finsch & Hartl. Vögel Ostafr. p. 231, note. *Hemipteryx abyssinica*, Heugl. Ibis, 1869, p. 138. *Cisticola abyssinica*, Blanf. p. 376. no. 155.

The comparison of the type specimen of *H. abyssinica*, Heugl., from Adoa, with the type of *C. ayresi* in the Bremen Museum, proved immediately their identity without the slightest doubt. Whether Mr. Blanford's specimen, shot near Fokada, belongs indeed to this species is to be doubted, the length of wing being noticed as 2·11 (probably this is a misprint, and should be 1·11; then it would be right).

DRYMOICA GRACILIS (Licht.), p. 373. no. 148.

"Very common amongst the low bushes of the plain country near Zulla. Mr. Jesse found the nest, with two young birds apparently only hatched a few days before, on June 12." (Blanf.)

DRYMOICA MYSTACEA, Rüpp., p. 373. no. 149.

"Shot on the highlands at Adabagi, two marches south of Adigrat."

DRYMOICA PULCHELLA (Rüpp.), p. 374. no. 150.

DRYMOICA LEVAILLANTI, Smith. *Graminicola levaillanti*, Blanf. p. 375. no. 152. *Drymoica cantans*, Heugl. Ibis, 1869, p. 96.

I am not quite sure whether *D. levaillanti* and *D. cantans* are really identical, finding that specimens of the former species from South Africa vary considerably in size and colour.

DRYMOICA ROBUSTA, Rüpp. *Graminicola robusta*, Blanf. p. 375. no. 153.

"A single specimen at Adigrat."

EREMOMELA GRISEOFLAVA, Heugl. p. 355. no. 116, t. 3. f. 1 (opt.).

In the Anseba valley.

PHYLLOSCOPUS ABYSSINICUS, Blanf., nov. spec., p. 378. no. 158, t. 3. f. 2.

Most nearly allied to *Ph. trochilus* (L.), but a different species, which I had the pleasure of seeing when Mr. Blanford visited our Museum. Discovered about Mayen, in the pass below Senafé, and at Senafé, Halai, and other places on the highlands.

A specimen from the plateau of Wogara, which Von Heuglin (Orn. N. O. Afr. p. 299) mentions sub nom. *Ph. rufa*, belongs to the true *Ph. trochilus*, as I convinced myself on examining it.

HYPOLAIS LANGUIDA, H. & Ehrb., p. 379. no. 162.

"In the Lebka valley and Samhar."

Whether this species is really separable from *H. olivetorum*, Strickl., I am unable to say, not having had before me a series large enough, the only way to settle the question. The specimen collected by Mr. Jesse I determined to belong to *H. olivetorum*, finding no important difference between it and a specimen from Greece. I must remark that the length of the primaries is by no means constant, but differs in individuals.

SYLVIA MELANOCEPHALA, Gml., p. 379. no. 160.

"A single specimen near Rairo."

SAXICOLA FRENATA, Heugl., p. 362. no. 132; Finsch & Hartl. Vögel Ostafr. p. 258 (note).

"On the Wadela plateau, near Saintora, and Gazoo, at an elevation of 10,500 feet."

Dr. Rüppell erroneously considered this species to be the male of *S. isabellina*. Other specimens in the Senckenbergian Museum were labelled *S. albigularis*, a name never published by Rüppell.

SAXICOLA DESERTI, Rüpp., p. 362. no. 133[1]; Finsch & Hartl. Vögel Ostafr. p. 255. no 119.

"Only seen close to the coast. In December and January about Annesley Bay, but not seen in May, June, July, or August."

The comparison of specimens of *S. atrogularis*, Blyth, sent by Dr. Salvadori, has convinced me of the identity of this with the Indian species.

SAXICOLA LUGENS, Licht., p. 363. no. 134.

"Seen in the temperate region on the highlands, where it appears to replace *S. deserti* (Blanf.). According to Von Heuglin, found in the deserts of Egypt and Arabia."

Von Heuglin's newly erected *S. finschi* (Orn. N. O. Afr. p. 350) is based only on the single specimen from Siberia in the Bremen Museum, which, showing some differences from *S. leucomela*, Pall., I described previously in my MS. notes, but without intending to publish it as a new species. I am informed by Von Pelzeln that the two specimens from the Sakarah desert (near Cairo) in the Vienna Museum, mentioned by Von Heuglin as being identical with the Siberian specimens, belong to *S. xanthomelæna*. Ehrb.

PRATINCOLA RUBETRA (L.), p. 364. no. 137.

"At Rairo, in Habab (3000 feet), in the middle of August."

PRATINCOLA PASTOR, Strickl., p. 364. no. 138.

"Not rare on the highlands."

PRATINCOLA HEMPRICHI, Ehrb., p. 364. no. 139.

PRATINCOLA SEMITORQUATA, Heugl., p. 365. no. 140. t. 5 (♂ ♀, opt.).

Localities: Adigrat, Antalo, Lake Ashangi; never below 8000 feet.

The female has been already figured in the Atlas of Ferret and Galinier, Voyage en Abyssinie, Zoologie, pl. 12. fig. 2.

RUTICILLA SORDIDA (Rüpp.). *Pratincola sordida*, Blanf. p. 366. no. 141.

This aberrant species, which Mr. Blanford did not meet with below 9000 feet, I take to be more nearly allied to *Ruticilla* than to *Saxicola* or *Pratincola*.

[1] A very nearly allied species is *Saxicola albomarginata*, Salvad. (MS.), in nearly every respect resembling *S. deserti*, but distinguishable at once from having all the tail-feathers tipped with white.

The type specimen (male), collected by the Marchese Orazio Antinori in the Sahara of Tunis, is now in the Museum of Turin, whence I received it for inspection through the kindness of Dr. Salvadori. I have compared it with several specimens of *S. deserti*.

RUTICILLA SCOTOCERCA (Heugl.). *Saxicola scotocerca*, Heugl. Orn. N. O. Afr. Livrais. 9–11 (November 1st, 1869). *Ruticilla fuscicaudata*, Blanf. Ann. & Mag. N. H. (November), 1869; *id. l. c.* p. 359. no. 125, t. 4 (opt.).

"A single specimen on the hills between the Anseba and Lebka valley (4000 feet)."

This curious bird is somewhat anomalous, but apparently rather a *Ruticilla* than a *Saxicola*. Some years ago I examined the type specimen of Heuglin's *S. scotocerca*, from Keren, labelled at that time *Saxicola infuscata*, and therefore easily recognized the bird brought home by Mr. Blanford.

ZOSTEROPS EURYOPHTHALMA, Heugl. *Z. poliogastra*, Heugl. Ibis, 1861, pl. 13; Hartl. Mon. *Zosterops*, J. f. Orn. 1865, p. 9; Blanf. p. 354. no. 114.

The single specimen obtained by Mr. Blanford at Dongola is undoubtedly referable to this species, as I feel sure after having compared it. The figure in 'The Ibis' is not quite true, showing the yellow supercilium extended to the temporal region.

Von Heuglin having first named this species *euryophthalma*, had no right to change this appellation.

MOTACILLA ALBA, L., p. 380. no. 165; Finsch & Hartl. Vögel Ostafr. p. 259. no. 121.

"Common both on the highlands and near the coast. On the 1st of May there were still specimens on the highlands around Lake Ashangi, but only very few remained." (Blanf.)

MOTACILLA SULPHUREA, Bechst., p. 381. no. 166.

"Not common. Only one specimen obtained in the Lebka valley."

BUDYTES MELANOCEPHALA, B. CINEREOCAPILLA, et B. CAMPESTRIS, pp. 381, 382, nos. 167, 168, et 169, are merely varieties of *Motacilla flava*, of which I have given a full account in our work (Vögel Ostafr. p. 268. no. 123).

ANTHUS CAMPESTRIS?, p. 383. p. 172.

Mr. Blanford is unable to draw a precise line between this species and *A. sordidus*. Not having seen his series, I can only say that I still take them to be distinct species.

MACRONYX FLAVICOLLIS, Rüpp., p. 384. no. 173; Finsch & Hartl. Vögel Ostafr. p. 278 (note).

"On the highest part of the Dalanta plateau and near the crest of the Wandaj pass; never observed below 10,000 feet."

TURDUS OLIVACINUS, Bp., p. 357. no. 120; Finsch & Hartl. Vögel Ostafr. p. 280 (note).

Localities: Senafé, Adigrat, Lake Ashangi.

PETROCINCLA CYANEA (L.), p. 357. no. 121.

"On the highlands."

PETROCINCLA RUFICINEREA (Rüpp.), p. 358. no. 123.

"By no means rare on the highlands, and found as low as about 4500 feet."

MALACOCERCUS ACAZIÆ (Licht.), p. 372. no. 147.

"About Zoulla, but rare."

ORIOLUS MONACHUS (Gmel.), p. 369. no. 144; Finsch & Hartl. Vögel Ostafr. p. 293. no. 137.

"Near Antalo."

LANIUS ISABELLINUS, H. & Ehrb. p. 339. no. 83.

"Common on the coast in December, January, and February."

AMYDRUS BLYTHII, Hartl., p. 399. no. 191.

"Abundant around Mayen at an elevation of from 3000 to 4000 feet in the pass below Senafé."

After having examined and compared Mr. Blanford's specimens, I have convinced myself that we were wrong in uniting this species with *A. rueppellii* (Vögel Ostafr. p. 382)—an error corrected already by us (p. 867).

PENTHETRIA LATICAUDATA (Licht.). *Coliupasser laticauda*, Blanf. p. 405. no. 201.

"Near Antalo and Agula."

ORTYGOSPIZA POLYZONA (Temm.), p. 408. no. 206. *O. fuscocrissa*, Heugl. Journ. f. Orn. 1863, p. 18.

Mr. Blanford got this species from Senafé, through Captain Sturt.

Von Heuglin has confounded with this bird (Journ. f. Orn. 1868, p. 4) the nearly allied *O.* (*Fringilla*) *atricollis*, Vieill. (=*Amadina lunulata*, Temm., Hartl. W. Afr. p. 148), which is readily distinguished, wanting the white on the chin and around the eyes; the whole face is black. We possess this species from the Cama, in Western Africa, and from the White Nile; a specimen from Bongo in von Heuglin's collection, which I examined, proved to be also *O. atricollis*.

HYPHANTORNIS MELANOTIS (Guér.), p. 403. no. 196.

"Common throughout the highlands, and seen at nearly 10,000 feet, though generally more common at a rather lower elevation."

PYROMELANA CAPENSIS (L.), Finsch & Hartl. Vögel Ostafr. p. 416. no. 216. *Euplectes xanthomelas*, Rüpp., Blanf. p. 405. no. 199.

The reasons for which we united the smaller north-eastern race (*P. xanthomelas*) with the larger southern are pointed out in our work as cited above.

Mr. Blanford found this species on the Wandaj Pass (at 10,500 feet elevation), at Santara, in Dalanta, and at Ashangi.

ESTRELDA QUARTINIA, Bp., p. 409. no. 209.

"Obtained near Senafé."

Having compared type specimens of *Estrelda ernesti secundi*, Heugl., I feel quite sure of their identity with *E. quartinia*, Bp., as pointed out by Mr. Blanford.

PASSER CANICAPILLUS, Blyth, p. 412. no. 215.

"In small flocks both in the woods and around villages, in the Lebka Valley and its neighbourhood, at 3000 to 4000 feet. Especially abundant at the village of Rairo."

Mr. Blanford does not seem quite sure as to the identity of this species, having put against it a note of interrogation. Singularly enough neither von Heuglin nor Dr. Brehm has met with this bird, which seems to differ from *Xanthodina dentata* chiefly in having the eyebrow cinnamon instead of pale rufous, and in the head being more grey. I take it as not quite impossible that these differences may depend upon the stage of plumage, *P. canicapillus* of Mr. Blanford and *X. dentata* of Mr. Jesse having been collected at nearly the same localities.

FRINGILLA TRISTRIATA, Rüpp., p. 413. no. 217; Finch & Hartl. Vögel Ostafr. p. 449. no. 238.

"Very common throughout the highlands."

CRITHAGRA FLAVIVERTEX, Blanf. p. 414. no. 220. pl. 7 (opt.).

This is an interesting and undoubtedly new species, which I had the pleasure of seeing in Mr. Blanford's collection when here. It escaped von Heuglin's observation.

SERINUS CITRINELLOIDES, Rüpp., p. 414. no. 221.

"Near Senafé."

SERINUS NIGRICEPS, Rüpp., p. 415. no. 222.

"Very common on the passes above 9000 feet."

ALAUDA ARENICOLA? Tristr., var. *fusca*, p. 387. no. 176.

Alauda præterimissa, Blanf., p. 388. no. 177. pl. 6 (opt.).

Having compared Mr. Blanford's type specimen, I take it to be a new species. Its nearest ally will be *A.* (*Melanocorypha*) *infuscata*, Heugl. (Journ. f. Orn. 1864, p. 273), which von Heuglin unites (J. f. Orn. 1868, p. 222) erroneously with *A. erythropyga*, Strickl.; and the identity of the two seems to be not impossible; but this could only be determined by comparing the type specimens.

Alauda brachydactyla, Temm. *Calandrella brachydactyla*, Blanf. p. 389. no. 178.

"Not rare on the shores of Annesley Bay."

Alauda andersoni, Tristr. *Calandrella andersoni*, Blanf. p. 389. no. 179.

"Abundant on stony ground near Senafé."

Closely allied to, but apparently different from, *A. ruficeps*, Rüpp. I saw the type specimen in Mr. Blanford's collection.

Coraphites nigriceps, Gould. *Pyrrhulauda albifrons*, Blanf. p. 391. no. 182.

Mr. Blanford thinks this species doubtfully distinct from *C. melanauchen*, in which opinion I cannot agree with him. The distinctive characters of the two species I have already pointed out, *antèa*, page 275.

Coraphites leucotis (Stanl.), p. 392. no. 183; Finsch & Hartl. Vögel Ostafr. p. 466. no. 249.

Chrysococcyx klaasi (Steph.), p. 314. no. 44; Finsch & Hartl. Vögel Ostafr. p. 520. no. 284.

"Only a single specimen, obtained in the Lebka valley."

Turtur semitorquatus, Rüpp. (*nec* Sws.), p. 416. no. 225; Finsch & Hartl. Vögel Ostafr. p. 541. no. 292.

Localities: Lake Ashangi, Lat, Dildi, Ain, on the Lebka, Anseba valley.

From examination of Rüppell's type we can state the identity of western and north-eastern specimens.

Pterocles gutturalis, Smith, p. 421. no. 234.

"Obtained near Agula and Antalo."

There is no difference whatever between these and specimens from South Africa, as the careful comparison of Mr. Blanford's specimens has proved. Von Heuglin thinks the Abyssinian bird to be somewhat different (Journ. f. Orn. 1862, p. 416).

OTIS MELANOGASTER, Rüpp., p. 427. no. 241; Finsch & Hartl. Vög. Ostafr. p. 614. no. 322.

"Common on the tableland, especially on the open plains between Adigrat and Antalo."

CHETTUSIA MELANOPTERA, Rüpp. p. 429. no. 248; Finsch & Hartl. Vögel. Ostafr. p. 638. no. 335.

Mr. Blanford never met with this species below about 7000 feet; but Dr. Rüppell procured his type near Djedda, on the Arabian coast.

LOBIVANELLUS MELANOCEPHALUS, Rüpp., p. 430. no. 250.

"On the higher portion of the Dalanta and Wadela plateau, above 10,000 feet."

CHARADRIUS ASIATICUS, Pall. *Eudromias asiaticus*, Blanf. p. 429. no. 244. *Ægialitis ruficollis*, Heugl. Syst. Uebers. no. 586; *Ch. damarensis*, Strickl.

At Rairo.

The specimens from Damaraland (Anderson's collection) do not differ from those from Eastern Asia.

CHARADRIUS MARGINATUS, Vieill.; Finsch & Hartl. Vögel Ostafr. p. 654. no. 344. *Ægialitis niveifrons*, Blanf. p. 429. no. 246.

"Abundant at Zoulla in June, and apparently breeding."

ARDEA MELANOCEPHALA, Vig.; Finsch & Hartl. Vögel Ostafr. p. 681. no. 358. *A. atricollis*, Blanf. p. 434. no. 268.

"Near Adabagi, at an altitude of about 8000 feet."

ARDEA GARZETTA, L.; Finsch & Hartl. Vögel Ostafr. p. 687. no. 362. *Herodias garzetta*, var., Blanf. p. 435. no. 269.

"Common on the coast."

ARDEA COMATA, Pall., p. 435. no. 271; Finsch & Hartl. Vögel Ostafr. p. 697. no. 366.

"One specimen was obtained at Antalo."

IBIS COMATA, Ehrb., p. 436. no. 275.

Localities: Senafé and Antalo.

NUMENIUS ARQUATA, L., p. 432. no. 255; Finsch & Hartl. Vögel Ostafr. p. 736. no. 387.

"Common on the shore in winter."

XENUS CINEREUS, Güldenst.; *Terekia cinerea*, p. 433. no. 259.

"A single specimen shot at Zoulla in January."

TRINGA CINCLUS, L., p. 433. no. 263; Finsch & Hartl. Vögel Ostafr. p. 758. no. 395.

"On the coast in January."

TRINGA MINUTA, Leisler, p. 433. no. 264; Finsch & Hartl. Vögel Ostafr. p. 764. no. 397.

Shot at Zoulla.

GALLINAGO SCOLOPACINA, Bp.; Finsch & Hartl. Vögel Ostafr. p. 771. no. 400. *Scolopax gallinago*, Blanf. p. 432. no. 257.

"Common on the highlands in the winter months."

RHYNCHÆA CAPENSIS (L.), Finsch & Hartl. Vögel Ostafr. p. 774. no. 401. *Rh. bengalensis*, Blanf. p. 432. no. 258.

"Only met in reeds on the banks of running water at Ailat and Ain, near Massowah. The specimens are quite undistinguishable from Indian ones" (Blanf.).

FULICA CRISTATA, L., p. 434, no. 267.

"Abundant on Lake Ashangi."

BERNICLA CYANOPTERA, Rüpp. p. 439. no. 281.

Localities: Wadela and Dalanta plateau, above 9000 to 10,000 feet; in a high valley at about 8500 feet, between Antalo and Ashangi.

ANAS FLAVIROSTRIS, Smith: Eyton's Monogr. on the Anatidæ (1838), p. 141; Blanf. p. 437. no. 277; *A. undulata*, Dubois, Ornithol. Gallerie, p. 119 (1839), t. 77.

"Common throughout the highlands, and especially on the higher plateaux" (Blanf.).

QUERQUEDULA CRECCA, L., p. 438. no. 279.

"Occasionally met with on the highlands."

FULIGULA CRISTATA, Ray, p. 437. no. 278.

"Lake Ashangi, in pairs, and not very common at the commencement of May."

PODICEPS CRISTATUS, L., p. 440. no. 282.

"Extremely abundant on Lake Ashangi, where it is doubtless a permanent resident."

PODICEPS AURITUS, L., p. 440. no. 283.

"Not very common on Lake Ashangi."

LARUS FUSCUS, L., p. 440. no. 285; Finsch & Hartl. Vögel Ostafr. p. 820. no. 427.

"Common at Zoulla. The wing is a little longer, about an inch, and the bill a trifle smaller, than in most European specimens; but there appears to be no constant distinction" (Blanf.). We also have not been able to distinguish specimens from Egypt and the Red Sea (*L. fuscescens*, Licht.) from European ones.

Phaëton rubricaudatus, Bodd., p. 441. no. 290; Finsch & Hartl. Vögel Ostafr. p. 839. no. 439.

"A single specimen of a young bird was captured alive in Annesley Bay. I did not notice any flying about the bay" (Blanf.).

Graculus africanus, Gmel., p. 441. no. 291; Finsch & Hartl. Vögel Ostafr. p. 847. no. 446.

"I only saw Cormorants on Lake Ashangi, and only this species" (Blanf.).

Pelecanus rufescens, Gmel., p. 442. no. 292; Finsch & Hartl. Vögel Ostafr. p. 849. no. 448.

"I shot a pair on Dissi Island at the end of August. They were in fine plumage, with a rich roseate tinge on the back" (Blanf.).

Pelecanus philippensis, Gmel., p. 442. no. 293.

"Between this bird, which was common on the shore of Zoulla, and of which I shot a single specimen, and the last, there is no difference in measurements, in the form of the frontal feathers, or the disposition of those behind the eye. The crest also appears similar; and although the feathers of the head are shorter and more woolly, this may partly be due to wear. Under these circumstances I should have been inclined to regard the roseate back and breast of *P. rufescens* as seasonal, but for the circumstance that, while the present specimen is unquestionably identical with the common Indian *P. philippensis*, with specimens of which I have compared it, *P. rufescens* does not appear to have been noticed in India. If it were only the nuptial plumage of the present species, it ought to be equally common" (Blanf.).

I agree with Mr. D. G. Elliot, who, in his valuable 'Monograph' of the genus *Pelecanus* (P. Z. S. 1869, p. 583), unites *P. philippensis* from India with the African *P. rufescens*, and am of opinion that these species are inseparable, as pointed out by Professor Schlegel long since. The red tinge on the back is not peculiar to the African bird; for we possess a specimen from Malacca which shows the red very well marked, and Mr. Elliot mentions a specimen from Nepaul in the British Museum which "exhibits very distinctly the reddish colour on the back and rump."

O. F.

Bremen, May 26th, 1870.

DESCRIPTION OF THE PLATES.

PLATE XXIII.

Sketch Map of North-eastern Abyssinia and the Bogos country, showing the routes followed by Mr. Jesse, and his various collecting-stations. The routes are coloured *pink.*

PLATE XXIV.

Caprimulgus inornatus (p. 211), from specimens obtained by Mr. Jesse.

PLATE XXV.

Lanius fallax, sp. nov. (p. 249), from specimens obtained by Mr. Jesse.

PLATE XXVI.

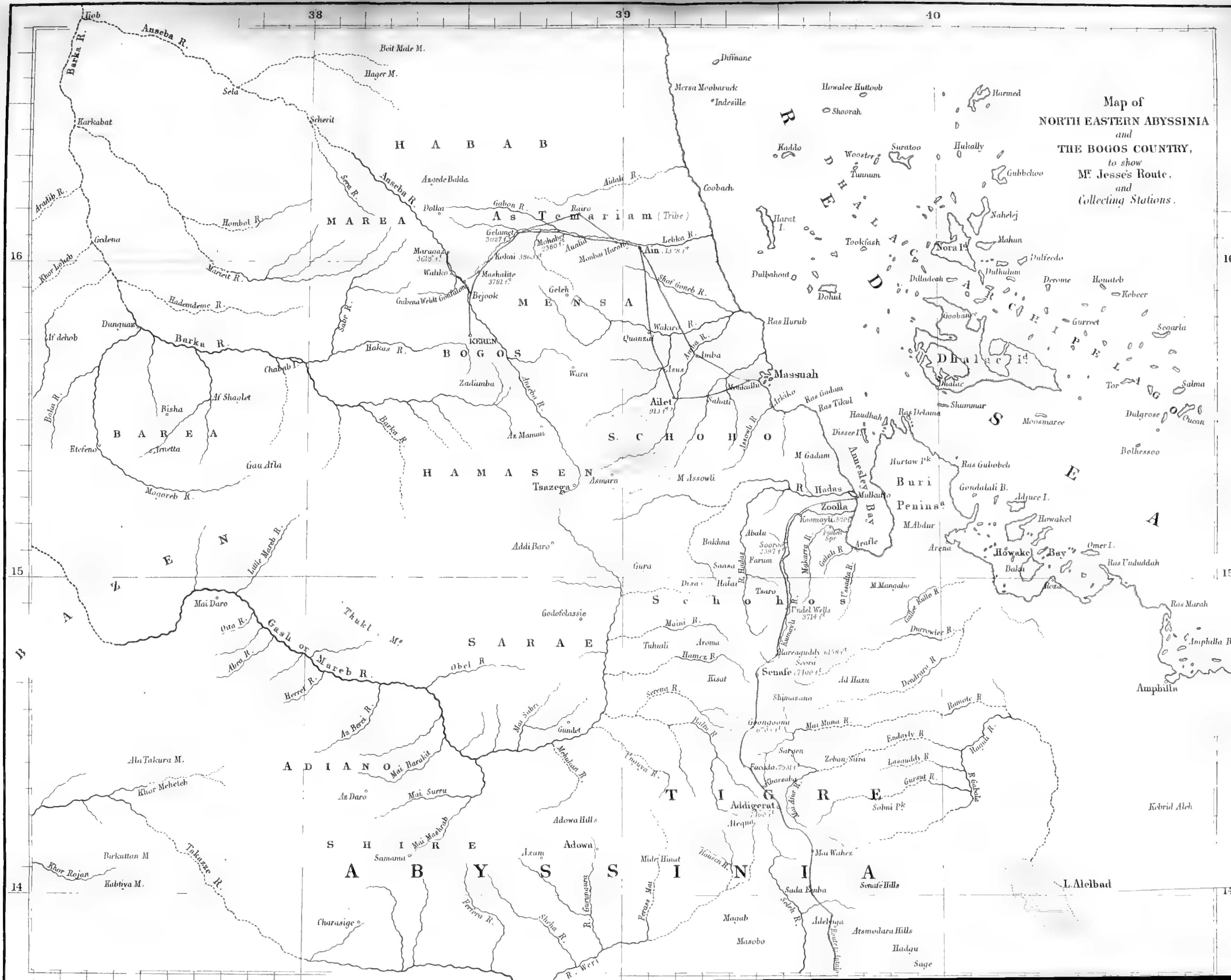
Coraphites melanauchen, Cab. (p. 275), ♂ et ♀, from specimens obtained by Mr. Jesse.

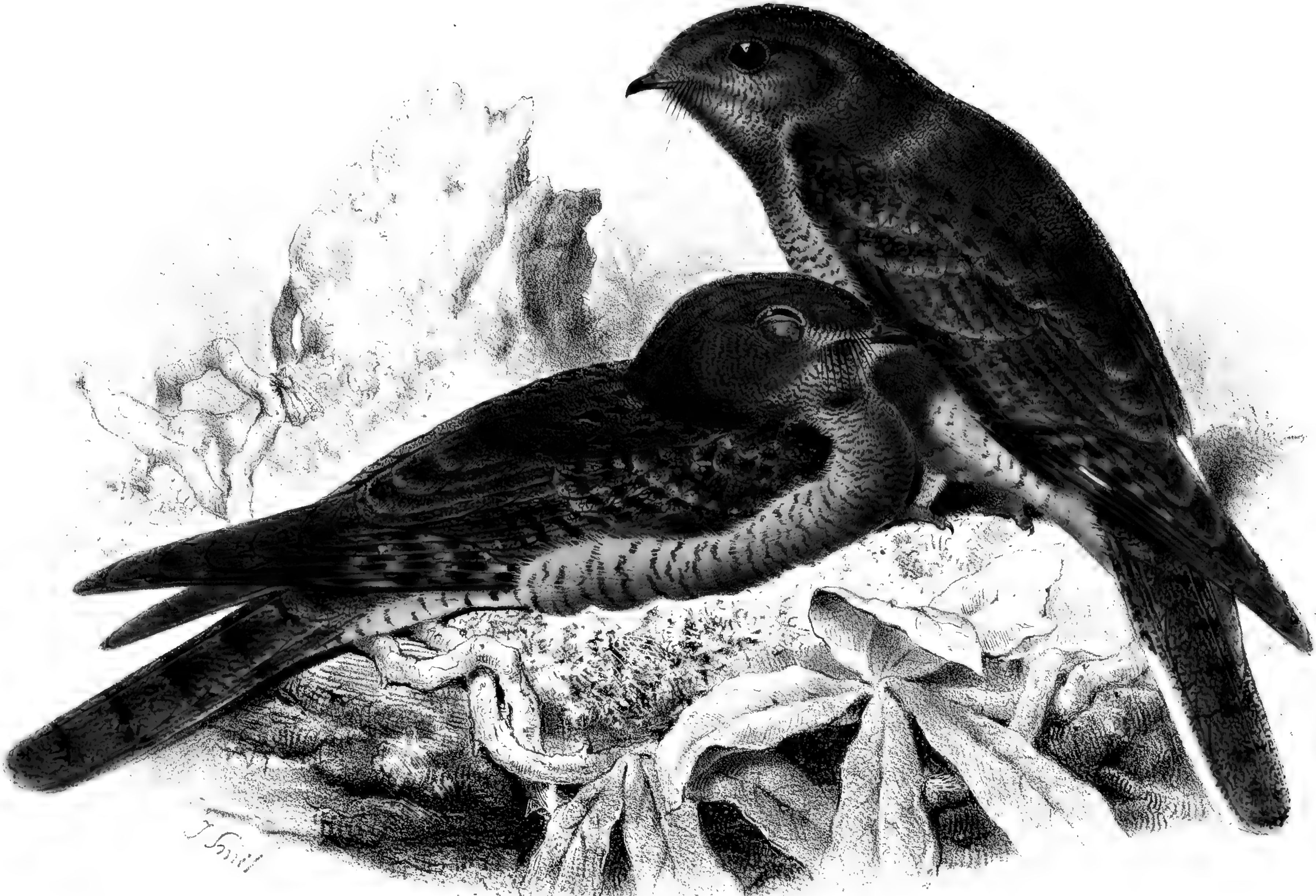
PLATE XXVII.

Larus hemprichii (p. 302), from a skin obtained by Mr. Jesse.

N.B.—The specimens figured in these Plates are included in the complete series of Mr. Jesse's birds now in the collection of Viscount Walden, Pres. Z.S.—Ed.

Trans. Zool. Soc. Vol. 1. Pl. 23.

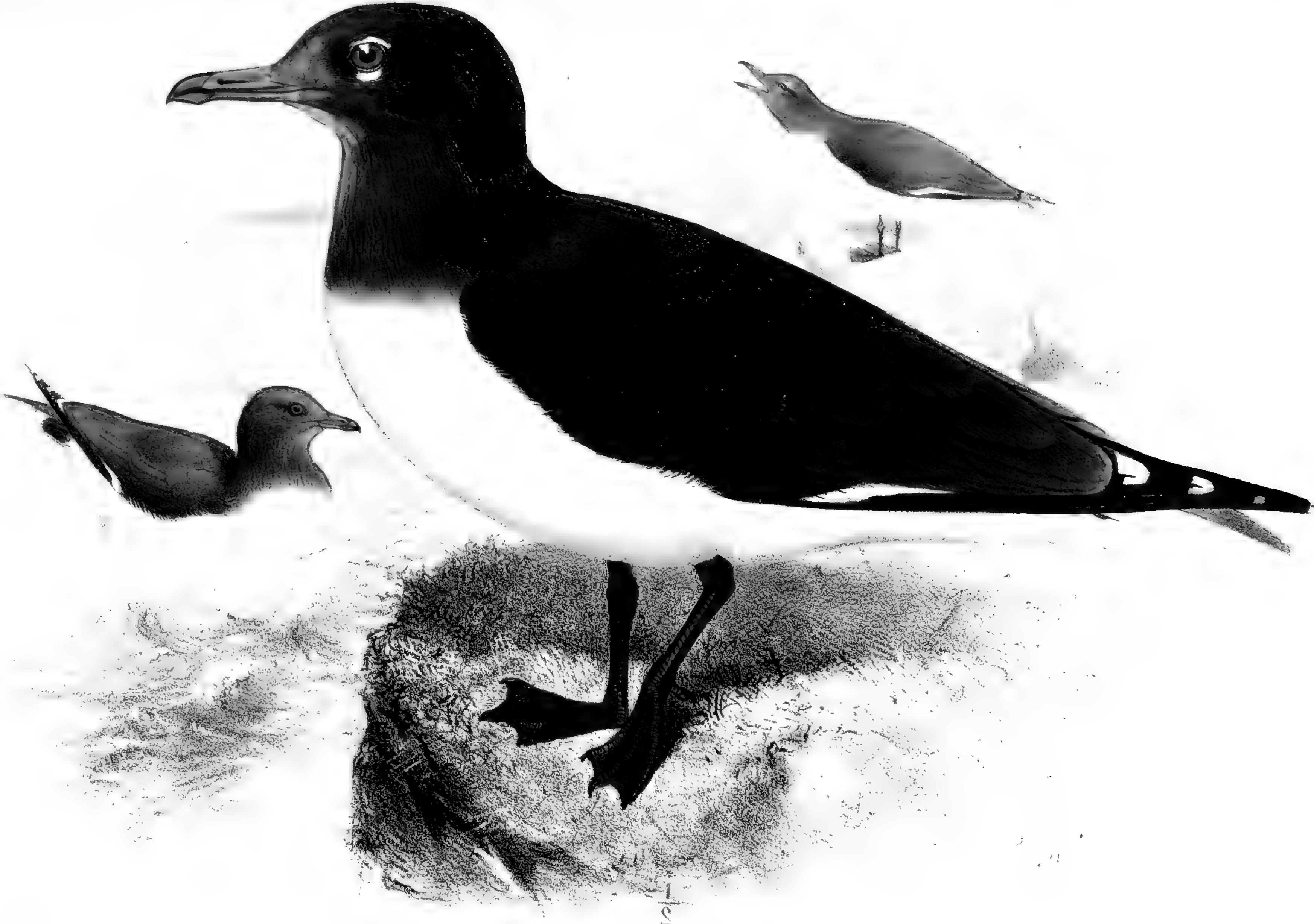




CAPRIMULGUS CORNUTUS


J. S.

CORAPHITES MELANAUCHEN



LARUS HEMPRICHII

VII. *On certain Species of Deer now or lately living in the Society's Menagerie.*

By P. L. Sclater, *M.A., Ph.D., F.R.S., Secretary to the Society.*

Read February 24th, 1870.

[Plates XXVIII. to XXXIX.]

THE series of Cervidæ in the Society's Menagerie has been considerably augmented of late years, particularly as regards the larger species of the Old World, which have been conveniently arranged in the new Deer-house recently erected in the eastern corner of the South Gardens. Several of these Deer are now or have been lately represented by examples of both sexes and of the young born in the Gardens; and amongst them are certain species which are very little known to science. Under these circumstances I propose to offer to the Society some notes upon these animals to accompany a set of illustrations of the rarer species which have been prepared from the living specimens.

I must, however, premise that my notes relate principally to the history of the introduction of these animals into the Society's Gardens, and to the synonymy and distribution of the species there exhibited. It is not possible to gather much exact information concerning the structure of animals from the examination of living specimens, except as regards one or two obvious external characters which may be noticed without close handling.

The species of Deer to which I have thus to call the Society's attention are *nine* in number, all belonging to the genus *Cervus*, as I should be disposed to consider it.

They are:—

1. Cervus davidianus. (Plate XXVIII.)

Elaphurus davidianus, A. Milne-Edwards, Compt. Rend. 14 May, 1866; Ann. Sc. Nat. ser. 5, v. p. 380; Nouv. Arch. d. Mus. ii. Bull. p. 27, pl. iv. (1866); Alcock, P. Z. S. 1868, pp. 210, 530; David, ibid. p. 210; Swinhoe, ibid. p. 530; Sclater, ibid. p. 531, et P. Z. S. 1869, p. 468.

This fine animal is one of the many zoological discoveries which are due to the researches of M. le Père Armand David, Missionary of the Congregation of Lazarists at Pekin, an active correspondent of the Museum of Natural History of the Jardin des Plantes, and a Corresponding Member of this Society. M. David first made known the existence of this Deer in 1865, in a letter addressed to Professor Milne-Edwards, having become acquainted with it by looking over the wall of the Imperial Hunting-park, in which it is kept in a semidomestic state. This Park is situated about two miles south of Pekin, and is called the *Nan-hai-tsze* or "*Southern Marsh*"[1]. No European is

[1] "The Imperial hunting-ground, or *Hae-tsze*, as it is called, is three miles outside the south gate of the Chinese city; it is a tract of country enclosed by a wall forty miles long. The Emperors Kanghi and Keen-

allowed to enter it. It is stated to contain Deer of different species[1], and herds of *Antilope gutturosa*, besides the Elaphures. M. David saw from the wall more than a hundred of the last-named animal, which he described as resembling a "long-tailed Rein-deer with very large horns." At that time he was unable, in spite of every effort, to get specimens of it, but, being acquainted with some of the Tartar soldiers who mounted guard in the park, subsequently succeeded in obtaining the examples upon which M. Alphonse Milne-Edwards founded his description of this remarkable animal.

Shortly after this M. Henri de Bellonet, Chargé d'Affaires of the French Legation at Pekin, managed to procure a living pair of Elaphures from the Imperial Park, and kept them for nearly two years in a court near the Embassy in that city. Upon his return to Paris in the summer of 1867, M. de Bellonet, having heard of our applications to our correspondents at Pekin to obtain living examples of this animal, was kind enough to place this pair at the disposal of the Society upon our undertaking the expense of their removal to this country. This the Council willingly agreed to, and application was at once made to H.E. Sir Rutherford Alcock and our other correspondents at Pekin to make arrangements for their transport. Unfortunately, however, these animals died before this could be effected; but the skin and skeleton of the male were carefully preserved under Sir Rutherford Alcock's directions and forwarded to the Society along with two pairs of the shed horns of the same animal. They were exhibited at our meeting on November 12, 1868, after which the skin was deposited in the British Museum and the skeleton and horns in the Museum of the Royal College of Surgeons[2].

Meanwhile Sir Rutherford Alcock lost no time in making application to the Chinese authorities for other specimens, and, after interviews with Prince Kung and other high officials, ultimately succeeded in procuring several young pairs, one of which reached the Society's Gardens in perfect health and condition on the 2nd of August last[3].

The illustration (Pl. XXVIII.) represents this pair of Elaphures shortly after their arrival. It will be observed that the male is growing his young horns. I will add a few remarks which occur to me on examination of these interesting animals.

The general aspect of the Elaphure is much more like that of the true *Cervi* than I had anticipated from the description and figure of M. Milne-Edwards. The only two very noticeable points of distinction, besides the horns of the male, which are not at

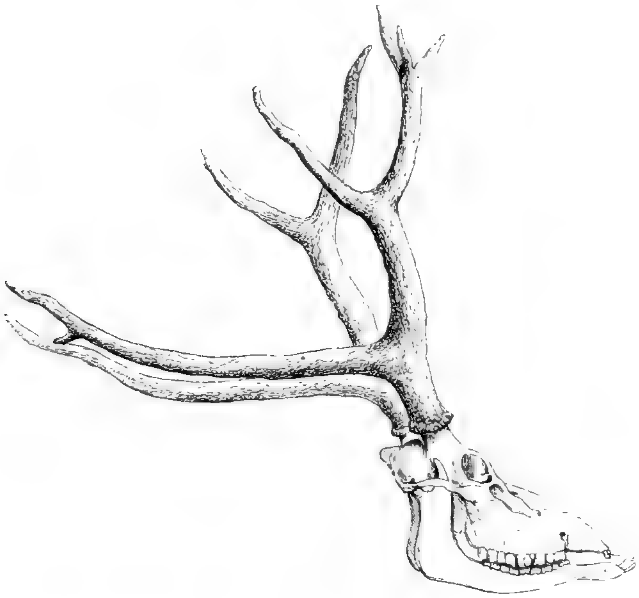
lung used often to hunt there. Several villages are in the enclosure, which is given up to pasture; herds of oxen and horses, and flocks of sheep for the use of the Court are fed there; and great numbers of deer are seen in all directions. It is simply an Imperial domain, and was used as a hunting-ground by the Court when public business did not permit a sojourn in the wild hunting-grounds of Tartary."—LOCKHART, in *J. R. G. S.* xxxvi. p. 148.

[1] *Cervus xanthopygus*, *Cervus mantchuricus*, and *Capreolus pygargus*, according to Mr. Swinhoe.

[2] This skeleton has since been beautifully mounted, and now stands in the centre of the inner room of the Museum. I believe it is still the only complete skeleton of this animal in Europe.

[3] See P. Z. S. 1869, p. 468.

Fig. 1.



Antlers and skull of *Cervus davidianus* from the skeleton in the Museum of the Royal College of Surgeons.

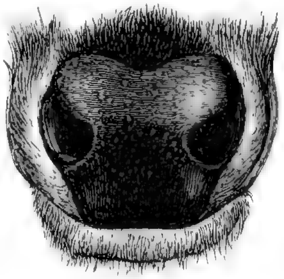
Fig. 2.

Head of young male *Cervus davidianus*, with the antlers growing.

present shown in our animals, are the rather larger, heavier legs, the longer and more expanding toes, and the long tail.

The latter character, however, seems to me to have been somewhat exaggerated in M. Milne-Edwards's figures—the tail in our specimen not nearly reaching the hocks, and, though of somewhat different form, being really little, if any, longer[1] than that of the Fallow Deer and some of the American Deer (such as *Cervus virginianus*).

Fig. 3.



The muffle of *Elaphurus*, as M. Milne-Edwards has already stated, is quite naked and moist, as in the true *Cervi* (see fig. 3).

The lachrymal sinus is small, and the eye also remarkably small. The muzzle (fig. 2, p. 335) is terminated by a good many single straggling bristles, as in *C. duvaucelli*.

The insides of the ears in this Deer are very closely filled with dense hairs.

I cannot ascertain positively whether the usual gland on the outer side of the metatarsus is present or not in this Deer; but it is certainly not very highly developed.

On the whole I can find no character to take this species out of the genus *Cervus* as I think it ought to be understood. The Elaphure is no doubt very distinct in the form of its horns from every other described species of the genus, and should be placed in a section by itself, just as *Rusa*, *Axis*, *Hyelaphus*, and the numerous other (so-called) genera of some authors. Those who regard these subordinate groups as generic will likewise use *Elaphurus* as a genus. To me its nearest ally seems to be perhaps the Barasingha (*C. duvaucelli*), which has likewise a long muzzle terminated with outstanding hairs, and rather long expanding toes. Like the Barasingha the Elaphure is in all probability an inhabitant of marshes and wet grounds.

M. Swinhoe informs me that the young *Cervus davidianus* is spotted with white like other true *Cervi* at its birth, and retains the spotted dress about three months, when these markings gradually disappear.

2. Cervus maral. (Plate XXIX.)

Cervus elaphus, Pallas, Zoograph. Rosso.-As. i. p. 216 (partim)?

Maral, McNeill, P. Z. S. 1840, p. 11.

Cervus maral, Ogilby, Report of Council of Z. S. 1840, p. 22; Gray, Knowsley Menag. vol. i. tabb. 40 et 50; Sclater, Zool. Sketches, ii. pl. 12; and List of Vert. ed. iv. p. 46.

—— *wallichii* (partim), Gray, Letterpress to 'Knowsley Menag.' vol. i. p. 60; Cat. of Ungulate Furcipeda, p. 197, et P. Z. S. 1852, p. 227; Sclater, Cat. of Vert. ed. 1, p. 10, ed. 2, p. 14, ed. 3, p. 27 (partim); Wagner, Säugeth. Suppl. v. p. 356.

On the 16th January, 1840, Sir John McNeil, a Corresponding Member of the

[1] In the mounted skeleton of this animal in the Royal College of Surgeons the caudal vertebræ are fifteen in number, measuring altogether 16·5 in. in length. In the adjoining skeleton of *Cervus elaphus* there are eleven caudal vertebræ, measuring 10·25 in. The height of the skeleton of *C. davidianus* above the shoulder is 4 feet; that of the skeleton of *C. elaphus* 3 feet 8 inches.

Society, presented to the Menagerie two "new Deer from the Persian Mountains." These were entered in the "List of Mammals exhibited for the first time," printed in the Council's Report for that year, as the "Persian Deer, *Cervus maral*, Ogilby"—Mr. Ogilby, no doubt, having intended to describe them under that name, which, however, he never appears to have done. These Deer were subsequently transferred to the collection of the late Earl of Derby, but, having been in bad condition, never recovered; and the last of them died in 1849[1]. In the collection of portraits of animals living in that collection, drawn by Mr. Waterhouse Hawkins, and commonly known as the "Knowsley Menagerie," are two pictures of this pair of Deer. Pl. XXXVIII. represents them both in winter dress, and Pl. XXXIX. the male in that of summer. In the latter stage the spotting is very conspicuous.

During the Crimean war a male of this Deer was captured in Circassia and "presented to the French Admiral by the chief into whose possession it fell. A female having been obtained at some other point on the coast of the Black Sea, the two animals were ultimately sent to the Earl of Ducie, who, after keeping them for three seasons at Tortworth, most liberally presented them to this Society"[2] on the 12th of March, 1857. On the 23rd of August, 1858, the female produced a hind of the same sex; and nearly every year since that period this species of Deer has reproduced in the Society's Gardens, as the subjoined list of the original pair and their descendants will show:—

List of Persian Deer in the Society's Gardens.

a. Male	Presented by the Earl of Ducie	March 12, 1857.
b. Female	,, ,,	,, ,,
c. Female	Born in the Menagerie	July 9, 1857.
d. Female	,, ,,	August 23, 1858.
e. Female	,, ,,	July 24, 1860.
f. Female	,, ,,	August 19, 1860.
g. Female	,, ,,	June 19, 1862.
h. ———	,, ,,	November 2, 1862.
i. Male	,, ,,	September 28, 1863.
j. Male	,, ,,	October 10, 1863.
k. Male	,, ,,	July 9, 1865.
l. Male	,, ,,	August 1, 1866.
m. Male	,, ,,	August 6, 1867.
n. Female	,, ,,	September 19, 1868.

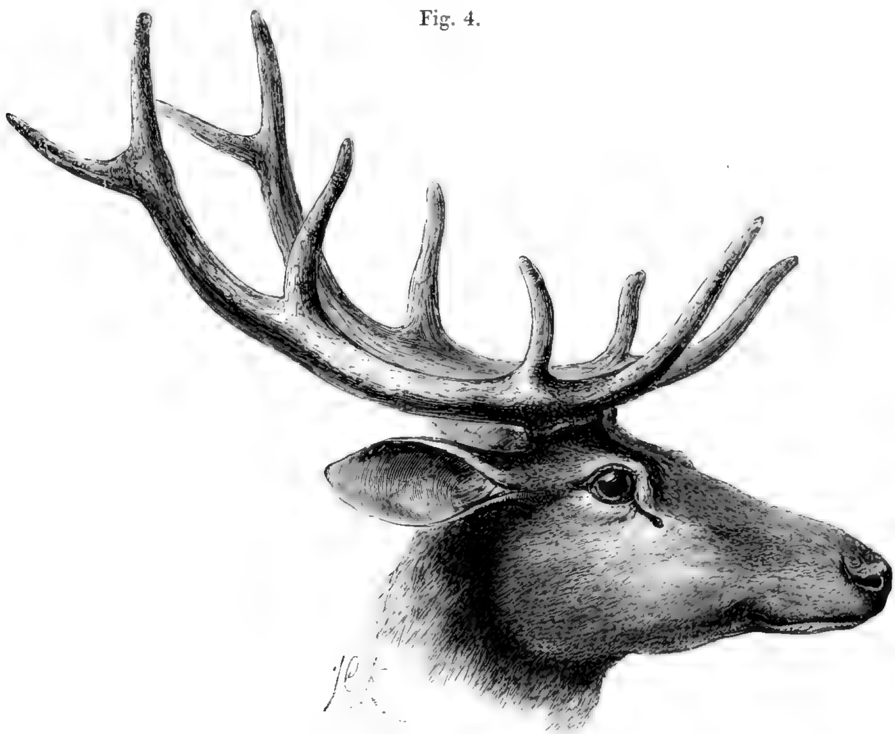
The Society have at different times sold off their duplicate stock of this Deer to the King of Italy, the Jardin des Plantes of Paris, the Zoological Society of Hamburg, Sir Victor Brooke, and elsewhere; but I am not aware that any other importation of this animal has taken place, nor do I believe that any of the Continental Museums contain specimens of it, unless from the stock disposed of as above mentioned.

[1] 'Guide to the Gardens of the Zoological Society of London,' by D. W. Mitchell. 1858, p. 48.

[2] Mitchell's Garden Guide, *l. s. c.*

Having stated thus much concerning the history of the introduction and propagation of this Deer, I must now say a few words concerning its proper specific name—a subject that has given me no little trouble. As I have already stated, the original examples of this species received from Sir John McNeil were regarded by Mr. Ogilby as new to science, and proposed to be called *Cervus maral*, after their Persian name. Under this name they are likewise figured in the plates of the 'Knowsley Menagerie.' But in the letterpress of the 'Knowsley Menagerie,' prepared by Dr. Gray, the "Persian Deer" is united with the Cashmirian Deer (*Cervus cashmeerianus*) and called *Cervus wallichii*. The same course is pursued in Dr. Gray's other catalogues, and has been generally followed by subsequent authors, until in 1866 I convinced myself that this view was erroneous, and proposed to restore the specific name *maral* to the present species. As I have never published the grounds for making this change I shall now endeavour to explain them, and to show, first, that the Persian and Cashmirian Deer are specifically different, and, secondly, that the term *Cervus wallichii* is not applicable to the former animal, whatever may be the case as regards the latter.

Fig. 4.



Side view of head of *Cervus maral*.

That the Persian and Cashmirian Deer are of different species must, I think, be allowed by every one who has examined the examples of these two animals now living in our Gardens. The Persian Deer is remarkable for its long, narrow, pointed head, whereas the Cashmir Deer has a short head like the Red Deer, *Cervus elaphus.*

A second very noticeable point of distinction is the colour of the upper surface of the tail, which in *Cervus maral* is pale brown or ferruginous, in *Cervus cashmeerianus* is dark, very nearly black. The anal disk is also smaller in the latter animal and more darkly margined.

Now as to the term *wallichii.* This name was established by Cuvier in 1825 (Oss. Foss. ed. 3, iv. p. 504), upon a drawing made by M. Duvaucel from an animal living in 1822 in the Barrackpore Menagerie, which drawing was subsequently published by F. Cuvier in the 'Histoire Naturelle des Mammifères' (pl. 356). We learn from Mr. Blyth (J. A. S. B. x. p. 745), who has carefully investigated General Hardwicke's MSS. on this subject, that this animal was originally brought from Muktenauth, near Dewaligiri, to the east of the Gundhuk river, but beyond the snowy range[1], about five weeks' journey from the valley of Nepaul. The horns of this individual are still in the Museum of the Asiatic Society of Calcutta; and Mr. Blyth had "compared them carefully with mature horns of both the *Hungal*" (i. e. *Cervus cashmirensis*) "and the *Shou*" (i. e. *Cervus affinis*), and, "though it is impossible to pronounce with confidence, is inclined to refer them to the former." But Dr. Jerdon, who has also examined into the question, is inclined to think that Cuvier's figure represents *Cervus affinis*; and if the locality whence the animal came has been correctly stated, I should think there can be little doubt that this latter view is correct. Whichever be the case, there can be no doubt that it is quite erroneous to apply the name *wallichii* to the Caucasian species.

3. Cervus cashmeerianus. (Plate XXX.)

Cervus cashmeerianus, Falconer, MS. (1839).
—— *wallichii,* Blyth, P. Z. S. 1840, p. 79.
"*Kashmir Stag,*" Blyth, J. A. S. B. x. p. 747 (1841).
"*Cervus cashmerensis,* Falconer, MS.", Gray, Osteol. Cat. B. M. p. 65 (1847).
—— *casperianus,* Gray, ibid. p. 147 (1847).
—— *wallichii,* Gray, Letterpress to 'Knowsley Menagerie,' vol. i. p. 60; Cat. of Ungulata Furcipeda, i. p. 197; P. Z. S. 1852, p. 227.
"*Shu,* or *Tibetan Stag,*" Cunningham, Ladák, p. 201 (1854).
Cervus cashmeriensis, Adams, P. Z. S. 1858, p. 529.
—— *wallichii,* Gray, Cat. of Bones of Mamm. in Brit. Mus. p. 258 (1862).
—— *cashmirensis,* Sclater, List of Vert. Z. S. L. p. 47 (1866).
—— *wallichii,* Jerdon, Mammals of India, p. 250 (1867).
—— *cashmeerianus,* Falconer, Palæont. Memoirs, i. p. 576 (1868).
—— *wallichii,* Kinloch, Game of Thibet and the North-west, p. 44 (1869).

The first scientific traveller who appears to have recognized the existence of a large species of *Cervus,* allied to our *Cervus elaphus,* in Cashmeer was the late Dr. Hugh

[1] *Cf.* Jerdon's 'Mammals of India,' p. 252.

Falconer, who, during his expedition to Cashmeer and Little Thibet, obtained several specimens of the present species. Dr. Falconer made careful notes of this animal, designating it in his MS. *Cervus cashmeerianus*, but unfortunately never published these notes; and it is only since his lamented decease that these and many other of his valuable contributions to science have been made known. Mr. G. T. Vigne, the well-known traveller, who was in Cashmeer at the same time as Dr. Falconer, seems to have furnished him with some sketches of this Deer, which are likewise published in the 'Paleontological Memoirs'[1].

In 1840 Mr. Vigne seems to have shown a horn of the Cashmirian Deer to Mr. Blyth, who gave a short account of it on July 28th of that year before this Society. Mr. Blyth suspects that it "would prove to be the *C. wallichii* of Duvaucel, or a closely allied species, a description of which may be expected from Dr. Falconer."

In 1841 Mr. Blyth, in his article on the "True Stags or Elaphine form of *Cervus*," published in the Journal of the Asiatic Society of Bengal (x. p. 736), again speaks of the "Kashmir Stag" (p. 747), and considers it "very likely" to be identical with the "Jerrael, *Cervus wallichii*, Duvaucel, *Cervus affinis*, Hodgson," but understands that "Dr. Falconer considers them distinct," and "leaves the Kashmir species to be described by the latter eminent naturalist." At the same time he takes the opportunity of giving two drawings[2] of the antler in Mr. Vigne's collection, which he had previously described in this Society's 'Proceedings.'

In 1846 Dr. Falconer presented to the British Museum skulls of the male and female of his "*Cervus cashmeerianus.*" In the "list of osteological specimens" of that institution, published in 1847, this name was misprinted "*cashmerensis.*" Dr. Falconer, as he once told me himself, endeavoured to have this mistake corrected, but was only successful in getting the miswritten term altered into the much worse form of *casperianus*! (List of Ost. Spec. *errata*, p. 147). Both these MS. names are quoted in the subsequently published catalogue of "Ungulata Furcipeda," and other catalogues of Dr. Gray, where the Cashmir Deer is united to the Persian Deer, and called *Cervus wallichii.*

In Cunningham's 'Ladak' (1854), a notice is given (p. 201) of the "Shu, or Tibetan Stag" found in Cashmeer, and a figure of its horns (pl. 7). This is doubtless intended for *C. cashmeerianus.*

In Jerdon's 'Indian Mammals' a short account is given of the Cashmeerian Deer under the name *Cervus wallichii*, which term, however, Dr. Jerdon subsequently allows, as I have stated above, to be more probably referable to the *Cervus affinis.* Dr. Jerdon also erroneously united the Persian Deer (*Cervus maral*) with this species.

In his article on the habits and haunts of various Indian Mammalia, published in the Society's 'Proceedings' for 1858, Dr. A. Leith Adams has given a good account of the habits of this species under the name *Cervus cashmeriensis.* According to Dr. Adams,

[1] See Paleontological Memoirs and Notes of the late Hugh Falconer. Edited by Charles Murchison, vol. i. p. 578 (1868).

[2] See the accompanying plate, J. A. S. B. vol. x. figs. 8 & 9.

this Deer is abundant in the dense pine-forests of the Northern Pinjal, and in the valleys amongst these ranges. More recently still, Lieut. Kinloch has given us some interesting notes on the same animal, in his volume on the larger game-animals of Tibet and north-western India.

On the 24th of November 1865 a fine young male of the Cashmeerian Deer was presented to the Society by Capt. M. H. S. Lloyd, of the 89th Regiment, being, as is believed, the only individual of this species ever received alive in Europe. The figure (Pl. XXX.) represents this animal as he appeared in November 1867, while the drawing now exhibited (fig. 5) will serve to show the present appearance of his head, which may be compared with the corresponding figure of *Cervus maral* (fig. 4).

Fig. 5.

Head of *Cervus cashmeerianus*.

Besides these two species, of which illustrations are given, the Society's collection contains representatives of three other species of typical *Cervus*—namely, the Wapiti (*C. canadensis*), the Red Deer of Europe (*C. elaphus*), and the Barbary Deer of North Africa (*C. barbarus*).

I will now add a few words concerning our present state of knowledge of the geographical distribution of the Elaphine Deer, or species allied to *Cervus elaphus*. Of course, geographical distribution cannot be properly worked out without a complete knowledge of the species. This in the present case we are very far from having yet attained, most of the public museums of Europe (where only the larger Mammalia can be preserved and studied) being miserably deficient in their series of these animals. But I believe I can make some little advance upon what has been hitherto known upon this subject.

This section of the genus *Cervus* is confined to the two principal regions of the earth's surface, which I have called the Palæarctic and Nearctic regions, and is therefore one of a numerous series of natural groups which may be termed "arctopolitan"[1]. In the neotropical region only one species is found, namely the Wapiti (*Cervus canadensis*[2]). In the palæarctic region there would appear, according to our present state of knowledge, to be probably six species. These are:—

1. CERVUS ELAPHUS, Linn. Of Europe and North-western Asia. The Russian naturalists Middendorff[3], Schrenck[4], and Radde[5], all agree in extending the range of *Cervus elaphus* into Amoorland and the extreme east of Siberia. But the species met with in the extreme east may be the next.

2. CERVUS XANTHOPYGUS, Alph. Milne-Edwards, Ann. Sc. Nat. 5 ser. Zool. viii. p. 376; Recherches Hist. Nat. Mamm. tab. xxi.

Cervus from Pekin, allied to *C. elaphus*, Leadbeater, P. Z. S. 1861, p. 368.

The existence of a large Deer of the Elaphine group in the vicinity of Pekin became known in 1860, when, on the entry of the allies into the Summer Palace, herds of two species of Deer were found grazing in the parks. Heads of the larger animal, obtained by Lieut.-Col. Sarel, F.Z.S., were exhibited by Mr. Leadbeater before a meeting of this Society in November 1861; but the species was not considered to be certainly distinct from *C. elaphus*.

Recently M. Fontanier has forwarded a skin of this animal to the Musée d'Histoire Naturelle of Paris, and M. Alphonse Milne-Edwards has named it *Cervus xanthopygus*, stating that it differs from *C. elaphus* in the lengthened form of the head, the greyish colour of the fur, and the greater size of the anal disk. M. Alphonse Milne-Edwards will, no doubt, give us further particulars of this animal in the 'Recherches pour servir à l'Hist. Nat. des Mammifères' now in course of publication, but at present has only issued the figure of it.

As stated above, the geographical limits between this species and *C. elaphus* remain to be decided, likewise how far it is really distinct from the next species.

[1] ἄρκτος, *pars orbis borealis*, et πολίτης, *civis*.

[2] Hamilton Smith separated the western Wapiti as *Cervus occidentalis* (Griffith's A. K. iv. 101). But we have a fine male of this form in the collection from Oregon (received April 16, 1863), and I cannot see that it has any claims to specific distinction.

[3] Sibir. Reise, ii. p. 120. [4] Amur-reise, Säug. p. 170. [5] Reisen im Süd. v. Ost-Sibir., i. p. 284.

3. Cervus affinis.

Cervus wallichii, Cuv. Oss. Foss. (ed. 3) iv. p. 504; F. Cuv. Hist. Nat. Mamm. pl. 356; Puch. Arch. d. Mus. vi. p. 396; Blyth, J. A. S. B. x. p. 745, et xx. p. 174.

—— *affinis*, Hodgson, J. A. S. B. x. p. 721, et xvi. p. 689, et xix. pp. 466, 518, et xx. p. 388; Jerdon, Ind. Mamm. p. 251.

—— *tibetanus* et *C. elaphus*, Hodgson.

I have already given my reasons for considering Cuvier's *Cervus wallichii* probably identical with the "Shou or Tibetan Stag" of Hodgson, usually called *Cervus affinis* by Indian naturalists; but as there is still a certain amount of uncertainty in the matter, it is perhaps better to retain Hodgson's name for the species. It now, however, seems quite certain that Hodgson was deceived in stating that this animal ever occurs in the Sâl Forests of the Nepalese Terai. It is also probable that Mr. Blyth and other authorities who speak of it as a "Tibetan" animal have been equally mistaken, the only certain locality for it yet known being the Choombi valley, near Sikim. This district, although politically belonging to Tibet, is on the south side of the Himalayas, and is drained by the Machoo river, which flows due south into the Burrampooter[1].

4. Cervus cashmeerianus. (Cashmirian Deer.) As far as is certainly known, this

[1] Dr. A. Campbell, late resident at Darjeeling, has kindly favoured me with the following reply to a request for information concerning *Cervus affinis*:—

"I took a great interest in the 'Shou' at one time, and in 1862 I brought home a beautiful head and horns, and a pair of very large loose horns, but I have not got them now. The cause of my especial interest in the animal was this. The first notice of it was by Hodgson, I believe, and was derived from a single horn picked up in the *Nipal Tarai* by Wallich's plant-collector—such is my impression. This must have been about the year 1824. In 1839 I left Cathmandu to march through the Tarai to the Sikim frontier, two hundred miles. On starting, Hodgson gave me a sketch of the horns of the 'Shou,' and asked me to make particular inquiry about it, and, if possible, to get him a skin, head, and horns complete. During my march I saw no end of all the known deer of the Tarai and lower hills, but could never fall in with any having two brow-antlers; and whenever I showed my sketch of the horns to the Shikarees or Elephant-catchers, who knew the country and all its animals most intimately, they invariably told me that 'no such deer as that was ever seen in the Tarai.' Two or three years later my official duties took me into the *Bootan Tarai*, and I renewed my inquiries after this deer, but with the same result. I now turned to the people at and about Darjeeling for information about the animal, and learned that a large deer with double brow-antlers, called the 'Shou,' was found in Choombi; and at last I procured its head and horns, and skins of the male and female. The point of interest, therefore, about the 'Shou' or 'Tibetan Stag' is, that its habitat is not '*Thibet*' at all; and indeed this might have been inferred from the absence, which I believe to be the case, of all other deer from the fauna of that country.

"The 'Shou' is an animal found in the valley of 'Choombi,' which, although politically belonging to Thibet, is in its physical aspect totally different from Thibet. It is well wooded, well watered, and fertile. Thibet proper is destitute of wood, bare, and mostly barren. It is in the woods surrounding the valley of '*Choombi*' that the 'Shou' finds its genial shade and pasture. Choombi lies between the Chola Pass of the Sikim Himalayas and Phari, on the frontier of Thibet proper. See Hooker's 'Himalayan Journals,' vol. ii. p. 110."

Deer is only found in Cashmeer; but Hodgson's *Cervus nariyanus* (J A. S. B. xx. p. 393, pl. 8), said to be from Gnari or Western Tibet, may be the same animal.

5. Cervus maral. (Persian Deer.) Inhabits the Caucasus, and thence ranges into Armenia and Northern Persia.

6. Cervus barbarus. (Barbary Deer.) This is the representative of the Red Deer in the Atlas and adjoining districts, which, as is now well known, are still zoologically, as they were in former days territorially, part of Europe.

4. Cervus mantchuricus. (Plates XXXI., XXXII.)

Cervus wallichii, Swinhoe, P. Z. S. 1861, p. 134.
—— *pseudaxis*, Gray, P. Z. S. 1861, p. 236, t. xxvii.
—— *hortulorum* et *C. mantchuricus*, Swinhoe, P. Z. S. 1864, p. 169, et 1865, p. 1.
—— *mantchuricus*, Sclater, P. Z. S. 1864, p. 721, 1865, p. 1; List of Vert. ed. 3, p. 27, ed. 4, p. 47; Zool. Sketches, ii. tab. xiii.

Next to the typical *Cervi* comes a small group of deer confined to China and Japan, which are undoubtedly closely allied to the Elaphine series, but are distinguishable by their inferior size, the distinct spotting of the summer dress, and the invariable want of the brow-antler. Of all of these we have living examples in the Society's collection; and two out of the three have bred with us. They are chiefly distinguishable *inter se* by their size, the present species being the largest of the three.

The Mantchurian Deer, like the *Cervus xanthopygus*, was first discovered when the English and French forces entered the parks of the Summer Palace, near Pekin, in October 1860. Mr. Swinhoe obtained from Lieut.-Col. Sarel three skins of this animal (procured on this occasion), and forwarded them to this Society[1], by whom they were presented to the British Museum. Mr. Swinhoe at first thought that this deer, as well as the larger deer procured at the same time (which afterwards turned out to be *Cervus xanthopygus*), might be referable to *Cervus wallichii*. Dr. Gray subsequently communicated to the Society a notice of these specimens, but referred them to *Cervus pseudaxis*[2], under which name also he has given a good figure of what Mr. Swinhoe regards as a "two-year-old buck," but which is probably a somewhat older animal. This specimen is now in the gallery of the British Museum, and is, I have no doubt, identical with our living *Cervus mantchuricus*.

In 1864 Mr. Swinhoe having had another opportunity of examining heads of the larger deer of the Summer Palace (*Cervus xanthopygus*), convinced himself that they were quite distinct from the smaller species which Dr. Gray had determined as *C. pseudaxis*. Mr. Swinhoe was likewise of opinion that the smaller species could not be the true *Cervus pseudaxis*, and proposed the new name *hortulorum* for it[3]. In the same letter Mr.

[1] See Mr. Swinhoe's letter, P. Z. S. 1861, p. 134.
[2] P. Z. S. 1861, p. 236.
[3] See Mr. Swinhoe's letter, P. Z. S. 1864, p. 168.

Swinhoe announced that he had forwarded to the Society a "Mantchurian Deer, apparently of a new species, procured at New-chwang," and gave a short description of it under the name *Cervus mantchuricus.* It appears, therefore, that Mr. Swinhoe unwittingly gave this deer two new names in the same letter.

Mr. Swinhoe's typical specimen of *Cervus mantchuricus* reached this country in safety in July 1864[1], and has since remained with us in good health, though unfortunately we have never succeeded in getting a mate for him.

Plate XXXI. represents this individual in his summer dress, which stage has also been described by Mr. Swinhoe (P. Z. S. 1865, pp. 1, 2) from a specimen examined at Amoy in October 1864.

Plate XXXII. represents the same individual in the more soberly coloured dress of winter, when the spots are barely visible at all, except just on the back, above the shoulders.

5. CERVUS TAËVANUS. (Plates XXXIII., XXXIV.)

Cervus taiouanus, Blyth, J. A. S. B. xxix. p. 90.

—— *taëvanus,* Sclater, P. Z. S. 1860, p. 376, 1862, p. 152, tab. xvi., 1866, p. 80; Swinhoe, P. Z. S. 1862, p. 362; Sclater, Zool. Sketches, ii. tab. xiv.; Sclater, List of Vert. ed. 1, p. 11, ed. 2, p. 15, ed. 3, p. 27, ed. 4, p. 47.

The Formosan Deer was one of Mr. Swinhoe's numerous zoological discoveries in the little-known Chinese island to which it is confined. In 1860 Mr. Swinhoe forwarded a skull of this animal to Mr. Blyth at Calcutta, who described it as *C. taiouanus,* after the Chinese name of Formosa. In December 1861 we received from Mr. Swinhoe a fine living male example of this deer, of which animal I gave a notice and figures in the 'Proceedings' for 1862 (p. 150, pl. xvi.). In 1866 we received through Mr. Swinhoe our first female of this species; and in 1868 (July 21) the first fawn was born, which is represented with its mother in Plate XXXIV. as it appeared in November of that year. This Deer, however, has not done nearly so well with us as the following species, *C. sika.*

Mr. Swinhoe has given some details respecting the habits of this Deer in his article on Formosan Mammals published in the Society 'Proceedings' for 1862 (p. 362).

I think it probable that the *Cervus pseudaxis* of Eydoux and Souleyet (Voy. Bonite, Zool. p. 64, pl. 3), established upon a living animal obtained by these naturalists in Java and brought to the Jardin des Plantes in 1838, was of this species; and if this be case, the name *pseudaxis* has priority over *taëvanus.* M. Pucheran informs us[2] that another individual of this species was obtained by the expedition of the 'Astrolabe' and 'Zelée' at the Sooloo Islands; but this, as well as the former example, may have been carried away in ships from their native land.

[1] See notices of its arrival, P. Z. S. 1864, p. 721, and 1865, p. 1.

[2] Arch. d. Mus. vi. p. 489.

6. Cervus sika. (Plate XXXV.)

Cervus sika, Temm. et Schl. Jap. Mamm. p. 54, tab. 17; Sclater, P. Z. S. 1860, p. 377; Sclater, Zool. Sketches, ii. tab. xv.; List of Vert. ed. 1, p. 12, ed. 2, p. 15, ed. 3, p. 27, ed. 4, p. 47.
Rusa japonica, Gray, Ann. N. H. ser. 3, p. 218; P. Z. S. 1861, p. 236.

Our first pair of Japanese Deer were received in July 1860, having been obtained at Kanagawa, and presented to the Society by Mr. J. Wilks. In 1861 we purchased a second female of the same species. From these three individuals has descended a numerous progeny, as the following list will show:—

List of Japanese Deer which have lived in the Society's Gardens.

a. Male	Presented by J. Wilks, Esq.	July 21, 1860.
b. Female	,, ,,	,, ,,
c. Female	Purchased	June 5, 1861.
d. Female	Born in the Menagerie	September 5, 1862.
e. Female	,, ,,	August 2, 1863.
f. ———	,, ,,	July 8, 1864.
g. ———	,, ,,	June 8, 1865.
h. ———	,, ,,	June 26, 1865.
i. ———	,, ,,	June 3, 1866.
j. ———	,, ,,	July 8, 1866.
k. Male	,, ,,	June 8, 1867.
l. Male	,, ,,	July 16, 1867.
m. ———	,, ,,	June 13, 1868.
n. ———	,, ,,	August 5, 1868.
o. Male	,, ,,	June 14, 1869.
p. Male	,, ,,	June 25, 1869.

Most of the larger zoological gardens on the Continent have also living specimens of this beautiful deer, which seems in every way qualified to become a permanent denizen of our parks. It is extremely hardy, breeds well, and requires very little care and attention.

The figure of *Cervus sika* in the 'Fauna Japonica' appears to be intended for this animal in its winter dress, in which the spotting is almost obsolete, although in our animals it never quite disappears. The accompanying Plate (XXXV.) represents this deer in its summer dress. The figure in the 'Fauna Japonica' is also incorrect in not showing the conspicuous white of the anal region, which is nearly as evident in winter as in summer.

7. Cervus duvaucelli. (Plate XXXVI.)

Cervus duvaucelli, Cuv. Oss. Foss. (3 ed.) iv. p. 505.
—— *bahraiya,* Hodgson, P. Z. S. 1834, p. 99 (descr. nulla).

Cervus elaphoides, Hodgson, J. A. S. B. iv. p. 648 (1835), et P. Z. S. 1836, p. 47.
Rucervus elaphoides vel *duvaucelli,* Hodgs. J. A. S. B. xvi. p. 689.
Cervus euceros, Gray, Knowsley Menag. pls. 40 & 41.
Rucervus duvaucellii, Gray, Knowsley Menag. p. 61; Cat. of Ung. Furc. p. 213; Jerdon, Mamm. of India, p. 254.

Cuvier established his *Cervus duvaucelli* in the second edition of his 'Ossemens Fossiles,' upon three antlers sent to the Paris Museum by Duvaucel from "the Indies." The exact locality where these were procured is not stated; but the species thus indicated has hitherto by general consent been considered to be the same as the Bengalese animal subsequently named by Hodgson *Cervus bahraiya* and *C. elaphoides* [1].

The first individual of this Deer received in the Society's Gardens was a female acquired at the sale of the late Lord Derby's collection at Knowsley in 1851. In 1857 a young male was presented to the Society by the Babu Rajendra Mullick, of Calcutta. The pair bred in 1858; and the female produced a fawn on the 23rd of August of that year. The same pair and their descendants bred again in 1860 and subsequent years, as will be seen by the following list:—

List of Barasingha Deer in the Society's Gardens.

a. Male	Purchased at Knowsley sale	October 26, 1851.
b. Female	Presented by the Babu Rajendra Mullick	July 14, 1857.
c. Female	Born in the Menagerie	July 17, 1858.
d. Female	,, ,,	July 24, 1860.
e. Female	,, ,,	August 19, 1860.
f. Male	,, ,,	August 26, 1861.
g. Female	Deposited	December 5, 1863.
h. Male	Born in the Menagerie	June 30, 1864.

At the present time, however, I regret to say that our stock of this Deer has been reduced by a series of accidents to a single female (*c* of list).

The winter coat of this Deer is of a dullish brown, which, however, changes in summer into a brilliant golden yellow, glossed over in the male with purplish black in front. The summer dress of both sexes is shown in the plate (Pl. XXXVI.).

In a state of nature the "Barasingha," as this Deer has been usually termed in this country, is a water-loving species. It is found in the reedy marshes and islands bordering the large rivers of Bengal, extending eastwards into Assam (where it is said to be very abundant in the islands of the Burrampooter), and westwards into the great forest-tract of Central India.

[1] *Cf.* Pucheran, Arch. d. Mus. d'H. N. vi. p. 378. But Professor Milne-Edwards has informed me that he is doubtful of the correctness of this identification. If these doubts are well founded, the present species must bear the name *elaphoides.* But I do not know any other described species to which the horns as figured by Cuvier (*l. c.* pl. 39. figs. 6, 7 & 8) could be referred.

8. Cervus eldi. (Plates XXXVII. & XXXVIII.)

"Nondescript Deer," McClelland, Calc. J. N. H. i. p. 501; Eld, ibid. ii. p. 415.

Cervus eldi, auct. anon. Calcutta Journal N. H. ii. p. 417 (1842); Beavan, P. Z. S. 1867, p. 759; Swinhoe, P. Z. S. 1869, p. 6.

—— (*Rusa*) *frontalis*, McClelland, ibid. iii. p. 401, tt. xiii. et xiv.

Panolia eldii, Gray, Cat. of Ung. Furc. p. 202.

—— *eadii*, Gray, Knowsl. Men. p. 61.

—— *acuticornis* et *P. platyceros*, Gray, List of Mamm. B. M. pp. 180, 181, 118; Horsf. Cat. Mamm. p. 187.

Cervus dimorphe, Hodgs. J. A. S. B. xii. pt. 2, p. 897 (1844); Ann. N. H. xiv. p. 74.

Rusa dimorphe, Gray, Knowsl. Men. p. 62; List of Ung. Furc. p. 209.

This Deer was first discovered in the valley of Munipore in 1838 by Lieut. Eld; and its horns having been sent to Dr. M'Clelland, were described by him in the first volume of the 'Calcutta Journal of Natural History.' In the second volume of the same journal will be found a full notice of the habits and localities of the animal by Lieut. Eld, to which is appended a suggestion (communicated to the Editor by the *correspondent* who forwarded Lieut. Eld's paper) that it should be called *Cervus eldi*. The Editor, however, thinks this suggestion "premature," and in the third volume of the same journal describes the animal as *Cervus frontalis*. Under these circumstances it is somewhat difficult to decide what should be its proper appellation. The term "*eldi*" was the first published; but we do not know who is the authority for it. Dr. M'Clelland, the Editor of the Journal, who used it, clearly repudiated it subsequently in favour of his own name "*frontalis*." On the whole, however, it seems most just to retain the name "*eldi*," it being absolutely the first published specific appellation for this Deer.

Lieut. Beavan has lately contributed to the Society's Proceedings (1867, p. 759) a very complete account of the habits and range of this Deer; and Mr. Swinhoe has recorded its occurrence in Hainan. It is probably found all through the Burmese countries in suitable localities—that is, in the low watery swamps and jungles that border the large rivers of those countries.

It now seems to be generally agreed that Hodgson's *Cervus dimorphe*, of which the type is in the British Museum, is a young male *Cervus eldi*; but if so, he was probably deceived as to the locality of his specimen, which he gives as the Sâl forest of the Nepalese Morung[1].

Our first and only specimen of this Deer was a young male presented to the Society by Mr. Grote, and brought home to England by Mr. C. Bartlett, along with a collection of other Indian animals, in August 1867. Mr. Grote had received it when quite a fawn from Col. Phayre, the Governor of British Burmah. The principal figure in Pl. XXXVII. represents this individual as he appeared when commencing to grow his

[1] *Cf.* Jerdon, Mamm. of Ind. p. 256, and Swinhoe, P. Z. S. 1869, p. 658.

new horns in the autumn of 1867, from a sketch of Mr. Wolf; the hinder figures have been added to show the form of the perfect horns in the adult and semiadult males. Plate XXXVIII. represents the same individual in his winter dress in 1868. We unfortunately lost him just as he was acquiring his new horns.

Allied to the present species, and still more to *Cervus duvaucelli*, is *C. schomburgki* from Siam, characterized by Mr. Blyth in the Society's Proceedings for 1863, p. 155, and 1867, p. 835. I believe all three will be ultimately found to belong to the same subgeneric group, The Jardin des Plantes of Paris now contains a living example of a *Cervus schomburgki*; so that we may shortly expect a full description of the animal, of which the horns only were known to Mr. Blyth.

9. Cervus swinhoii. (Plate XXXIX.)

Cervus swinhoii, Sclater, P. Z. S. 1862, p. 152, pl. xvii.; 1867; p. 818; Sclater, Zool. Sketches, ii. tab. xvii.; Swinhoe, P. Z. S. 1862, p. 364.

In a letter received from Mr. Swinhoe in the spring of 1852 the existence of a second species of Deer in Formosa, called the "*Cheeang*," was first mentioned; and

Fig. 6.

Head of *Cervus swinhoii*.

shortly afterwards two bucks of this species were procured alive and forwarded to the Society. One of these reached us in safety on the 28th of April of that year, and turned out to be a species of the Rusine group, which I subsequently described in the Society's 'Proceedings,' and proposed to call *Cervus swinhoii* after its discoverer. The figure given along with the description (P. Z. S. 1862, pl. xvii.) represents this individual shortly after its arrival, when its young horns were growing. The accompanying Plate, copied from a sketch by Mr. Wolf (Pl. XXXIX.), shows the adult form of the animal.

In September 1862 we received a second young male of this Deer, and in September 1867 a third example, which, at the moment, we believed to be a female and was so entered in the register [1]. This, however, was subsequently discovered to be unfortunately an error, as the individual turned out to be a young male, which has since developed horns, and is still living in the Gardens.

Mr. Swinhoe has given us an account of the habits of this Deer in a state of nature in his article on Formosan Mammals (P. Z. S. 1862, p. 364).

As regards the affinities of this species, it is unquestionably nearly allied to the

Figs. 7 & 8.

Cervus aristotelis.

Cervus equinus of Sumatra and Borneo (*cf.* Müller, Verh. Zool. p. 212, tab. 42); and I do not pretend to be able to point out the differences between these two Deer, as we

[1] See P. Z. S. 1867, Appendix, p. 1046.

have never had adult specimens of the latter[1]. But the Formosan form of Rusa is certainly, in my opinion, quite distinct from the true Sambur of continental India (*C. aristotelis*) which Mr. Blyth now seeks to unite with *C. equinus*[2]. The true Sambur is a larger and more lightly and uniformly coloured animal, and attains much larger and better developed horns than *C. swinhoii*, which is further remarkable for the rufous colour of its hinder quarters and its black and very thick and bushy tail.

I exhibit some drawings of the head of a young male Sambur (*C. aristotelis*) now in our Gardens (figs. 7 & 8) (where he was born May 31, 1866), one of which shows the development of horns attained by this species even when four years old. The extended suborbital sinus, which in all Rusine Deer is very large, is well shown in the figures.

DESCRIPTION OF THE PLATES.

PLATE XXVIII.

Cervus davidianus, male and female, from the pair presented by Sir Rutherford Alcock, C.M.Z.S., taken shortly after their arrival, August 2nd, 1869. Height at shoulders 3 ft. 10 in.

PLATE XXIX.

Cervus maral, adult male and female, in winter dress, and fawn, copied from an original water-colour drawing by Wolf, composed from animals living in the Society's Gardens. Height at shoulders 4 ft. 6 in.

PLATE XXX.

Cervus cashmeerianus, adult male, taken in November 1867. Height at shoulders 4 ft. 5 in.

PLATE XXXI.

Cervus mantchuricus, in summer dress, from an original water-colour drawing by Wolf, prepared from the typical example in the Society's Gardens. Height at shoulders 3 ft. 8 in.

PLATE XXXII.

Cervus mantchuricus, in winter dress, taken from the same individual in April 1868.

[1] *Cf.* Swinhoe, P. Z. S. 1869, p. 659.

[2] See Jerdon, Ind. Mamm. p. 260, and P. Z. S. 1869, p. 658.

PLATE XXXIII.

Cervus taëvanus, adult male, in summer dress, from an original water-colour drawing by Wolf. Height at shoulders 2 ft. 11 in.

PLATE XXXIV.

Cervus taëvanus, female and young, from animals in the Society's Gardens in November 1867.

PLATE XXXV.

Cervus sika, male and female, in summer dress, from an original water-colour drawing by Wolf. Height at shoulders 2 ft. 8 in.

PLATE XXXVI.

Cervus duvaucelli, male and female, in summer dress, from an original water-colour sketch by Wolf. Height at shoulders 3 ft. 11 in.

PLATE XXXVII.

Cervus eldi, in summer dress, from an original water-colour drawing by Wolf. The full figure represents the individual received August 6th, 1867, with the new horns just growing.

PLATE XXXVIII.

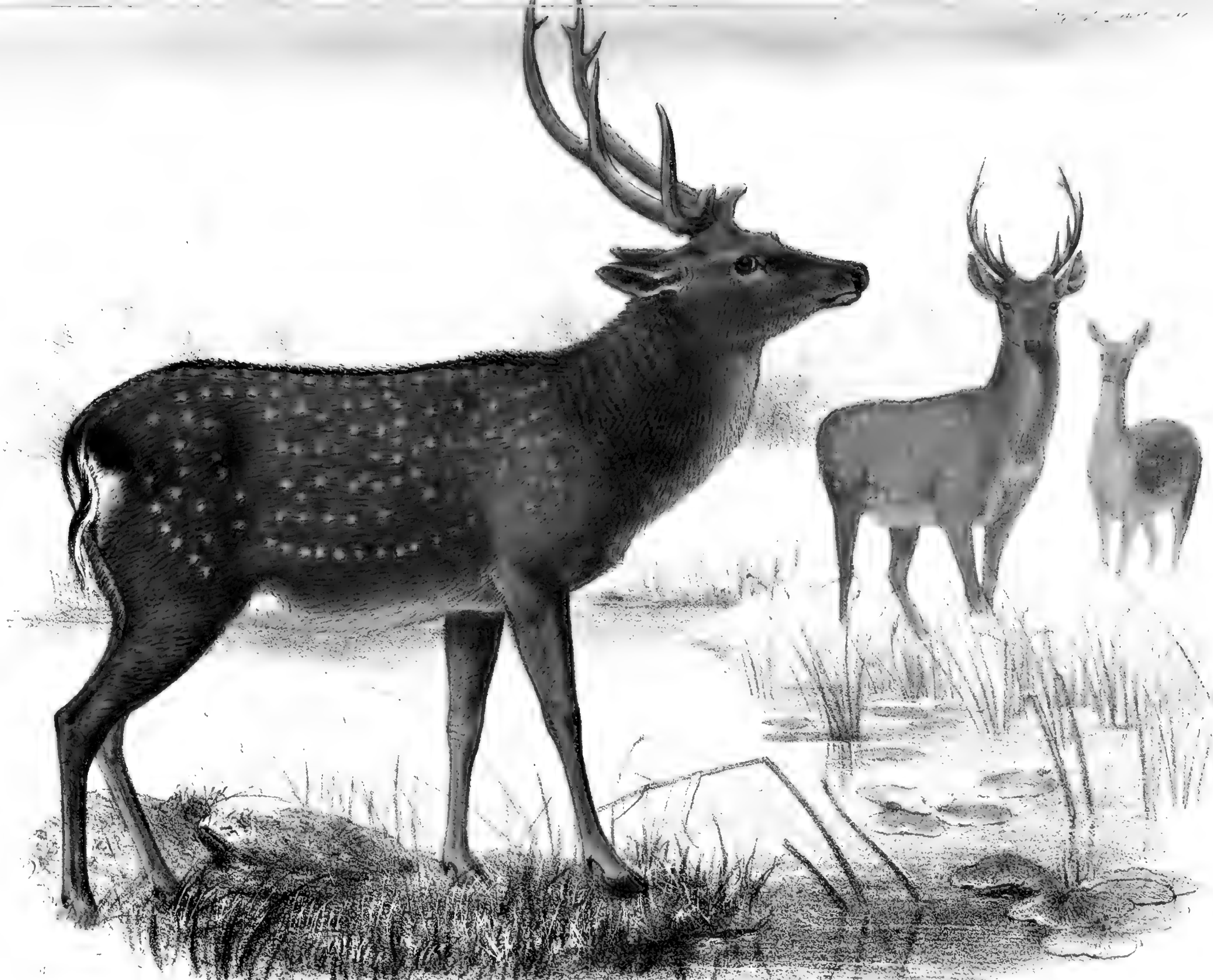
Cervus eldi, in winter dress, from the same individual.

PLATE XXXIX.

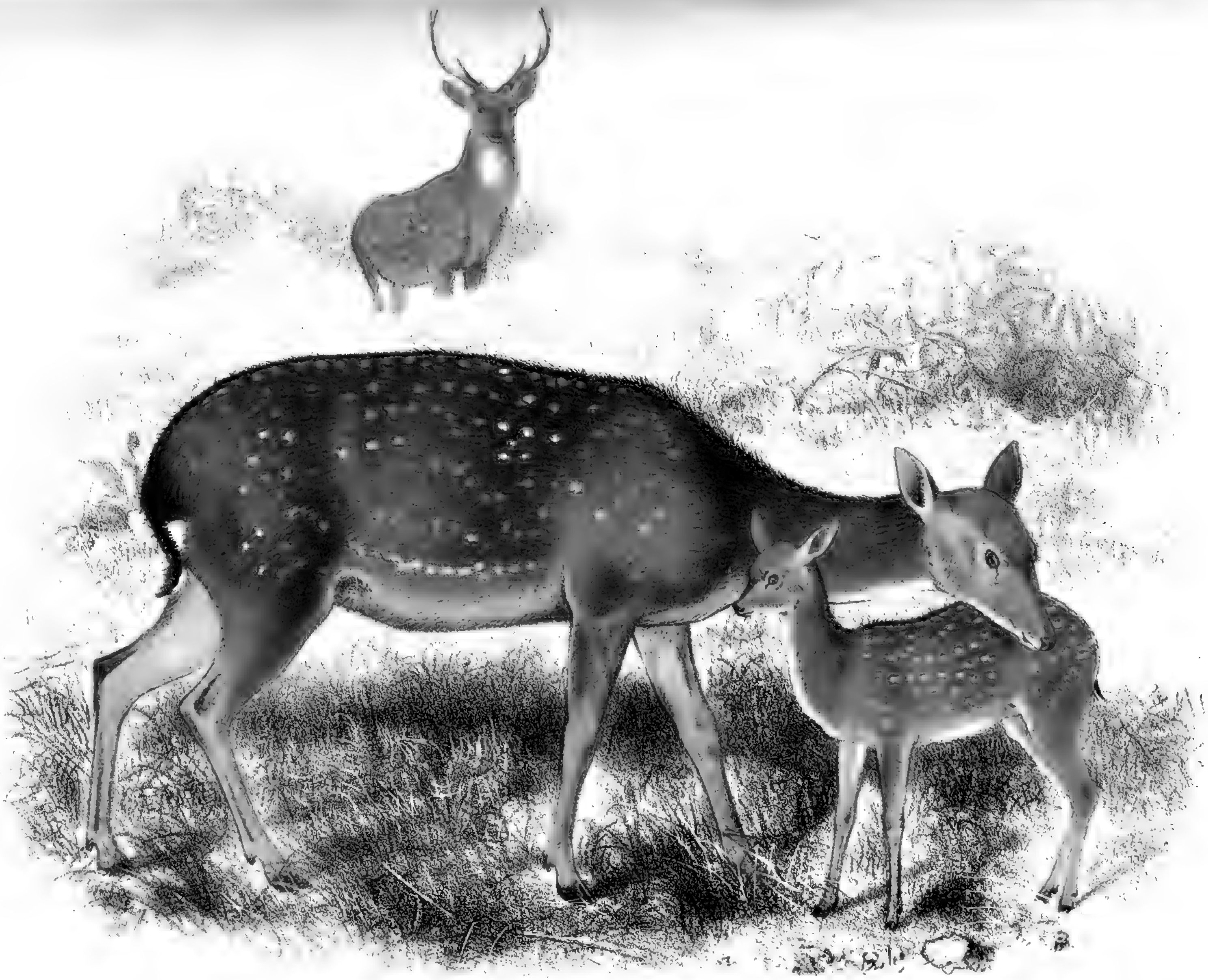
Cervus swinhoii, in winter dress, from an original water-colour by Wolf. Height at shoulders 3 ft. 11 in.

J. Smit lith.

CERVUS CACHMERIANUS.



CERVUS MANTCHURICUS



CERVUS TAIVANUS

VIII. *On* DINORNIS (Part XV.): *containing a Description of the Skull, Femur, Tibia, Fibula, and Metatarsus of* Aptornis defossor, *Owen, from near Oamaru, Middle Island, New Zealand; with additional Observations on* Aptornis otidiformis, *on* Notornis mantellii, *and on* Dinornis curtus. *By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read March 10th, 1870.

[PLATES XL. to XLIV.]

§ 1.

THE Rev. RICHARD TAYLOR, M.A., to whose valuable cooperation in advancing the Natural History of New Zealand, the field of his devoted missionary labours, I have had occasions to testify [1], was so obliging as to submit to my inspection, on his recent return to England, a skull, femur, tibia, and fibula, which I recognized, with intense interest, to belong to that very rare and singular genus of extinct New-Zealand birds the *Aptornis*. Mr. Taylor favoured me with a copy of the following "entry" from his note-book relative to these bones:—"They were discovered in a cave of soft sand about fourteen miles from Oamaru, which was filled with birds' bones. The peculiarity of this skull is its massiveness, very small brain-receptacle, and width of bill: it appears to be allied to the *Notornis*, but of a much larger size."—July 1st, 1863.

It will be seen in the course of the following descriptions that these bones belong to that ornithic form first indicated by a tibia referred to a *Dinornis otidiformis* [2], but subsequently shown by metatarsal and cranial characters to represent a distinct genus, for which I proposed the name *Aptornis* [3].

The generic characteristics of both skull- and leg-bones are closely repeated in the present specimens; but, as shown in the "Table of Admeasurements" (p. 378), they are larger than those parts of *Aptornis otidiformis*. This increase of size is also associated with some modifications of form and proportion. The original (smaller) specimens, on

[1] From the period, viz., of my Memoir on the first general collection of *Dinornis*-remains of November 1843. "The Rev. Mr. Taylor, of Wanganui, has a large collection of these bones, found in a river between that place and New Plymouth."—Trans. Zool. Soc. vol. iii. (November 1843), p. 271. This locality is in the North Island, where the smaller species of *Aptornis* was found. Mr. Taylor has recorded the results of long experience and observation in his work 'On New Zealand and its Inhabitants,' 8vo.

[2] Trans. Zool. Soc. vol. iii. p. 247, pls. 25 & 26. fig. 6.

[3] In the Memoir (No. III.) read January 11th, 1848; ib. vol. iii. p. 347. In the 'Revue Zoologique' for October 1848, M. de Selys-Longchamps proposed the minor abbreviation "*Apterornis*" for some, then vaguely indicated, extinct birds of the Mascarene Islands.

which the genus was founded, are of a mature bird[1]; and accordingly I propose to refer the bones under description to an *Aptornis defossor*.

§ 2. *Skull of* Aptornis defossor. (Plate XL. figs. 1–3, Plate XLI. figs. 1–4 & 6–8.)

The skull, as Mr. Taylor remarks, may be said to be massive, the cranial walls are thick, much of its osseous substance is compact, and there is the full amount of confluence of the bones of the head observed in birds. The beak is moderately down-bent, and terminated by a transverse subtrenchant margin, in both upper and lower jaws. The length of the part of the skull anterior to the orbit exceeds the rest by one-eighth; the fore-and-aft extent of the orbit is rather less than one-fifth that of the entire skull. The cranium, viewed either from above or below (Pl. XL. figs. 2 & 3), offers a subquadrate form. The breadth of the occiput at the paroccipitals (4, 4) equals that of the cranium at the postfrontals (12, 12), a character to which the skull in *Notornis* and *Dinornis* offers the nearest approach. The occipital region (Pl. XLI. fig. 1) extends below the foramen magnum (*o*) further than above it—a proportion unique in the class *Aves*.

Those most conversant with the osteological features of birds will best appreciate the singular and exceptional characters above defined. The external bony nostrils (Pl. XL. fig. 1, *n*) are large and triangular, or oval-elongate, with the upper, small end almost pointed. No groove or furrow is continued forward from them. The interorbital septum (ib. fig. 1, *o*) is entire; the temporal fossæ (*t*) are deep, though wide apart above (ib. fig. 2, 7); they are over-arched externally by an upper zygoma (ib. fig. 1, 8′–12), as in Crocodiles. The cerebral bosses are hardly raised above the level of the interorbital region (ib. fig. 2, 11).

The occipital tubercle (Pl. XLI. fig. 1, 1) is hemispheroid, 5 lines in transverse diameter, feebly impressed by a small pit at the middle of its upper half. The basioccipital advancing from the condyle about two lines, then curves downward, and, with the basisphenoid, forms a subquadrate almost vertical plate, inclined somewhat forward, below, with the lower angles produced and swollen to form a pair of oblong convex tuberosities (Pl. XL. fig. 3, *l*′, Pl. XLI. fig. 1, 5′, 5′).

The vertical surface of this descending part of the occiput is concave across, but less deeply than in *Aptornis otidiformis*[2], the lateral margins not being so produced backward, especially at their upper part. In both species they form angular lamelliform processes, each defending the inner side of the corresponding vagal fossa (ib. fig. 1, *v*). Three minute precondyloid foramina, in a vertical line, range on each side of the base of the condyle. The depth of the basioccipito-sphenoidal ("basilar") tract, from the under part of the condyle to the middle of its under surface, measures 1 inch 2 lines, to

[1] The anchylosis of the stylohyal in the original skull (Trans. Zool. Soc. vol. iii. pl. 52. figs. 3 & 6, 38) indicates it to have come from an old bird.

[2] Trans. Zool. Soc. vol. iii. pl. 52. fig. 4.

the end of the tuberosity 1 inch 4 lines; the breadth of the tract is 1 inch ½ line: in the centre of the tract is a small venous foramen. The tuberosities bend forward and inward; each is indented by an oblique channel; and from each a ridge continuing the convergence is lost after 3 lines course upon the fore part of the basisphenoid. This curves upward and contracts to a median ridge slightly produced, as a compressed process, projecting about 2 lines forward freely below the base of the presphenoid (Pl. XL. fig. 3, 9). The occipital foramen (Pl. XLI. fig. 1, *o*) is vertically elongate, with a small process on each side, projecting inward and forward from the junction of the lower with the middle third, as in *Aptornis otidiformis*[1]. The vertical diameter of the foramen is 7 lines, the transverse one 5½ lines, the foramen being relatively smaller than in *Aptornis otidiformis*. As in that species, the occipital surface, as it rises from the foramen magnum, slopes forward to the superoccipital ridge (Pl. XL. fig. 2, 3).

From the under and inner base of the paroccipital an irregular ridge or bar of bone (Pl. XL. figs. 1 & 3, 4′) passes downward and inward, forming the outer side of the vagal fossa, and bending forward into and abutting against the smooth deep channel outside the descending basicranial tract (1–5), where it terminates like an adherent process, with a rough tuberous ending. It was to the left of these productions (Trans. Zool. Soc. vol. iii. pl. 52. fig. 6, 4′) of the paroccipital, which might be called "styloid processes," that the proximal element of the hyoid arch (stylohyal, ib. 38) was anchylosed in the skull of *Aptornis otidiformis*: this is significant of the arbitrariness of the ascription of the tympanic or quadrate bone to that arch. The hind part of the base of the alisphenoid is more produced and tuberous outside the end of the hyoid process of the paroccipital in *Aptornis defossor* than in *Apt. otidiformis*. Between this process and the expanded base of the alisphenoid there is a groove-like extension of the tympanic cavity.

The alisphenoid expansion is pneumatic; in advance of that swelling are two wide pneumatic openings; and two lines in advance of these is the foramen ovale.

The mastoid in mammals is characterized by its early ossification, the centre or centres appearing in the primordial or protocranial cartilage containing the acoustic vesicle. In this developmental relation Cuvier's "temporal" in birds agrees with the mammalian mastoid. Mr. Parker admits that the mastoids are already ossified at the "time that the parietals are small ovoid patches;" but he cannot apparently bring himself to state that his "squama temporis" in the chick is ossified in and from the protocranial cartilage, including the labyrinth. The "squama temporis" in the human embryo is ossified in a membranous basis, like the parietal; the base of the zygoma alone shows cartilage. The condition of the mammalian squamosal in Monotremes, in which it is almost reduced to its zygomatic part, shows well the homologous bone in birds. The mastoid, connate, as usual in birds, with the petrosal, here joins the alisphenoid, pushing inward, between the pneumatic vacuities and the canal for

[1] Trans. Zool. Soc. vol. iii. pl. 52. fig. 4, *o*.

the third division of the trigeminal nerve, to form the articulation for the double condyle of the tympanic. The cavity is oval, directed from behind, forward and outward; the postero-internal division is the largest and shallowest; the antero-external one is the deepest, and is hemispheroid. The articulation is close and deep, whereby, with a peculiar suspensory structure, the tympanic is retained on the right side of the present skull, where the surrounding parts of the cavity are entire. Between the articular cavities for the tympanic and the paroccipital are the large pneumatic vacuities; and behind them is a smooth, transversely extended deep fossa. This is partially bounded externally by the normal mastoid process, but is continued outward, contracting into the groove between the mastoid (Pl. XL. fig. 1, 8) and the mesomastoid (8′) process. This process has contracted a filamentary bony union with the expanded base of the alisphenoid, the filament passing behind the neck of the tympanic, and helping to suspend and maintain it *in situ*. But the great characteristic of this part of the skull of *Aptornis* is the large size and advanced position of the premastoid process (ib. 8*). This diverges, like the two hinder ones, from the common diapophysial basis, developed in and from the primordial cranial cartilage, and retaining all the guiding homological characteristics of the Crocodile's mastoid. The process (8*), repeating the zygomatic development thereof, is three-sided; the fore and hind sides are broadest, and meet externally at a sharp ridge directed downward and forward, bisecting the temporal fossa, but leaving the hinder division widest. Near its lower end the premastoid contracts a bony union with the postfrontal (12) as in *Aptornis otidiformis*, but with a shorter, broader, and more compressed free termination beneath that union. The inner, narrow side of the premastoid process presents a rough surface for apparently ligamentous union with a process from the outer side of the tympanic.

The basisphenoid is pierced anteriorly by the outlets of the Eustachian canals, continued into each other by converging channels, underlapped by the process (Pl. XL. fig. 3, *m*), which is compressed and slightly produced downward. Above the Eustachian channels the basisphenoid contracts, and is produced into the presphenoid, first sending off on each side a small, horizontally compressed ridge or plate representing a "pterapophysis," but without an articular surface. If it is joined at all to the pterygoid, it must be only by ligament.

Each orbito-sphenoid shows three small foramina in a transverse line, representing the "prelacerate fissure," behind the large optic foramen. The optic foramina are barely two lines apart anteriorly. Beneath them the connate orbito-presphenoid is impressed by a smooth, oblong cavity, and is continued forward, confluent with the prefrontal, as an entire but thin "interorbital septum," expanding anteriorly to form the back part of the olfactory chamber. The rhinal platform (Pl. XL. fig. 3) is subcompressed vertically.

The olfactory chambers do not extend backward beyond the "platform;" they are subspherical, half an inch in diameter, divided by a thin but complete septum, and perforated each by a single olfactory foramen a little external to their hind walls.

They are wholly anterior to the cerebral cavity. Their condition in *Aptornis otidiformis* (Trans. Zool. Soc. vol. iii. pl. 52. fig. 5, 18) is closely repeated in *Apt. defossor.*

The cranial cavity, exposed in the present specimen by an opening on the left side (which may have been made to extract the brain), shows a slight falcial ridge; and about half an inch outside this, runs a less marked parallel ridge, indicative of a longitudinal sulcus on the surface of the cerebral hemisphere. The under parts of the anterior cerebral lobes were divided from each other by a short ridge continued forward from above the common intracranial beginning of the optic foramina. A well-marked curved "tentorial" ridge marks the boundary between the prosencephalic and the combined mes- and ep-encephalic divisions of the cranial cavity. The "sella" is small and moderately deep. There is a well-defined, oblong, rough depression for the "Harderian gland" at the back part of the orbit.

The nasal bones (Pl. XL. figs. 1 & 2, 15) seem to touch each other at their postero-internal angles, whence they diverge, and are distinct from each other in the rest of their course. They coalesce with the frontal; but the fronto-nasal suture seems traceable, forming a strong curve convex backward, touching the transverse parallel of the middle of the superorbital ridge, and thence curving forward to the antorbital process, where a portion of the suture is persistent: it is possible that this curved line may indicate the limit of a frontal expanse of the nasal. At one inch and a quarter from the hindmost part of the nasal, that bone bifurcates into its maxillary (*b*) and premaxillary (*a*) branches.

The maxillary branch (Pl. XL. fig. 1, *b*) is a long, straight, narrow, subdepressed rod, a little wider midway, and coalescing with the nasal process of the maxillary (ib. 21) too closely for any trace of the original distinction.

Although the nasal branch of the premaxillary (22') has coalesced with the nasals, the line of original distinction is traceable, and shows the premaxillary branch of each nasal (ib. fig. 1, *a*) to have become soon overlapped by the premaxillary, and to have extended forward from the bifurcation of the nasal nearly two inches, each slightly inclining toward its fellow, underlapping and strengthening that part of the bony arch of the upper mandible.

The palatine plate of the maxillary (Pl. XL. fig. 3, 21') underlaps that of the premaxillary (22''), filling the interval between it and the dentary part of the premaxillary. The line of suture is apparent; it is transverse and convex forward, nearly in the same relative position to the prepalatine vacuity as in *Dinornis*[1]. This vacuity is continued backward between the maxillaries (ib. 21'), and then between the palatines (ib. 20), and is continuous with the palato-nares (ib. *e*, *e*).

The palatines (20), at their upper and mesial beginnings, extend backward, parallel to each other, for an inch or more on each side of the vomer and the fore end of the presphenoid. Their contiguous sides in this extent are nearly straight, with an interval of

[1] See *Dinornis ingens*, Trans. Zool. Soc. vol. vii. pl. 15. fig. 3, 22'', 21.

from one to two lines. From this type connexion or origin each arches obliquely upward and outward, in a degree increasing from behind forward, where opens the base of a semiconical cavity so formed, the thin lamellar wall of which is continued down into the posterior one of the palatal nostril. The cavity above this opening is divided by a horizontal portion into two *culs-de-sac*. From the walls of this cavity two plates are continued, one median, the other lateral. The median one projecting, where the palato-narial cavity begins to expand, from the common posterior plate or body of the palatine, descends vertically and abruptly, for 5 lines, gradually losing depth and gaining breadth at the level of the roof of the mouth, where it extends forward on each side the midpalatal vacuity for about one inch, coalescing with the maxillary, but leaving a trace of the original separation; the median side of the median plate is convex; the outwardly curved free border is somewhat thickened; the outer concave side of the plate and the oblique longitudinal channel between the median and lateral descending plates of the palatine have a rather rough surface. The outer or lateral lamella, continued from the outer wall of the palato-narial *cul-de-sac*, extends downward and outward in a less degree than does the median plate, and without thickening of the free border, but expanding horizontally, as it advances, to coalesce with the base of the malar process of the maxillary. The interlamellar channel, with a general breadth of 4 lines, gradually deepens as it retrogrades, until the inner plate suddenly ceases; the outer plate then contracts, becomes horizontal, and converges to unite with that of the opposite palatine behind the palato-nares. The inner wall of the palato-narial *cul-de-sac* is continued forward, contracting to a styliform process, which is, indeed, the fore end of the articular origin of the complex cranial pleurapophysis—such origin extending backward, as above described, from its own to the succeeding centrum, as the head of a rib is apt to do.

At the opposite end the palatine, as above described, bifurcates to effect two junctions with its hæmapophysis, the maxillary—one with its outer or dentary border, the other with its inner or palatal productions.

The short maxillary (21) presents or radiates, as usual in birds, its premaxillary, palatine, nasal, and malar productions. Posteriorly, between its palatine, nasal, and malar rays, it expands into a sort of rudimental "antrum" consisting of two low, shallow, pneumatic fossæ divided by a horizontal shelf, concave backward; and from the lower division goes a small oblique communication with the fore part of the hypopalatine channel, just showing where the maxillary contributes to and continues the fore part of that channel. The small foramen answers to the commonly larger (palato-maxillary) vacuity at this part of the roof of the mouth. The nasal process of the maxillary preserves part of its posterior margin free; the rest is intimately blended with the long maxillary style of the nasal (fig. 1, *b*) above described. The anterior transversely expanded part of the maxillary is intimately blended with and contracts above to be wedged between the maxillary and palatal parts of the premaxillary. These are the true or type beginnings, or basis, of that "hæmal spine." They speedily coalesce as they extend forward into a horizontal plate half an inch broad (fig. 3, 22″); it is slightly concave, with an irregular surface below, more concave and smooth above; it has a thickish, smooth median margin, and a rough outer one rapidly rising as it advances to be continued into the nasal branch of the premaxillary.

The anterior part or "body" of the bone (Pl. XL. figs. 1 & 2, 22) is 2 inches 9 lines in length, 1 inch 3 lines in breadth at the base, whence the branches radiate, thence tapering to an anterior, depressed, slightly rounded terminal trenchant edge half an inch broad. The upper surface for about an inch from this end is smooth; each lateral margin is rough, and gains in thickness as it recedes, forming a convex, non-canaliculate dentary border, 2 inches 5 lines long, about $1\frac{1}{2}$ line thick, continued, contracting, for about 6 lines, upon that of the maxillary. The rough surface gradually extends upon the outer side of the premaxillary to a breadth of $3\frac{1}{2}$ lines, where it is arrested by a very shallow smooth impression, above which open six or eight conspicuous nervo-vascular foramina in an irregular longitudinal series. Here the sides of the premaxillary are more rapidly continued into the upper surface; the arch or transverse convexity not being a regular curve.

The palatal surface of the premaxillary (ib. fig. 3, 22′) is concave lengthwise, but more so across, especially midway between the fore and hind end of such surface. It is divided lengthwise into three tracts—one median, becoming concave and smooth at its posterior half, and two lateral, similarly concave, but irregular of surface. They deepen forward into narrow grooves, from which nervo-vascular canals pass into the substance of the bone; and the grooves grow more shallow as they extend to the almost trenchant termination of the upper beak. The fore part of the common midpalatal vacuity is half an inch in advance of the fore part of the outer bony nostril; and the ridge from the upper mid tract of the premaxillary part of the roof of the mouth extends half an inch in advance of the palatal vacuity before it rises to the upper plate of the premaxillary. The vacuity of the premaxillary, which is an anterior extension of the common nasal cavity, becomes divided only along the anterior half of the outwardly seeming solid part of the premaxillary. From the apices of the long conical cavities, so separated and extended toward the fore end of the upper beak, one or two canals are continued outward, forming by their termination the anterior of the conspicuous nervo-vascular canals above noted. The nasal branch (22′), 2 inches 8 lines in length, gradually loses breadth as it recedes, viz. from 11 lines to 7 lines between the bifurcating part of the nasals, then more rapidly to its cranial termination, which is nevertheless broadly rounded, where it overlies the smooth and free prefrontal, coalescing by its periphery with the frontals and nasals. The premaxillary processes of the latter underlap the premaxillary, the margins of which appear thickened by bending down to the nasal coalescence; the under surface of the internarial part of the premaxillary is reticulate. This part of the long arch of the base of the beak is strengthened by the pair of longitudinal ridges due to the produced premaxillary processes of the nasals.

The tympanic[1] (Pl. XL. fig. 1, 28, Pl. XLI. figs. 2, 3, 4) has its mastoid end expanded and divided into two convex condyles (figs. 2 & 4, *k*), corresponding in form and relative size to the cavities for their reception above mentioned. The inner, larger, oblong condyle is more convex lengthwise than transversely; the outer, smaller condyle is subhemispheric; they are connected by a narrow tract, forming the upper part of a pneumatic foramen which divides the condyles from each other posteriorly. The stem of the condyles, subcompressed, from 3 lines to 4 lines in length, quickly expands as it descends, sending off anteriorly a broad, thin, compressed, triangular, obtusely pointed orbital plate (ib. *e*), and downward and backward outswelling in every direction, but chiefly antero-posteriorly, to form an unusually large lower end (*i*), the anterior half of which affords the single articular surface (Pl. XLI. fig. 3, *i*) for the mandible. On the outside of the base of the articular stem is the process with the flat articular surface (fig. 4, *f*) for the premastoid; on the outside of the mandibular articular expansion is the articular cavity (ib. *h*) for the squamosal. The orbital plate is widely excavated internally; and the lower border of the cavity sends off the small hemispherical articular tubercle (fig. 2, *g*) for the pterygoid. Thus there are not fewer than five articular facets on this singularly modified homologue of the element or "process of the tem-

[1] In regard to the homology indicated by this name, I have no better reason for breaking a silence which an accuser might call obstinate, save the following, which I give for what it is worth. Prof. Huxley states (Proc. Roy. Soc. Nov. 18, 1858), with the emphasis of italics, and a repetition of negatives, implying sense of the insecurity of his ground, "that the tympanic of the mammal does *not* articulate with the lower jaw, nor with the pterygoid, nor with the jugal or quadrato-jugal;" and so trite a statement of a commonly known fact would have remained unnoticed by me if it had not been quoted, in a former volume of the 'Transactions of the Zoological Society,' with commendation, as if it were a novel contribution to the elements for determining the homology of that bone in other vertebrates. Mr. Parker puts this statement, which he rightly characterizes as "very true," in the van of his arguments for opining "that the quadratum of birds is the homologue of the mammalian incus" (Trans. Zool. Soc. iv. p. 316).

But the "incus" "of the mammal does *not* articulate with the lower jaw, nor with the pterygoid, nor with the jugal, or quadrato-jugal." What is more, also, and what Mr. Parker's guide was careful to be silent upon, is this, viz. that the incus of the mammal does *not* articulate with the mastoid, or with the squamosal, nor does it support the membrana tympani or any part thereof. No doubt the tympanic of the mammal is reduced in divers degrees in that class; but it always retains those relations with the mastoid and squamosal, and performs that function in reference to the ear organ, which characterize it under all its subordinate and accessory developments in Birds, Chelonians, Crocodiles, and other air-breathing vertebrates. The averment that "Professor Owen, once wrong, goes far astray" (Parker, ibid. p. 304), does not affect the facts nor the legitimate deductions from them which guide to a recognition of the homology of the tympanic, the mastoid, and the squamosal—at least by one bent "on *ascertaining*, instead of pleasantly *supposing*, the true nature of an anatomical element" (Parker, ib. p. 271). The case is this: the negative argument tells as strongly against the incus or other member in the chain of ossicles or gristles connecting the membrana fenestræ vestibuli with the membrana tympani, as it does against the tympanic, whilst the positive evidence is exclusively in favour of the tympanic.

One use of homology or "namesakeism" is to rid anatomy of different names for the same thing. Why do not those who believe the "quadratum" to be the "incus" or the "malleus" call it one or the other in the bird and hæmatocrya, or else call the mammalian otosteal of their choice "quadratum"?

poral bone" reduced, in human anatomy, mainly to the support of the tympanic membrane. The feebly marked groove and ridge on the hind concavity of the tympanic intimates the degree in which the function in relation to the organ of hearing is exercised in the ornithic modification of the air-breathing vertebrate tympanic bone. The vertical length of the present tympanic is 1 inch 2½ lines; the long diameter of the distal articular surface is 1 inch; it is slightly convex, but by a downward production of the middle of the outer border is there made concave transversely at the outer half.

The mandible of *Aptornis* presents in profile (Pl. XL. fig. 1, 29–32) a series of graceful curves. By the downward production of the angle (30) and the elevation of the articular surface (29), it is curved for a short way with the concavity below, then becomes concave above for a longer extent, and finally is again bent with the concavity downward. The extent of the symphysis (Pl. XLI. figs. 6, 7, 32) is 2 inches, following the curve, rather more than one-fourth the length of the mandible; its upper surface (ib. fig. 6, 32) is longitudinally convex, transversely concave, deepening, as it widens, backward. The hinder half of this concavity is smooth; the fore half shows two parallel longitudinal nervo-vascular tracts, with canals leading forward and opening upon the outside of the symphysis near the end; this has a horizontal, subtrenchant, slightly convex border. The dentary margins are rather sharp as they extend backward for an inch and a half, then begin to thicken into a convex border, 1½ line across, which border again contracts before it is lost in the thick hinder half of the ramus. The outside of the trenchant margin of the symphysis is indented by a delicate line. An oblique groove, beginning about the middle of the outside of the ramus, indicates the junction of the dentary (Pl. XL. fig. 1, 32*) with the angular element (30), which is further denoted by a ridge continued backward from the groove. A fissure on the upper border of the ramus, half an inch in front of the articular surface (Pl. XLI. fig. 6), sinks into the substance of the bone as it advances, and opens by a shorter fissure upon the inner surface of the ramus nearly two inches from the angle. The tract between the two fissures probably included the hind end of the splenial. Save at these indications all the elements of the mandible are fused into one bone of a strong, compact osseous tissue, as in a few other strong-billed birds[1]. The articular surface is single (Pl. XLI. fig. 6, 29) with the moderate convexities and concavity of its undulated surface answering to those on the tympanic. The fore-and-aft diameter of this surface of the mandible is 7 lines, the transverse diameter is 7½ lines. I never saw a mandibular condyle of an oviparous Vertebrate in which so large a proportion was convex. Behind the articular surface there is a very small and not deep fossa; internal thereto the bone extends obliquely upward and inward into an irregular conical process, attached by ligament to the posterior non-articular part of the mandibular end of the tympanic. The outside of the ramus, below the articular surface, is strengthened by a tuberous ridge, between which and the angle is a broad oblique channel. There is no "coronoid" elevation; the ramus rather loses than gains

[1] *Ramphastos, Buceros, Psittacidæ, Balæniceps.*

vertical extent from the symphysis, where it is $6\frac{1}{2}$ lines, to the articular end; but the thickness of the rami, with the outer angular ridge and the curvatures, indicate adaptations for strength in relation to powerful applications of the beak. And this accords with the massive character of the cranium, the extraordinary lever afforded by the transfer of the attachments of the recti capitis laterales[1] to the large basilar tuberosities carried down to so exceptional an extent below the bony junction of the head with the neck.

The skull of *Aptornis* offers many and well-marked differences compared with that of *Dinornis*. The occipital condyle is larger, more hemispheroid, more prominent; the foramen magnum is narrower in proportion to its vertical extent (comp. fig. 2. pls. 10, 12, 15, with fig. 1. Pl. XLI.); the paroccipitals are more outwardly and less backwardly extended, the breadth there across exceeding that at the mastoids or at the postfrontals; in this particular *Aptornis* resembles *Apteryx*[2] and *Notornis*. But the angle or protuberance (Pl. XLI. fig. 1, *t*) for the insertion of the portion of the "longus colli posticus" called "biventer capitis"[3] is more developed than in any bird[4]. The linear depression, indicative of the "coronal suture," is more marked than in *Dinornis*.

The mastoid process is smaller, but the premastoid much larger; and it adds by its bony union with the postfrontal another to the few exceptions (*Tetraonidæ*, *Crax*, *Lophophorus*, and some *Psittacidæ*) in which the Crocodilian character is repeated in the class of Birds.

The "rhinal chambers"[5] are much smaller, absolutely and relatively, than in *Dinornis*[6], and receive the olfactory nerves each by a single foramen instead of by several foramina.

The basilar tract descends much lower before developing the tuberosities for the "recti capitis laterales;" and these tuberosities are larger, indicative of the great strength of those muscles and of the other "recti" inserted into the marginal ridges and broad, deep, rough intervening surface of this extraordinary development. The basisphenoid contracts to a triedral process beneath the converging Eustachian channels, not present in *Dinornis*, and the surface in advance of the basilar tuberosities is more vertical and compressed in *Aptornis*. The pterapophyses are rudimental and devoid of articular surface. The mastoidal articular cavity for the tympanic is divided or double, instead of being single as in *Dinornis*[7]; the upper condyle of the tympanic is correspondingly modified. The tympanic has a premastoid process and articulation, not present in *Dinornis*; the squamosal articular cavity is not pedunculate; the surface for the mandible is single, not double as in *Dinornis* and most birds.

[1] See Trans. Zool. Soc. vol. iii. pl. 35, *b, c*.
[2] Ib. vol. ii. pl. 53. fig. 5.
[3] Ib. vol. iii. pls. 32 & 33, *o***.
[4] This has no relation whatever with the superior or any other of the semicircular canals; it answers to the thickened part of the superoccipital ridge marked *ep* in *Balæniceps* (Trans. Zool. Soc. vol. iv. pl. 65. fig. 3).
[5] Trans. Zool. Soc. vol. iii. pl. 52. fig. 5, 18.
[6] Ib. vol. v. fig. 1, *n*.
[7] Ib. ib. fig. 1, *u*.

The beak is more elongate, more decurved, more depressed terminally; the outer wall of the premaxillary extends so far back, before the divergence of the maxillary and nasal branches, as to hide from view the prenarial septum and convert the cavity on each side into a fossa. This septum is exposed in *Dinornis*[1]; and a shallow depression on each side represents the cul-de-sac of *Aptornis.*

The nasal branch of the premaxillary coalesces with the frontals and nasals. The maxillary branch of the nasal is longer, and directed more forward, leaving a larger antorbital vacuity (Pl. XL. fig. 1, *v*) in *Aptornis.* In *Dinornis*, as in *Apteryx*, the maxillary branch of the nasal descends anterior to and in connexion with the lacrymal[2], leaving no antorbital vacuity distinct from the external nostril. The mandible, besides the difference in shape and articulation, has the angle deflected.

It is instructive to find in the cranial organization of *Aptornis* these evidences of family distinction from *Dinornis* repeated in the second species of the genus, although the fact was more plainly and decisively shown by the leg-bones in the Memoir (Part III.) of 1848[3].

In the downward production of the basilar platform *Aptornis* differs from *Notornis* more than it does from *Dinornis*; it differs from *Notornis* and all Coots (*Rallidæ*) in the development of the premastoid process and its junction with the postfrontal; from the same group it differs in the adze-like form of the bill, which is commonly in Coots, as in *Notornis*, not only pointed but straight; *Aptornis* further differs in the entire, imperforate structure of the mandibular ramus, and more especially in the absence of the outer narrow second synovial articular surface for the tympanic. When to these well-marked differences we add the form and proportions of the metatarsus of *Aptornis*[4], the ornithologist might be pardoned for pausing before referring the present remarkable genus to the *Rallidæ.*

In *Aptornis*, e. g., the metatarsus is but three-fifths the length of the femur; but it is quite as broad as that bone at the middle of the shaft, and both articular ends expand to corresponding proportional dimensions.

The two upper articular surfaces of the metatarsus are very nearly on the same level, the inner one being rather the higher; and the intermediate eminence is broad and high. The calcaneal process is abruptly prominent, and is perforated, the outer and inner crests having coossified around the flexor tendons; such structure has not been seen in any Coot. The outer and inner calcaneal crests are distinct in *Rallidæ*—the outer one being most produced, but subsiding more gradually to the level of the shaft of the metatarsus than in *Aptornis.*

Yet the following correspondences of cranial structure show, unequivocally, a closer

[1] Trans. Zool. Soc. vol. vii. pl. 10. fig. 1, *s*.

[2] Ib. vol. v. pl. 55. fig. 1, 15″; vol. ii. pl. 54. In this specimen the suture between the nasal process and the lacrymal was obliterated, and both were referred to the lacrymal (ib. 286).

[3] Trans. Zool. Soc. vol. iii. p. 346.

[4] Ib. vol. iv. pl. 3. figs. 5, 6, 7, 8.

affinity of *Aptornis* to *Notornis* than to *Dinornis*. The basilar (basioccipito-sphenoidal) platform is pentagonal, the anterior angle projecting below the base of the rostral production[1]; the Eustachian canals have a corresponding adjustment. The pterapophyses are obsolete in both *Aptornis* and *Notornis*. The articular cavities for the tympanic are two in each mastoid, similarly divided by a pneumatic slit. *Notornis* has muscular productions from the outside of the mastoid, answering to the mastoid process—the midmastoid and premastoid ones; but the two latter are mere ridges, or, if the premastoid be produced, it ends freely in a point, as in smaller Coots[2]. The nasal branch of the premaxillary coalesces with the nasals and frontals in *Aptornis* and *Notornis*. The maxillary branch of the nasal is similarly directed, leaving an antorbital vacuity, with a long oval nostril, almost pointed at the upper, smaller end. The ossification of the fore part of the premaxillary hides from view the prenasal septum. In the mandible the angle is deflected in *Ocydromus*, *Porphyrio*, and *Notornis* as in *Aptornis*. The variation of palatal structure might be a bar to an approximation of *Aptornis* to *Notornis* and smaller Coots, were it not such in other families, united by sounder ties of organic character, as to show its low taxonomic value.

From another point of view the peculiarities of the skull in *Aptornis* may be considered in relation to the food of the bird and the work to which its long adze-like beak was put.

I infer this work to have involved frequent strong and deep thrusts into the ground, and that the quest was for animal, not vegetable matters. I have heard casually and vaguely of the great number, size, and unusual colour of the earthworms of New Zealand; and it is probable that a rich field here remains to be explored by the helminthologist.

The strange appearance of the parasitic cryptogam, *Sphæria*, sp., when it has achieved its growth at the cost of the caterpillar infested, has made us familiar with the burrowing habits of at least two species of New-Zealand Nocturnal Lepidoptera (*Cheiragria virescens* and *Cheir. rubroviridens*) at the larval stage of their existence. Such larvæ and earthworms were probably the food of *Aptornis*.

The cranial part of the skull may be regarded as the base or handle in which the digging adze was set; its expansion, radiating from the occipital condyle as a centre (Pl. XLI. fig. 1, 1), speaks decisively, by its superficial accentuation, to the size and power of the muscles therein implanted: the special development of the leverage-tract below the centre of motion relates to adequate fixation of the muscular powers that were to strike down the adze into the soil.

The muscles working the beak as part of the head are better developed in the ground-piercing *Apteryx* than in most birds, as will be estimated by the myotomist who may

[1] Trans. Zool. Soc. vol. iii. pl. 56. fig. 11.

[2] In a *Porphyrio smaragnotus* I have seen the tendon of each crotaphyte muscle ossified, and extending from a part of the temporal fossa answering to the "midmastoid" as far as its insertion into the mandibular ramus.

compare therewith the muscles in a fowl answering to those called rectus capitis anticus major (Zool. Trans. vol. iii. p. 285, pl. 35, *b*), rectus cap. ant. minor (ib. p. 286, pl. 35, *c*), rectus cap. lateralis (ib. pls. 32 & 35, *d*), biventer capitis (ib. p. 284, pl. 33, *o***), complexus (ib. pls. 32 & 34, *y*), and trachelo-mastoideus (ib. pl. 34. fig. 1, *x*). The developments of cranial bone for the insertions of the corresponding muscles in *Aptornis* indicate a fourfold increase of force and size, and bespeak corresponding power with which the beak was driven through the surface and the soil displaced. For this application it was requisite that the lower jaw should be held firmly in contact with the upper one, that both might penetrate as one instrument with a common sharp-edged extremity; hence the evidence of unusual extensions from the main cranial diapophyses of the bony processes giving origins to the muscles working the cranial rib, *i. e.* drawing up the mandible and holding it in close contact with the maxilla, as in that action of the corresponding muscles of the strong man who in a determined and vigorous effort sets his teeth.

Underlying all these exaggerations of apophysial outstandings, we nevertheless discern a "porphyrian platform"—so much more essential resemblance to the cranial characteristics of the Coots, especially the larger kinds, whose craniology is illustrated in plate 56 of the third volume of the Transactions of the Society, as to conclude *Aptornis* to have been (if one may not speak of it as present in the living creation) a gigantic modified "Ralline." The down-bending of the mandible, it is true, is not seen in *Notornis* or *Porphyrio*; but in the "Poule rouge au bec de Bécasse" of the Mascarene Islands (for a knowledge of which we are indebted to Von Frauenfeld's publication of the coloured drawing, from the life, preserved in the library of the Emperor Francis I.) one sees a curve of beak like that of *Aptornis*. The mandible of this probably extinct Mauritian bird, which has been obtained, with bones of the Dodo, from the famous "Mare aux Songes," shows also, in the figures given by M. Alphonse Milne-Edwards[1], the deflected angle answering to 30 in *Porphyrio* (fig. 1. pl. 56, Trans. Zool. Soc. vol. iii.) and *Notornis* (ib. fig. 7), also the small "prearticular foramen" (ib. ib. figs. 1 & 7, 10). The larger vacuity (ib. ib. *u*) is almost reduced to the state of obsolescence which characterizes the more consolidated and more powerful mandible of *Aptornis* (comp. fig. 4 with the mandible in fig. 1, Pl. XL.). The extent of symphysis, with its canaliculate upper surface, is interestingly similar in *Aphanapteryx* (Pl. XLI. fig. 5) and *Aptornis* (ib. fig. 6); and I concur in the conclusions to which M. A. Milne-Edwards has been led as to the "analogies of *Aphanapteryx* with the Rails"[2]. In speculating on the

[1] "Researches into the Zoological Affinities of *Aphanapteryx*," in Ibis for July 1869.

[2] Ibis, 1869, p. 267. By a curious coincidence, at a later period of the year (1848) in which I proposed a diminutive of "*Apterygiornis*" for the large extinct Coot of New Zealand, the accomplished Belgian ornithologist, M. de Selys-Longchamps, was moved to propound a minor diminutive of the same term for some loosely indicated Mascarene birds, one of which we now know to have been an extinct Coot of the Mauritius. Without entering into the question of the degree of synonymy of *Aptornis* and *Apterornis*, the priority of proposition of the first will, I apprehend, secure it for the main subject of my present Memoir.

origin of the much larger extinct(?) brevipennate Rallines of New Zealand, it may be remembered that our own Coots and Waterhens are poor fliers compared with most water-birds.

§ 3. *Pelvis of* Aptornis otidiformis. (Plate XLII. figs. 1–3; Plate XLIII. figs. 1–4.)

My materials for the description of this instructive part of the skeleton are derived from the smaller species (*Apt. didiformis*), and were obtained from Wanganui, North Island of New Zealand.

Referring for the definition of the bone called "sacrum" to my 'Anatomy of Vertebrates,' "Aves," vol. ii. p. 29, I find it most convenient to adhere to the character of "confluence of vertebræ in connexion with the pelvic arch." In the 'Archetype &c. of the Vertebrate Skeleton' are discussed the characters by which the homologies of the twenty "sacral vertebræ" of the Ostrich *e. g.* with the lumbar and caudal vertebræ of Reptiles and Mammals may be determined; therefore I need not be misunderstood if, to make plain, or easily comprehensible, the characteristics of the pelvis of the extinct ground-birds of New Zealand, I continue to speak of such confluent series of vertebræ as "sacrum."

In *Aptornis* the sacrum includes nineteen vertebræ (Pl. XLII. fig. 2, *s* 1–19). The under surface of the confluent centrums shows well-defined modifications: it is pinched into a median ridge in the first three; the ridge is then, as it were, scooped off, leaving a smooth concave surface or mid channel along the next six centrums, beginning and ending in a point (fig. 2, *c c'*). From the hind point (*c'*) a broadish obtuse ridge runs along the next seven centrums, which gradually lose breadth. The seventeenth centrum suddenly expands; and those of the eighteenth and nineteenth have the form of broad depressed plates moderately concave across; the lateral confluent productions of the vertebræ being defined by two pairs of small vertical canals.

The pleurapophyses of the first and second sacral vertebræ retain their moveable joints. The cup for the head of the rib (Pl. XLII. fig. 1, *pl*, *pl*) is oval, with the small end upward, rather deep, well defined, and supported on an eminence at the upper part of the centrum, nearer the fore end in the first than in the second sacral. The surface for the "tubercle" is small, flat, cut obliquely at the fore part of the end of the diapophysis, which expands above to contract bony union with its successor and with the overlying ilium (62). The unossified space left between the first and second sacral diapophyses constitutes the foremost of the "interdiapophysial holes" (Pl. XLII. fig. 2, *i d'*). The third pleurapophysis (ib. *pl*) is short, straight, expanded, and confluent at both ends, broadest at that which underlies and is soldered to the ilium, beyond which it does not extend. The fourth is still shorter, and abuts as a parapophysis against the distal end of the third, with an extensive bony union above with the diapophysis of its own vertebra. The fifth, sixth, and seventh parapophyses lose length, gain breadth, and abut, with complete confluence, against the ilium a few lines from its lower margin; the seventh blends with a smooth ridge-like thickening of the lower border of the acetabulum as it passes to be continued into the origin of the ischium (63).

There then follow three sacrals without "parapophyses;" a side view of these, defined by the double intervertebral foramina, is given from a fragment of a second pelvis at fig. 3, Pl. XLIII. In the eleventh sacral the lower process is suddenly resumed, passing obliquely outward and backward, straight to its confluent abutment against the postacetabular wall of the ilium; from this a continuous plate of bone curves inward and backward, with the lower margin bending forward to receive the expanded ends of the shortening parapophyses of the twelfth, thirteenth, and fourteenth, as well as of the eleventh, sacrals. The lower processes of the succeeding vertebræ are more or less broken away. The curved and bent lamelliform process of the ilium divides the inter-acetabular renal fossa from the ilio-ischial fossa behind. This (Pl. XLII. fig. 2, *r*) is remarkable for its size, depth, and smooth surface, so far as it is preserved.

Fracture of the fore part of the right ilium exposes the neural spine of the first sacral (fig. 2, *n s*). It is directed upward and forward, is 1 inch 5 lines in height, 7 lines from before backward, where it becomes free; and it terminates in a slightly expanded truncate border, which has contracted no anchylosis with the over-arching confluent iliac bones. The anterior articular surface of the first sacral (Pl. XLII. fig. 3, *c*) is, as usual, concave transversely, convex vertically, but almost bilobed in form from a shallow emargination below and the down-sinking of the neural canal above; its breadth is 11 lines, its mid vertical diameter but $3\frac{1}{4}$ lines. The neural canal is circular, $2\frac{1}{2}$ lines in diameter. The prezygapophyses (ib. *z z*) look upward, inward, and rather forward; they are each 6 lines in diameter; together, an inch across their outer margins. The fore part of the base of the spine is impressed with a rough laterally ridged surface for the interneural ligament. The beginning of the inferior ridge represents a short "hypapóphysis" in the front view (Pl. XLII. fig. 3, *h*). The vertical extent of the fore part of the first sacral is 2 inches 3 lines; from the lower ridge to the upper part of the coalesced ilia is 2 inches 6 lines. The extreme breadth of the fore part of the pelvis, which is that of the first sacral across its diapophysis, is 1 inch 11 lines. The neural canal of the sacrum expands, as usual, as it extends backward, chiefly transversely (Pl. XLIII. fig. 4, *n*), then contracts to the diameter shown at *n*, fig. 1, Pl. XLII.

The ilia (Pl. XLII. fig. 1, 62), anterior to the acetabulum, ascend from their outer margins and converge rapidly to contact and partial confluence with the bases or mid parts of the sacral spines, above which they coalesce and form a ridge, the contour of which describes a moderate convex curve from before backward. The ridge, which is about 4 lines across anteriorly, narrows as it recedes. The outer surface of the preacetabular part of each ilium is uniformly concave, and the concavity is continued, contracting, above the acetabulum (*a*). The "gluteal ridges" (Pl. XLII. fig. 1, *g*), which divide the concave tract (62) from the expanded convex or undulated tracts of the ilia, called "pelvic disk" (*r r*), rise as they recede and diverge, terminating rather abruptly

2 inches 3 lines from their origin; they recommence, to be continued with partial thickening to the hind end of the coalesced ilium and ischium, dividing its horizontal from its vertical surface.

The "pelvic disk" is deeply impressed along the middle of its anterior half, the channel or groove contrasting with the iliac ridge in advance. The bottom of the channel is entire, slightly widening as it recedes and descends, when the depressed spineless upper surface of the neural arches of the last three sacral vertebræ come into view at *n*, fig. 1, Pl. XLII., between the hind parts of the ilia. The sloping sides of the interiliac groove are pierced each by three interneural foramina. The fore part of each side of the pelvic disk is convex transversely; but this changes to a concavity as it recedes.

Of the ischial and pubic elements the broken origins are preserved at 63, 64, Pl. XLII. fig. 1, Pl. XLIII. fig. 2. That of the pubis has a long diameter of 5 lines, where it extends from below the acetabulum. Where the ischium becomes free, half an inch below the postacetabular facet, it is 4 lines by $2\frac{1}{2}$ lines in thickness.

This facet (ib. *b*) is a more continuous part of the general acetabular cavity than usual. Including it therein, the long diameter (from before backward) measures 1 inch 5 lines; the vertical diameter of the acetabulum proper is barely 1 inch; the acetabular vacuity (ib. *a*) has a diameter of half an inch; its margin projects, as usual, into the prerenal or interacetabular fossa. The vertical diameter of the postacetabular facet is $6\frac{1}{2}$ lines. Between the margin of the acetabulum and the free part of the ischium (63) is a well-defined (antischial) fossa (Pl. XLIII. fig. 1, *e*). The ischial foramen is subcircular, 8 to 9 lines in diameters. On the right side a distal part of the ischium, coalescent with the ilium, is preserved, descending vertically at right angles with the area of the "disk," and effecting, by an inwardly extended plate (Pl. XLII. fig. 2, *v*) underlying part of the postrenal fossa, a bony union with the depressed terminal sacral vertebræ (ib. 19). The degree of coalescence of the sacrum and iliac bones is such as to reduce the ilio-neural canals to small separate spaces (Pl. XLIII. fig. 4, *i d*), into which the interdiapophysial foramina (fig. 2, *i d*) open.

The pelvis of *Aptornis* differs from that of *Dinornis*[1] in its greater length relatively to the breadth, in its less sudden and minor expansion behind the acetabula, in the inferiorly carinate anterior centrums, in the more sudden expansion of the hindmost centrums, in the more convex contour and sharper upper ridge of the coalesced pre-acetabular plates of the ilia, in the deeper and narrower channel dividing the post-acetabular parts of the same bones, in the relatively narrower interval between the postacetabular parts of the ilium and ischium, and in the relatively smaller ischial foramen[2]. The rather sudden down-sinking of the preacetabular iliac ridge into the superacetabular iliac channel is also very significative of the distinction of ordinal groups between *Aptornis* and *Dinornis*.

[1] Compare Pl. XLII. figs. 1 & 2, and Pl. XLIII. figs. 1–4, with pls. 19, 20, 20 A, of vol. iii. Trans. Zool. Soc.

[2] Compare Pl. XLIII. fig. 1, with pl. 20. (*tom. cit.*) figs. 1 & 2.

Aptornis agrees with *Apteryx* in the proportional extent of the antacetabular part of the ilium[1], but offers the same differences, and some of them exaggerated, which have been noted in the pelvis of *Dinornis.* In the general proportions, as in size of pelvis, the correspondence between *Aptornis* and *Cnemiornis*[2] is closer than between either of them and *Dinornis*; but there are differences of at least generic value.

The anterior sacral centrums are relatively broader and less deep in *Aptornis*; there is no increase of breadth or expansion in the seventh or contiguous antacetabular ones, as in *Cnemiornis*; the narrowing is continuous, though quicker, after the seventh, in *Aptornis*, as far as the sixteenth, when the sudden expansion takes place. In *Cnemiornis* there is no indication of such expansion of terminal sacral centrums; they continue narrow and ridged below from the twelfth to the seventeenth. The breadth of the anterior sacral vertebra across the costal pits of the centrum in *Cnemiornis* is 7 lines, in *Aptornis* it is 13 lines; but the height of this vertebra must have been the same, or nearly so, in both. There are surfaces for the articulation of a third pair of free sacral ribs in *Cnemiornis*; but these do not exist in *Aptornis.* The concavity of the pre-acetabular part of the ilium in *Cnemiornis* is bounded above by a curved ridge, leaving a flatter tract between it and the summit of the bone; but there is no trace of this division of the bone in *Aptornis.* The posterior, horizontal iliac tract is divided by a median convex ridge in *Cnemiornis*, but by a deep median furrow in *Aptornis.* In that genus there is no trace of the superacetabular pneumatic fossa as in *Cnemiornis*, in which the acetabulum is relatively larger, its vacuity wider, its distinction from the posterior flat facet greater. The antischial depression of *Aptornis* is not repeated in *Cnemiornis.* In this genus there is no indication of the smooth, large, deep, hemispherical post-renal fossa on the under surface of the ilium which characterizes *Aptornis*; neither is there an iliac lamella bounding behind the interacetabular renal fossa.

In both genera there are indications of similarity of the pelvis to that in *Rallidæ*; there is the length of the antacetabular part and its steeply inclined roof-like iliac plates, the great reduction of the iliac fossæ through the non-extension, or slight extension, of the ilia beyond the sacral diapophyses; but this affinity is more marked in *Aptornis*, as by the development of the postrenal ischial lamellæ (Pl. XLII. fig. 2, *v*) and the small and round ischiatic foramen.

§ 4. *Notice of a mutilated Pelvis of* Notornis.

I have long entertained hopes of receiving, through the friendly cooperation of some collector of natural-history objects in New Zealand, materials for a monograph on the osteology of *Notornis*[3]; but, so far as I know, only a very few skins of that still lingering species of Ground-Coot have hitherto reached Europe.

[1] Compare Pl. XLII. fig. 1, 62, with Trans. Zool. Soc. vol. ii. pl. 54.

[2] Compare the figures in the present Memoir with figures 5, 6, 7, pl. 64. Trans. Zool. Soc. vol. v.

[3] *Notornis* is affirmed to be living in considerable numbers in some districts on the west coast of the Middle Island (Mackay in 'Ibis,' 1867, p. 144).

I no longer delay, therefore, to communicate a description of a very mutilated portion of pelvis received from the sand-beds at the embouchure of the Wanganui river, North Island of New Zealand, in the same brittle but unpetrified state as the parts on which the genus *Notornis* was originally founded[1], under the impression of its being extinct, as in the North Island of New Zealand it actually is.

I am led to refer the specimen about to be described to that genus by reason of the relation of its size to that of the skull described and figured in the under-cited Memoir, and also to the size of the femur and tibia described and figured in a subsequent Memoir[2].

This portion of pelvis includes thirteen confluent sacral vertebræ, the rest being broken off from the hind end of the series.

The first sacral offers the usual articular surfaces on the prezygapophyses (Pl. XLII. fig. 6, *z*) and on the fore part of the centrum, the transverse concavity of the latter (ib. *c*) being deep, the vertical convexity slight. A circular costal pit (ib. fig. 6, *pl*) impresses each side of the centrum and each diapophysis. A large pneumatic foramen opens at the base of each diapophysis. The neural spine, moderately compressed and high, is confluent at top with the iliacs: the vertical length of the vertebra is 1 inch 5 lines; the transverse diameter across the diapophyses is 1 inch. The sides of the centrum converge below to a tract from $1\frac{1}{2}$ line to 2 lines in breadth (Pl. XLII. fig. 5, *c*). The second sacral has no free rib; its transverse process, directed outwards, contracts an extensive anchylosis with the ilium; the centrum, expanding backward, has a broader convex under surface. That of the third sacral continues the expansion with a broad, smooth, convex under surface; the lamelliform transverse processes incline forward to their terminal coalescence. The more expanded fourth sacral centrum has a broad, flat under surface, on a level with which the thick, short parapophyses pass directly outward. Those of the fifth and sixth sacrals have a like position, size, and direction. The breadth of the flat lower surface is here half an inch. The four succeeding vertebræ are "interacetabular," have no parapophyses; the inferiorly flattened centrums gradually lose breadth, and are defined by the nerve-canals in pairs, as usual, opening obliquely backward, and progressively decreasing in size from the seventh to the eleventh (Pl. XLIII. fig. 9, *c*, 7-11). In this and the succeeding centrums the parapophysis reappears, but is broken away in each of the remaining sacrals.

As much of the iliacs remain as have coalesced with the neural arches of the thirteen sacrals here preserved. They meet and form an obtuse continuous smooth ridge above the first five sacrals, from which ridge the bones slope, like the sides of a steep roof, to their lower, fractured margin. The longitudinal contour above (ib. fig. 9) is slightly convex, then rather abruptly sinks to the lower level of the expanded neural arches of the seven or eight hinder vertebræ, describing a concavity, which again becomes convex

[1] On DINORNIS (Part III.): Trans. Zool. Soc. vol. iii., "Cranial characters of the genus *Notornis*," p. 366, pl. 56.

[2] Trans. Zool. Soc. vol. iv. p. 12, pl. 2. figs. 3 & 4.

in a slight degree. Here the upper surface is almost flat, with a feeble mid linear rising; where this rises to the anterior convexity there is a linear slit on each side, leading to the "ileo-neural" vacuities.

Fragmentary as is this portion of pelvis, it permits of the deduction of some characters which support the reference of it to the porphyrian genus *Notornis*. The antacetabular portion included, as I am led to infer, at least half the total length of the pelvis. In this respect it resembles *Apteryx*[1]; but the superior contour of the coalesced iliacs in that bird is convex. The undulated contour of the same part of *Notornis* rather exaggerates that in *Aptornis* (Pl. XLII. fig. 1), and still more so what is more feebly shown in *Tribonyx* and some other Rallines, viz. *Gallinula nesiotis*, Scl., *Porphyrio*, sp., and *Ocydromus*, sp. But in none of these is the undulation so strong as in *Notornis*. In *Gallinula nesiotis* I observe the same slit-shaped outlets of the ilio-neural canals on each side the descending mid ridge of the coalesced ilia.

The character of the under surface of the antacetabular centrums in *Notornis* (Pl. XLII. fig. 5) agrees with that in species of *Gallinula* and *Porphyrio*. The ridge-like shape of the same part in *Aptornis* and *Cnemiornis* finds a partial resemblance in the first and, sometimes, second sacral centrums of species of *Fulica*. Only the first sacral supports, as in *Notornis*, moveable ribs in *Gallinula nesiotis* and *Porphyrio cœlestis*; but in some species of *Fulica* both first and second sacrals have moveable ribs, as in *Aptornis* and *Cnemiornis*. In the vertebræ which I have called "interacetabular," though they are partly in advance of the internal openings of those articular cavities, *Notornis* resembles *Aptornis* and many existing Rallides, in the absence of transverse processes; the neurapophyses rise, from above the double nerve-holes, as vertical walls slightly expanding to be lost in the flat iliac roof of that part of the pelvis. In *Cnemiornis* oblique ridges extend from the neurapophyses of those vertebræ, strengthening, as buttresses, the support of the superincumbent bony roof[2].

§ 5. *Femur, Tibia, and Fibula of* Aptornis defossor.

Femur.—The difference in the size of this bone, as compared with the femur of *Aptornis otidiformis*, is given in the "Table of Admeasurements" (p. 378), and may be seen by comparing fig. 5. Pl. XLIII. with those cited below[3]. The differences which the femur of *Aptornis* presents, as compared with that of *Dinornis*[4], are repeated, and in some respects exaggerated, in *Apt. defossor*: the straight subcylindrical character of the proportionally longer and more slender shaft in *Aptornis* is better marked in the present species. That of *Apt. didiformis*, viewed in profile, as in the figure of the femur of the larger species given in Pl. XLIII., shows a slight bend, convex forward; this is due to a minor diminution of fore-and-aft diameter in the lower part of the shaft, and to a relatively greater fore-and-aft diameter of the outer condyle in *Apt. defossor*. The

[1] Trans. Zool. Soc. vol. ii. pl. 54.

[2] Ib. vol. v. pl. 64. fig. 6.

[3] Ib. vol. iv. pl. 3. fig. 3; vol. v. pl. 63. fig. 3.

[4] Ib. vol. iv. p. 10.

"well-marked ridge," extending down the back part of the shaft, and inclining to terminate in the border of the inner condyle[1], is repeated in the present species. In *Dinornis* the corresponding ridge is more median or even tends toward the outer side of the back surface of the femoral shaft, and ends abruptly in a tuberosity, usually one of a pair, at the lower third of the shaft, from the innermost of which extends the ridge to the inner condyle. This condyle in *Dinornis* does not reach so low as the outer one; and the terminal distal line is oblique, indicative of the greater angle at which that end diverges from the hip-joint to rest on the tibia of the robuster-bodied bird. In *Apt. defossor*, as in *Apt. didiformis*, the inner condyle more nearly equals in vertical extent the outer one, yet in a somewhat minor degree in the larger species. In both, the fore part of the two condyles is less prominent, and the rotular groove less deep, than in the femur of *Dinornis*[2]. The head of the femur is more truncate or depressed in *Aptornis*, through the relatively larger size of the ligamentous pit, than in *Dinornis*. The lower part of the head is more produced downward in *Aptornis*; and a short ridge from the under and back part of the head (*Apt. otidiformis*), or of the neck near that border of the head (*Apt. defossor*) (Pl. XLIII. fig. 6), extends downward and rather backward for 6 or 8 lines. Of this ridge there is no trace in *Dinornis*. A broader parallel ridge or rising extends about the same distance from along the back part of the supracervical articular surface: this extension from the head of the femur is more convex from before backward in *Aptornis* than in *Dinornis*. Of the pneumatic fossa, which in some species or individuals of *Dinornis* breaks the surface below the back part of the supracervical surface, there is no trace in either species of *Aptornis*.

For the characters of the femur of *Aptornis* as compared with that of *Cnemiornis*, reference may be made to Trans. Zool. Soc. vol. v. p. 400, pl. 65. They are as well marked in *Apt. defossor* as in *Apt. otidiformis*.

Tibia.—The importance of such distinctive characters as "the tibial half of the proximal articulation is broader from behind forwards than transversely," "the anterior ridge at the proximal end ['procnemial ridge'] is nearer the middle of the bone," "the more rounded or less angular inner side of the shaft," "the proportionally greater antero-posterior thickness of the shaft," "the deeper posterior notch between the distal condyles," "the more compressed and more backwardly produced inner condyle," could not be fully estimated in the solitary tibia of the smaller species first described[3]. In the absence of a femur or of a tarso-metatarsal bone to match this tibia, I could only venture to affirm that "it unequivocally established a fourth species of cursorial bird" in the series of tibiæ first received from New Zealand. The subsequent acquisition of the femur, the "tarso-metatarsal"[4], and the skull of the *Dinornis otidiformis* of 1843 impresses one instructively with the value of such seemingly insignificant modifications

[1] Trans. Zool. Soc. vol. iv. p. 10.

[2] In my fourth Memoir, Trans. Zool. Soc. vol. iv. p. 11, nine lines from top, for "more" read "less".

[3] Trans. Zool. Soc. vol. iii. p. 247, pls. 25 & 26. fig. 5.

[4] Ib. vol. iv. pl. 3.

of the chief leg-bone, and the need of close scrutiny and comparison of every character thereof in solitary fossil specimens.

The somewhat more perfect tibia of *Aptornis defossor* (Pl. XLI. fig. 9, and Pl. XLIII. fig. 8) than that of *Apt. otidiformis* (pl. 25. fig. 5, of Trans. Zool. Soc. vol. iii.) yields other differences between *Aptornis* and *Dinornis*, in this bone, than are noted in the first Memoir (ib. p. 247). The bony canal for the tendon of the "tibialis anticus" and "extensor longus digitorum pedis"[1], is nearer the middle of the anterior surface. The ridge forming the inner wall of the groove thereto leading is longer and sharper, the bony bridge (Pl. XLI. fig. 9, *f*) is broader, the fibular ridge (*h*) is more prominent and more lateral. In most of these characters may be discerned a significant resemblance to the tibia of *Notornis*[2]. In the median position and breadth of the "extensor tendon bridge" (*f*), in the development of the inner wall of the groove, in the outer position and prominence of the fibular ridge, similar affinities are indicated in the tibia of *Cnemiornis*; but the exaggerated development of ectocnemial and procnemial ridges in that genus only comes out the stronger in the comparison with *Aptornis* (Pl. XLI. fig. 9, and Pl. XLIII. fig. 8, *p*, *e*). As in *Apt. otidiformis*[3], the tendinal canal is less strictly median in *Apt. defossor*, and the fore part of the inner distal condyle is more produced and more compressed, than in *Cnemiornis*.

The fibula of *Aptornis defossor* (Pl. XLI. figs. 10, 10 *a*) is 6 inches in length, has the usual subcompressed head, with the convex elongate articular surface for the groove of the outer femoral condyle; the proximal end is slightly hollowed on the inner side, in a minor degree convex on the outer side; the shaft, gradually tapering as usual to a pointed end, which seems to have contracted a second junction with the tibia, shows also the two rough surfaces for tendinous attachments, but less strongly marked than in *Cnemiornis*.

§ 6. *Femur of* Notornis.

The acquisition of a second, somewhat more perfect specimen of the femur of *Notornis*, from Waingongoro, in the North Island of New Zealand, induces me to repeat and develope a description of the bone with special reference to the illustration of the Ralline affinities of *Aptornis*. The femur of *Notornis* (pl. 2. fig. 3, Trans. Zool. Soc. vol. iv.), in the proportions of length to thickness of shaft, in the degree of curvature, and of torsion on the axis, resembles that in smaller existing Rails and Coots more closely than does the femur in *Aptornis* or *Cnemiornis*.

The head shows the same free and sharp downward production of its lower margin, the same proportion and position of the depression for the round ligament as in *Aptornis*, the same form and degree of extension of the articular surface upon the neck, the same transverse convexity of that surface. The great trochanter rises higher than this surface, but is relatively less elevated than in *Aptornis*; it is relatively as broad;

[1] Trans. Zool. Soc. vol. iii. pl. 35, 8, 9. [2] Ib. vol. iv. p. 12, pl. 2. fig. 4. [3] Ib. vol. v. p. 402.

the anterior border is rather more sharply produced, and is brought more to the front surface of the bone. A linear ridge is continued therefrom down three-fourths of the shaft, inclining toward its inner side. A tuberosity projects below the base of the trochanter at the outer side of the bone, from which goes a linear ridge along the back part of the shaft, toward the outer side; a second linear ridge, commencing lower down, runs along the back of the shaft towards the inner side as far as the popliteal space; between these ridges, near halfway down the bone, opens the canal of the medullary artery. The distal end is less expanded than in *Aptornis* or *Cnemiornis*. The rotular channel, though wide, is relatively deeper and narrower than in *Aptornis*, and the inner border is more produced. A small tuberosity projects external to the upper end of the outer border: this may be individual. The popliteal space shows no definite fossa, and its surface is irregular. The fibular articular groove is deeper, with a better-defined and produced outer border. As in the thigh-bone of the *Rallidæ* generally, there is no pneumatic foramen.

§ 7. *Metatarsus of* Aptornis defossor.

In general form and proportions this bone resembles that in *Aptornis otidiformis*: the superiority of size is shown in the "Table of Admeasurements," and in figs. 1 & 6, Pl. XLIV. As compared with *Dinornis* (ib. figs. 7–10), the metatarsal of *Aptornis defossor* shows the same greater depth and nearer equality of size of the two condylar cavities (Pl. XLIV. fig. 4), with the broader and loftier intercondylar tract, as in *Apt. otidiformis*[1], the same superior prominence and perforation of the calcaneal process (ib. *c*, *c′*), the same flattening of the back part of the shaft through the non-projection there of the upper half of the mid metatarsal element, also the presence of the canal (ib. *t*) for the tendon of the "adductor digiti externi." The inner (entotibial) condylar cavity is on a rather higher level than the outer (ectotibial) one, is rather deeper, rather less from before backward. The cavity at the upper part of the front surface of the metatarsal shaft is relatively less deep than in *Aptornis otidiformis*; it is not continued so low down upon the shaft; but the anterior outlets of the interosseous canals open separately at its bottom, and the ridge at the inner border for the insertion of the corresponding part of the tendon of the "tibialis anticus" is strongly marked and defined. In *Dinornis* the interosseous canals converge from behind forward to a common orifice (*o*, fig. 7) at the bottom of the shallow upper and anterior depression. In one specimen of metatarsus of *Aptornis defossor* the groove (*t*, fig. 1) for the tendon of the "adductor digiti externi" deepens as it approaches the interspace between the middle and outer digital trochleæ, and perforates the bone above that interspace; in another it deeply grooves the interspace, but is not crossed by the bony bridge at the fore part of the interspace. A similar variety is shown by one of three specimens of metatarsus in *Apt. otidiformis*. Where the bridge exists, the tendinal canal opens in the interval or chink

[1] Trans. Zool. Soc. vol. iv. p. 11.

between the two trochleæ; but there is commonly another canal, continued from the "adductor groove," which traverses the bone backward and opens into the lower concavity of the posterior surface of the metatarsal above the interval between the outer (IV) and middle (III) trochleæ, as at fig. 2, *h*, Pl. XLIV., and in vol. iv. pl. 3. fig. 5, *Apt. otidiformis.* Now, this orifice is not present in one of three metatarsi of *Apt. otidiformis*, nor in one of the two metatarsi of *Apt. defossor.* Neither the vertical nor the fore-and-aft canal is present in *Dinornis*: I have once seen the latter canal, as an exception, in *Apteryx.*

At the back part of the shaft *Aptornis defossor* shows a perforate calcaneal process (Pl. XLIV. figs. 2, 3, *c*), relatively longer vertically than in *Apt. otidiformis*: the ridge on the inner side of each side-wall (fig. 4), indicating the portions of the canal traversed respectively by the tibialis posticus (*e'*) and the "flexor longus digitorum" (*e*), is better marked, and the bony canal is less contracted posteriorly, than in *Apt. otidiformis.* The postinternal longitudinal crest is shorter and more produced in *Apt. defossor*; the fossa internal to its upper part, for the origin of the "flexor brevis hallucis," is well defined, as is the surface below the crest for the attachment of the metatarsal of the hallux (fig. 2, I). The longer surface at the outer and back part of the metatarsal for the insertion of part of the strong gastrocnemial sheath-like tendon is strongly marked. Every thing bespeaks the force with which this massive metatarsal was worked in *Aptornis.* The proportions and disposition of the distal trochleæ in *Apt. otidiformis* (fig. 5) are closely repeated in the larger species (fig. 1, *a*); the inner one (fig. 2, II) does not terminate at a higher level than the outer one (ib. IV); the cleft between the outer and middle trochleæ is deeper and anteriorly wider than the inner cleft, in both species of *Aptornis.* The outer trochlea in *Dinornis* (fig. 8, IV) is shorter than the inner one (ib. II).

To exemplify the generic, or family, or ordinal distinction between *Aptornis* and *Dinornis*, I take the present opportunity to figure the metatarsus of the species coming nearest to *Aptornis* in size[1], viz. *D. curtus* (Pl. XLIV. figs. 7–10), first indicated by the mutilated bone described and figured in Zool. Trans. vol. iii. p. 325, pl. 48. fig. 6.

The metatarsus of *Aptornis defossor*, above described, formed part of the extensive series of remains brought by Mr. Walter Mantell from Ruamoa, Middle Island of New Zealand, and purchased by the British Museum in 1856 (Trans. Zool. Soc. vol. iv. pp. 149, 156). Deeming, then, that it might prove to belong to a larger variety of the *Aptornis otidiformis* of the North Island, I concluded to wait for further evidence, which the bones brought from the same neighbourhood (Oamaru) by Mr. Taylor have now given. The tibia (Pl. XLI. fig. 9) fits this metatarsus (Pl. XLIV. fig. 1) as well as the tibia of *Apt. otidiformis* (Zool. Trans. vol. iii. pl. 25. fig. 5) fits the metatarsus figured *in op. cit.* vol. iv. pl. 3. fig. 5.

[1] Unless the small bone (Pl. XLIV. fig. 7) should indicate an established breed of that inferior size, meriting a distinctive name, and should not belong to a female or somewhat dwarfed individual of *D. curtus.*

On comparing the metatarsus of *Aptornis* with that of *Notornis*, *Ocydromus*, or *Tribonyx*, the bone[1] would seem, at first sight, to drive the extinct genus far away from the Ralline waders: the occiput of *Aptornis* hardly presents more marked differences from that in any known recent Ralline's skull.

I discern, however, a certain harmony in the departures from type thus presented by the two extreme parts of the skeleton of *Aptornis*—an associated relation to the needs and habits of this most strange brevipennate bird. On the functional hypothesis of the large and long adze-like bill of *Aptornis*, as being designed and used for the purpose of feeding its great body with earthworms and burrowing grubs, the delving-instrument may have needed another one to clear off the broken-up surface and to help in the unearthing quest. What, then, we may ask, would be the modifications superinduced, say, upon the Ralline type, if indeed such type-characters be not predicable of a wider range of the "precocious birds"?

In the first place, the foot, if it is to be used, with due vigour, in scratching up and scraping away soil, must be brought near to the bending powers; their force must not be wasted upon long tendons traversing a stilt-like metatarsus before they can be inserted into the toes. The shortness of that segment in proportion to the tibia is accordingly notable in scratchers (*Rasores*, *Gallinæ*) as compared with waders (*Grallæ*).

The metatarsus is less remarkable for its length in most *Rallidæ* than in waders generally; but that of *Aptornis* is reduced to shorter proportions than have been seen in any known grallatorial or, even, rasorial bird. In some of the Grouse-tribe the metatarsus may be reduced to one-half the length of the tibia; but in *Aptornis* it is less than half. In strength or robustness it loses nothing in this comparison with *Gallinæ*, rather gains; the transverse diameter of the middle (narrowest part) of the shaft of the metatarsus in *Aptornis* is equal to, or exceeds, that of either the tibia or the femur.

For the strength of a "double joint," equality of the two condyles, and of their cups, may be a condition, as well as prominence and depth of interlocking; and both ecto- and entotibial cups on the proximal articular surface of the metatarsus in *Aptornis* are almost on the same level: the outer one (ectotibial) is rather the lowest; and this may be deemed significant of its porphyrian affinity, seeing that the level of this surface is conspicuously lower, in Coots, than that of the inner (ento-tibial) cup; and this cup, though higher, is deeper than the outer one, as in *Rallidæ* generally. The intervening rise of the proximal surface, however, which, as it passes into the joint between the condyles of the tibia, is called "intercondylar," instead of being low, as in *Rallidæ*, is raised considerably; but this is in more direct relation with the strengthening of the ankle-joint than is the equality or level of the two cups and balls.

The perforate condition of the strongly produced calcaneal process seems, with the shortness and thickness of the metatarsus, to speak for the rasorial affinities of the bird to which it belongs. But there are no longitudinal grooves upon either the back or

[1] Trans. Zool. Soc. vol. iv. pl. 3. figs. 5–8; and Pl. XLIV. figs. 1–6, of the present Memoir.

the sides of the perforate calcaneal process in *Aptornis*. If the ento- and ectocalcaneal plates of *Notornis*[1] or of *Porphyrio* were united by coossification of their free borders, the condition of the calcaneal process in *Aptornis* would be produced. One can see the advantage of a complete bony pulley for the traversing tendon of the flexors of the toes[2]; and this was a strong one in *Aptornis*, with a pulley to match. The base of the perforated process equals half the transverse diameter of the proximal end of the metatarsus, outstanding a little to the outer side of the middle of the hind part of that surface, slightly deflected at the end. The inner wall has a longer base of origin than the outer one. There is a feeble indication of the parts of the canal respectively traversed by the "perforans" and "perforatus" tendons, but no outside grooves; and the difference from the gallinaceous metatarsus is shown by the non-continuation of the entocalcaneal plate with the postinternal crest on the shaft of the bone, giving attachment to one of the divisions of the sheath-forming insertional tendon of the "gastrocnemius externus"[3].

The beginning of the postinternal crest is separated from the entocalcaneal process by a canal about $1\frac{1}{2}$ line wide, into which opens the antero-posterior (interosseous) canal between the inner and middle metatarsal elements. The surface on the inner side of the postinternal crest for the origin of the "flexor brevis pollicis" is extensive and well marked, according with the size of the digit indicated by the hallucial articular surface (Pl. XLIV. fig. 5, I). The anterior surface of the metatarsus is impressed, near the tibial articulation, with a deep fossa, into which open the two "interosseous" tubular canals; beneath these are surfaces for the origins of the "extensor pollicis brevis" and "adductor digiti externi;" and the inner side of the fossa is produced into a short ridge, into which the tendon of the "tibialis anticus"[4] is in part inserted. Midway down the fore part of the shaft begins the groove for the "adductor digiti externi," the tendon of which glides through the canal above the interval between the middle and outer trochlear condyles, which canal is present in the *Notornis* and Coots, though by no means peculiar to them. It is one of the well-marked distinctions between the metatarsus of *Aptornis* and of *Apteryx*, this latter bird agreeing with *Dinornis* in the absence of the intertrochlear canal.

The surface below the postinternal crest indicates a strong and large back toe (hallux, Trans. Zool. Soc. vol. iv. pl. 3. fig. 5, I); but *Notornis* and the Coots have this in common with the *Rasores*. The trochleæ of the digits II & IV descend almost to the same level; IV is, perhaps, rather the lowest; in *Notornis* and the Coots it is more decidedly so. The mid condyle is more advanced and more produced in *Aptornis*, as is usual in *Grallæ* and *Gallinæ*, and as it is, indeed, in *Apteryx* and *Dinornis*. The interval between the toes

[1] Trans. Zool. Soc. vol. iv. pl. 2. fig. 3.

[2] Trans. Zool. Soc. vol. iii. "Myology of *Apteryx*," pls. 22, 25, 1, 3, 4, 5, 6.

[3] *Op. cit.* vol. iii. pl. 35, R***.

[4] Ib. ib. 8.

III & IV in *Aptornis* is wider and deeper than that between III & II. The grooved or trochlear character of each condyle is well marked.

On the whole, the inference seems legitimate that we have in the metatarsus of *Aptornis* a bone extremely modified for "rasorial" functions upon a porphyrian or "ralline" type.

Table of Admeasurements.

	Aptornis defossor.		*Aptornis otidiformis.*	
Skull.	in.	lines.	in.	lines.
Length	7	2	6	2
Breadth (across paroccipitals)	3	3	2	9
Breadth (across postfrontals)	3	2	2	10
Breadth (across temporal fossæ)	2	3	1	1
Breadth of base of upper mandible at fore part of orbit	1	6	1	3
Breadth of middle of upper mandible	1	4	1	1
Breadth of fore end of upper mandible	0	7	0	6
Length of cranium to coalesced premaxillary	2	6	2	2
Length of premaxillary	5	0	4	3
From the fore part of external nostril to the end of the premaxillary	2	9	2	3
From the superoccipital ridge to the lower border of the fore basilar tuberosities	2	6	2	1
Femur.				
Length	7	6	6	2
Breadth of proximal end, in the axis of the neck	2	2	1	9
Breadth of distal end, across the condyles	2	2	1	9
Circumference of middle of shaft	2	9	2	3
Tibia.				
Length	10	3	8	9
Breadth of proximal end	2	3	1	9
Breadth of distal end	1	10	1	3
Circumference of middle of shaft	2	6	1	11
Metatarsus.				
Length	4	4	3	10
Breadth (transverse) of proximal end	1	8	1	5
Breadth (transverse) of distal end	1	9	1	6
Breadth (transverse) of middle of shaft	0	11	0	8
Breadth from fore part of proximal end to back part of calcaneal process	1	6	1	4

DESCRIPTION OF THE PLATES.

PLATE XL.

Aptornis defossor.

Fig. 1. Side view of skull.
Fig. 2. Top view of skull.
Fig. 3. Base view of skull (without mandible).
Fig. 4. Side view of mandible of *Aphanapteryx* (*ex* A. Milne-Edwards, 'Ibis,' July 1869).

PLATE XLI.

Aptornis defossor.

Fig. 1. Back view of cranium.
Fig. 2. Inner side view of tympanic bone.
Fig. 3. Mandibular articular surface of tympanic bone.
Fig. 4. Outer side view of tympanic bone.
Fig. 4 *a*. Hind view of palatines.
Fig. 5. Upper view of mandible of *Aphanapteryx* (*ex* 'Ibis,' &c.).
Fig. 6. Upper view of mandible.
Fig. 7. Under view of mandible.
Fig. 8. Hind surface of ramus of mandible.
Fig. 9. Front view of tibia.
Fig. 10. Side view of fibula.
Fig. 10 *a*. Upper end of fibula.
Fig. 12. Hind view of palatine bones.

PLATE XLII.

Aptornis otidiformis.

Fig. 1. Pelvis, from above, or dorsal aspect.
Fig. 2. Pelvis, from below, or ventral aspect.
Fig. 3. Pelvis, from before, or front view of first sacral vertebra and iliac bones.

Cnemiornis calcitrans.

Fig. 4. Front view of mutilated first sacral vertebra and iliac bones.

Notornis mantellii.

Fig. 5. Fore part of sacrum and iliac bones, from below.
Fig. 6. Front view of first sacral vertebra and iliac bones.

PLATE XLIII.

Aptornis otidiformis.

Fig. 1. Side view of pelvis.

Fig. 2. Side view of neural spine of first sacral vertebra.

Fig. 3. Side view of middle sacral vertebræ.

Fig. 4. Section of fourth sacral vertebra and confluent parts of iliac bones.

Aptornis defossor.

Fig. 5. Outside view of right femur.

Fig. 6. Back view of proximal end of right femur.

Fig. 7. Distal articular surface of right femur.

Fig. 8. Proximal articular surface of tibia.

Notornis mantellii.

Fig. 9. Side view of anterior portion of pelvis.

PLATE XLIV.

Aptornis defossor.

Fig. 1. Metatarsus, front view.

Fig. 2. Metatarsus, back view.

Fig. 3. Metatarsus, outer side view.

Fig. 4. Proximal end of metatarsus.

Fig. 1 *a*. Distal end of metatarsus.

Aptornis otidiformis.

Fig. 5. Distal end of metatarsus.

Fig. 6. Metatarsus, front view.

Dinornis curtus.

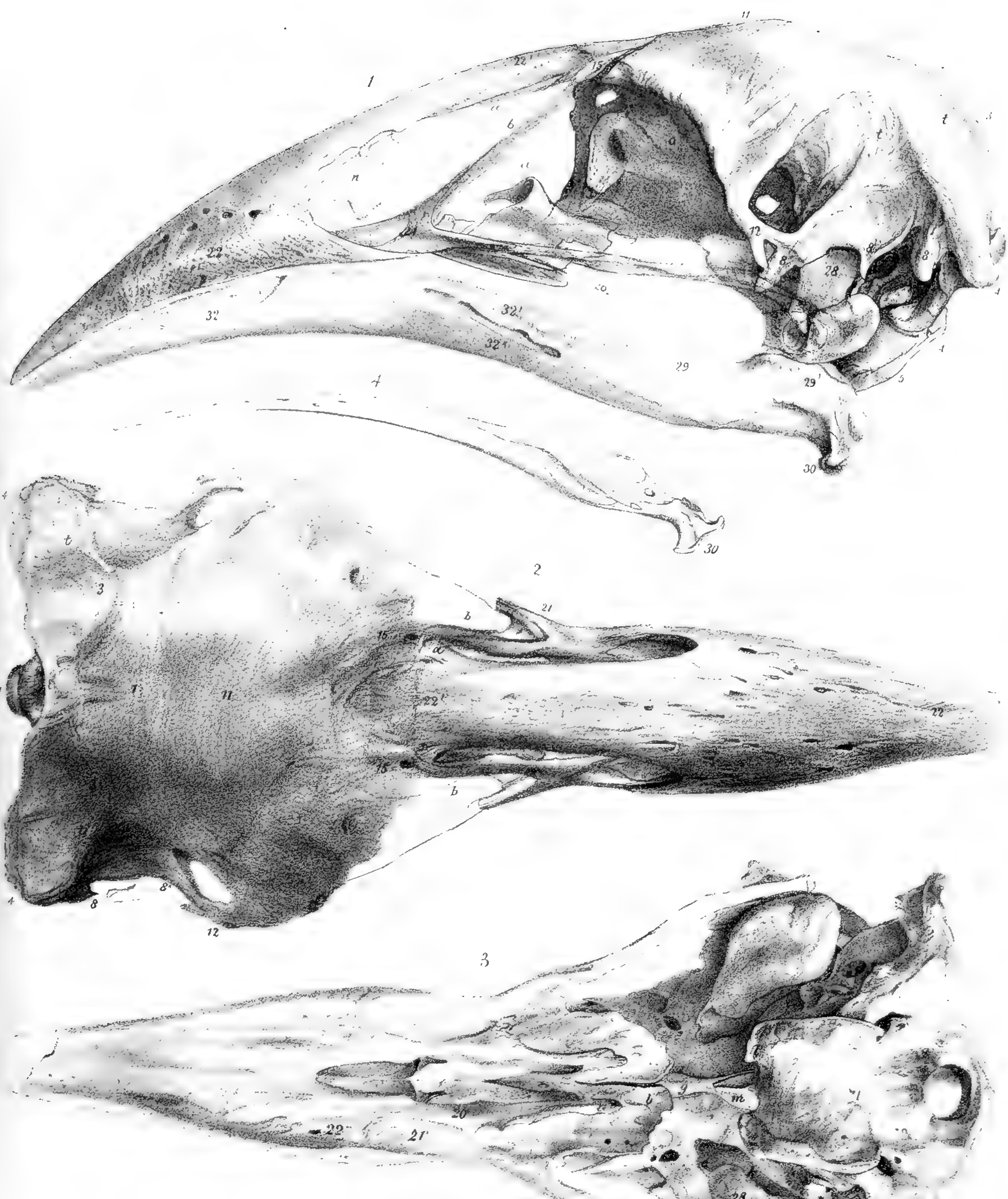
Fig. 7. Metatarsus, small var.: front view.

Fig. 8. Metatarsus, normal size: front view.

Fig. 9. Metatarsus, id.: proximal end.

Fig. 10. Metatarsus, id.: distal end.

All the figures are of the natural size. The letters and numerals of reference are explained in the text.



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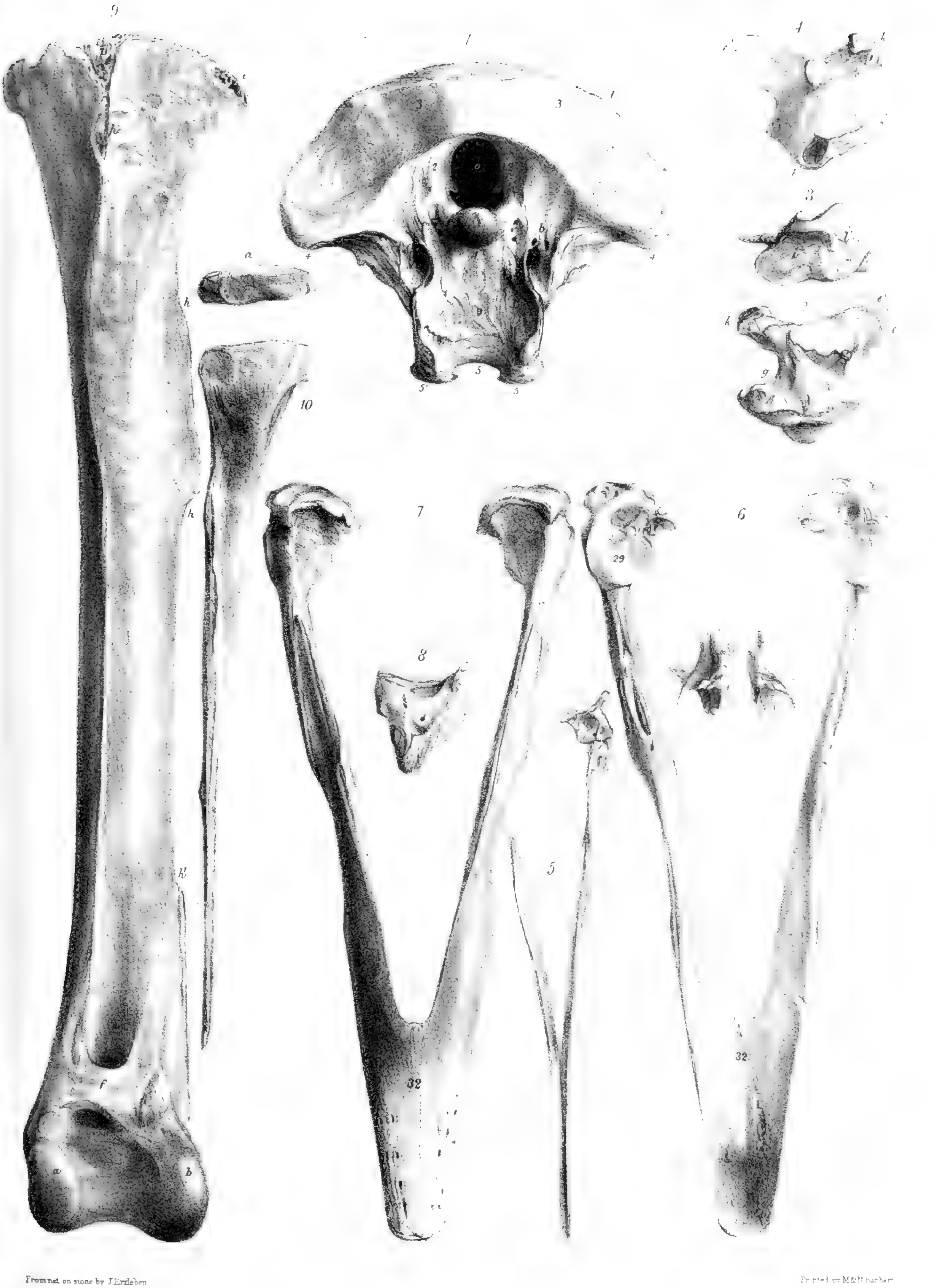
APTORNIS DEFOSSOR



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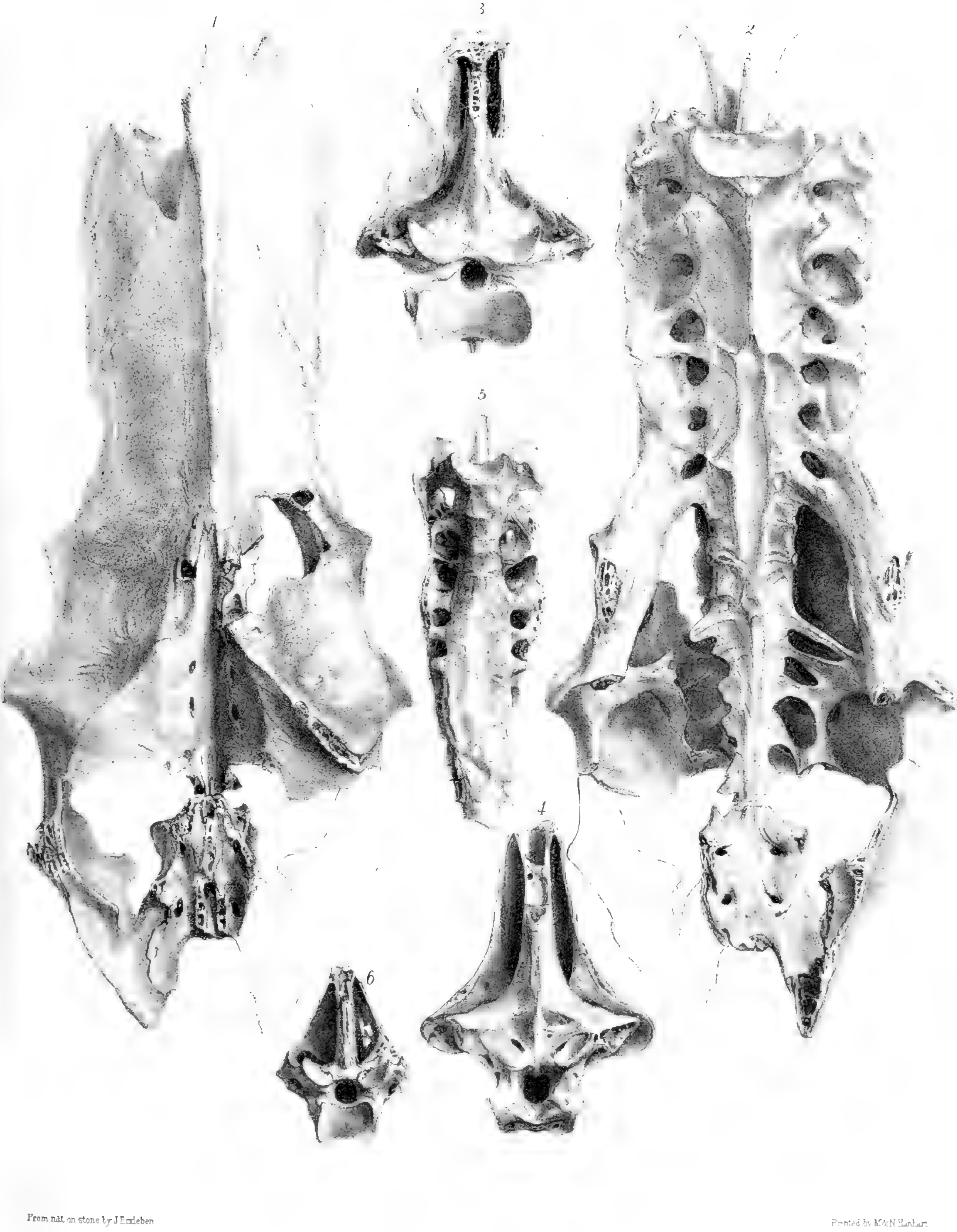

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1.3 APTORNIS 4 CNEMIORNIS 5 6 NOTORNIS

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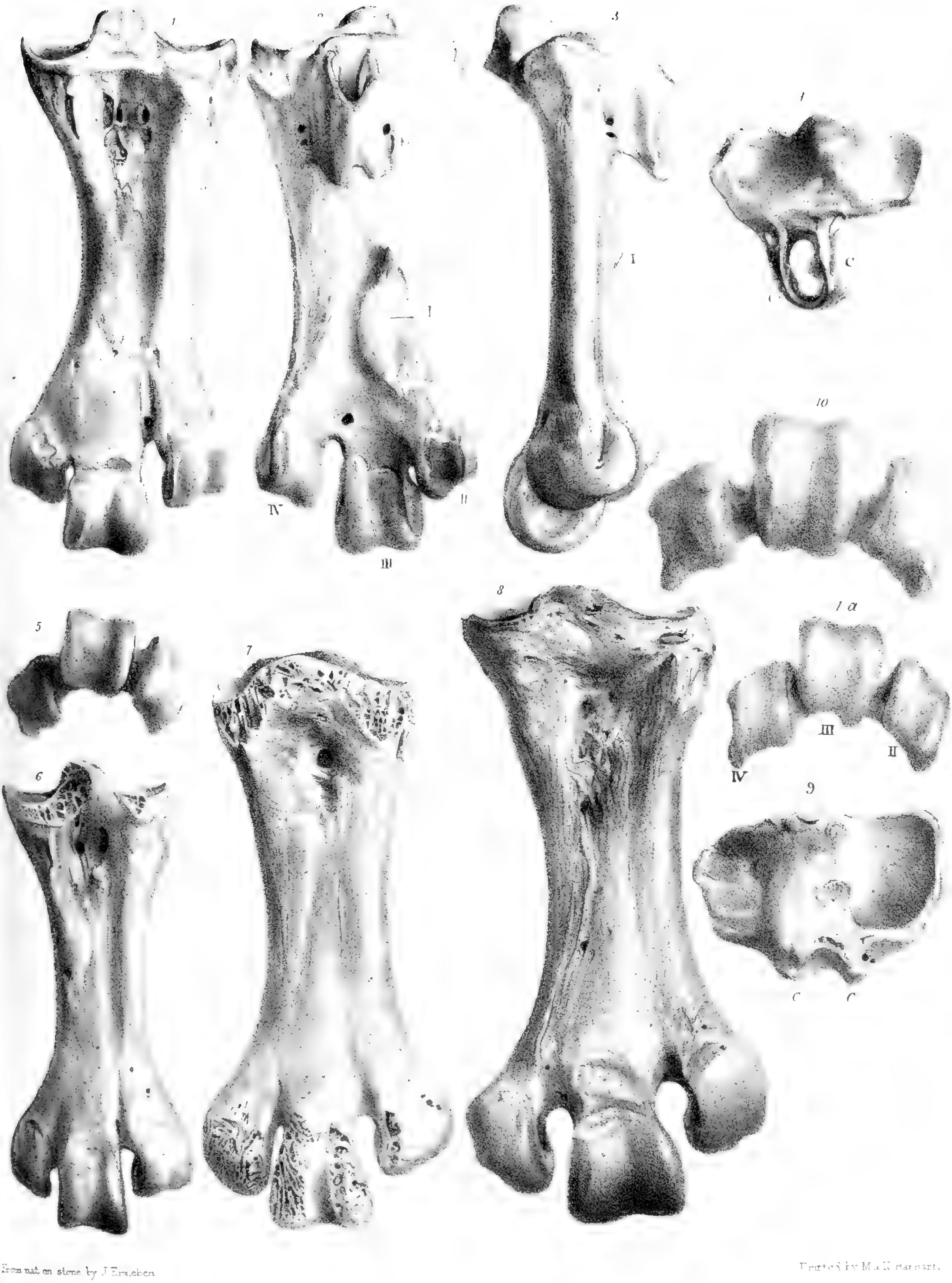

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1 5 APTORNIS DEFOSSOR 6. APTORNIS OTIDIFORMIS, 7 10. DINORNIS

IX. *On* DINORNIS (Part XVI.): *containing notices of the Internal Organs of some species, with a description of the Brain and some Nerves and Muscles of the Head of the* Apteryx australis. *By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read May 26th, 1870.

[PLATES XLV. to XLVII.]

§ 1. *Introduction.*

I AVAILED myself of the section of the mutilated cranium of *Dinornis giganteus*, described and figured in Part XIV.[1], to take a cast of the cavity (Pl. XLV. figs. 11, 12, 13), which affords an instructive representation of the brain of that species.

As my papers on the bones of *Dinornis* were preceded by a description of the osteology and myology of *Apteryx*, so I propose now to communicate some notes and figures made in the year 1848 from dissections of the brain and certain nerves of the head of the *Apteryx australis*, which I have kept back until I have been able to get satisfactory evidence of the brain of the *Dinornis*, with a view to bringing out the characteristics of which my investigations of that organ in the small surviving representative of the gigantic *Dinornithidæ* of New Zealand were mainly conducted.

§ 2. *Brain of* Apteryx.

The brain of the *Apteryx australis* (Pl. XLV. figs. 1–10) is of an ovate subdepressed form, $1\frac{1}{2}$ inch in length, 1 inch 3 lines in breadth; the cerebral hemispheres (*a*) overlap the optic lobes and four-fifths of the cerebellum (*c*); they are defined anteriorly from the olfactory lobes (fig. 2, *r*) by a curved linear depression (*a'*), convex forward.

Thus, as in most Mammals, three of the primary cerebral vesicles, or divisions of the brain, are exposed by removal of the calvarium, whilst no part of the mesencephalon comes into view.

At the base of the brain (ib. fig. 3) the myelon (*m*) expands into a long macromyelon (*d*). This shows on each side the small pneumogastric swelling (*v*), and the larger trigeminal one (*tr*); it then expands vertically, as well as laterally, at *d*, for the grey centres in connexion with the "crura cerebri" (fig. 4, *k*), the smaller fascicules diverging to the cerebellum and the mesencephalon. The length of the macromyelon ("oblong medulla" of Anthropotomy) is half an inch, its extreme breadth 4 lines; the under surface is impressed by a median line or furrow for the basilar artery (fig. 3, *e*), which is formed, as in birds generally, by the two "arteriæ communicantes" (*f*) sent

[1] Trans. Zool. Soc. vol. vii. p. 138, pl. 13. fig. 9.

backward from the cerebral divisions of the entocarotids (*g*). The basilar artery transmits or receives the branches from the vertebral arteries (*h*). A division of the macromyelon, defining a " pons," is not more definitely marked than in most other birds.

The cerebellum (Pl. XLV. figs. 1 & 2, *c*) is of a subcompressed, subconical shape; it gives 6½ lines in vertical, 5 lines in transverse diameter, and 6 lines in antero-posterior extent at the base. A rudimentary appendage or prominence represents the side lobes: the superficies is multiplied by about fifteen transverse folds, averaging 1½ line in depth; their grey and white matters are shown in the section (ib. fig. 6, *c*). About seven of these folds are visible on the exposed surface of the cerebellum (figs. 1, 2, *c*). A short fissural trace of the primitive cavity (ib. fig. 6, *c'*) communicates with the macromyelonal one, called " fourth ventricle."

The distinctive peculiarity in the base view of the brain in *Apteryx* is the small relative size of the optic lobes (figs. 3 & 4, *b*). M. Dareste was struck with the peculiarity in the specimen of the brain of an *Apteryx* in the Museum of Comparative Anatomy in the Garden of Plants. He speaks of the optic lobes as " à peine visible à l'extérieur "[1], and justly notices this confirmation by comparative anatomy of the relation of the optic lobes to vision, which relation MM. Flourens and Mayer had inferred from physiological experiment.

The optic lobes, reduced as they are in *Apteryx*, adhere, however, to the ornithic type by the degree in which they have diverged laterally from each other in the course of the brain's acquisition of its mature characters[2]; they are ovate and subdepressed. The optic thalami (ib. fig. 4, *i*) form a larger and more definite tract than in other birds, and contribute in a greater degree to the " radix optica," or chiasma.

The cavity or ventricle of the small optic lobe is shown in the section (fig. 6, *b'*), and in the base view (fig. 4, *b'*), in which the macromyelon, removed by a transverse section through the back parts of the optic lobes (*b b'*) and the " crura cerebri " (*k*), exposes the rudimental hippocampal enlargements (*l*) and the fissures (*m*) by which the artery of the " choroid plexus " penetrates the lateral ventricle.

The cerebral hemispheres (*a*, *a'*, figs. 1 & 2) are smooth: a feeble indent at the side of the base indicates the " Sylvian fissure," which receives a branch of the cerebral entocarotid (fig. 3, *g*); there is a more feeble indication of a mid longitudinal tract at the upper and hinder part of the hemisphere (fig. 2, *a*), and still more feeble indication of a transverse frontal depression marking off, as it were, an anterior lobe (ib. *a'*). The structure of the hemisphere adheres closely to the avian type. Each " crus" expands and commingles its white fibres with grey matter to form a large ganglion or " corpus striatum " (fig. 5, *n*), from the outer side of which the neurine, chiefly of the white

[1] Annales des Sciences Naturelles, Zoologie, 1856. His notice of this specimen is as follows:—" Le cerveau de l'*Apteryx*, tel que je l'ai entrevu au travers de ses membranes, m'a paru présenter des particularités intéressantes. Malheureusement je n'ai pu obtenir l'autorisation de le disséquer, ou même seulement de le dépouiller de ses membranes."—*Tom. cit.* p. 50.

[2] Anat. of Vertebrates, vol. ii. p. 119.

fibrous kind, expands, ascends, and arches inward over the great ganglion, becoming thinner as it approaches the median line, where it descends in contact with the corresponding part of the opposite hemisphere as a thin film forming the inner or median and the posterior wall of the "lateral ventricle" (Pl. XLV. figs. 7 & 8, *a''*). This is exposed by a longitudinal section of the thicker part of the roof (*a'* in fig. 5, and in Pl. XLVI. fig. 2), the smooth ventricular surface of the ganglion being shown at *n*. In Pl. XLV. fig. 7, the thin inner wall of the ventricle (*a''*) is exposed by removal of the "corpus striatum" and the thicker part of the ventricular wall (fig. 5, *a'*). The "corpus striatum" is impressed by equidistant transverse vascular linear grooves.

Figure 10 shows a vertical transverse section of the hemispheres, where they are united by the "anterior commissure" (*o*): the depth of the interhemispheral fissure (*p*) is seen below the commissure; and the shape of the section of the ventricular cavity is shown at *q*. A similar section, 3 lines in advance (fig. 9), shows the ventricle (*q*) shrunk to the under and inner surfaces of the hemisphere. The section across the base of the rhinencephalon (fig. 8) exposes the continuation of the ventricle (*q*) into that foremost primary division of the brain.

The rhinencephalon (figs, 1 & 2, *r*) is as remarkable in the present singular bird for its large size as is the mesencephalon (fig. 5, *b*) for the smallness of its principal elements. The mammalian proportions of the rhinencephalon (figs. 3, 4, *r*) involves the development of the fore part of the prosencephalon, including those continuations of fasciculi of white with grey matter forming the "crura rhinencephali," the homologues of what are described in Anthropotomy as the "roots of the olfactory nerves." It is that which gives rise to the semblance of "anterior lobes" of the hemispheres on the upper surface of the brain of the *Apteryx* (fig. 2, *a'*), and to the tumid tracts below continuing the hemispheres in advance of the chiasma and its minute optic nerves (figs. 3 & 4, *a a*). The prosencephala (fig. 1, *a*) overhang about two-thirds of the rhinencephala (ib. *r*). One may distinguish at the under part of the hemispheres an outer and an inner division of the "crura rhinencephali" (ib. *r'*) by feeble degrees of prominence; but they are not divided, as in Mammals, by a "perforate tract," or by the definite superficial fascicle of white fibres.

§ 3. *Cerebral nerves of* Apteryx.

The rhinencephala occupy special compartments or fossæ at the fore end of the cranial cavity. The olfactory nerves (Pl. XLV. fig. 2, *s*) perforate the anterior and inferior wall of the rhinencephalic chamber by several foramina, but are closely invested and united by the neurilemma, especially along their upper surface, so as to appear, for an extent of 8 or 9 lines, each as one large olfactory nerve. From the underpart of these fasciculi, filaments pass down to the broad ethmoturbinals (fig. 1, *ae*); the rest of the nerves are dispersed upon the septum narium and the middle turbinals (ib. *ai*), which seem to prolong forward and to make one huge mass with the ethmoturbinals of convolute bony laminæ covered with highly vascular pituitary membrane. The smaller and more remote anterior turbinal (ib. *ao*), rarely ossified, receives its nerves from the nasal branch (*x*) of the trigeminal.

The optic nerve is but one-fifth of a line in diameter, and about half an inch in length (Pl. XLV. fig. 4, *t*): its course to the eyeball is shown by dividing and reflecting the "obliquus superior" (Pl. XLVI. fig. 2, *o*), the "rectus superior" (ib. *r*), and the naso-maxillary division of the trigeminal nerve (ib. *w*).

The fifth or trigeminal nerve (Pl. XLV. fig. 1, *tr*) arises from the ganglionic enlargement of the macromyelon in connexion with or covered by the fibres of the transverse crus of the cerebellum. After a course of a line and a half, in which it leaves the cranium, it divides into two. The upper division (Pl. XLV. fig. 1, *w*) passes forward, ascending obliquely, traverses the orbit, diving beneath the "rectus superior" (Pl. XLVI. fig. 1, *r*), and the "obliquus superior" (ib. *o*), sending a filament here to the ciliary ganglion: it then, emerging at the upper and fore part of the orbit, subdivides. Prior to its subdivision it rests internally on the dura mater, closing an unossified part of the cranial wall external to the large rhinencephalic fossa. The branch (Pl. XLV. figs. 1 & 2, *x*, and Pl. XLVI. figs. 1 & 2, *x*) here reenters, as it were, the cranium, and emerges external to the cribriform plate by a canal larger than any of the olfactory foramina. The canal perforates the lacrymal bone, then grooves the outside of the turbinal mass (*ae*), and next perforates the base of the maxillary branch of the nasal: afterwards, inclining mesiad and sinking into the naso-premaxillary cavity, it gives branches to the anterior turbinal (ib. *ao*), attaching itself to the septum narium, near the lower margin, and becoming lost upon the septal membrane.

The branch (Pl. XLV. figs. 1 & 2, *y*) passes more directly forward, impresses the outer side of the upper (*ae*) and middle (*ai*) turbinals, and is continued more superficially beneath the horny sheath of the beak as far as the terminal disk perforated by the nostrils; it is diminished by filaments given off to the formative membrane and softer layer of the sheath to its termination at the tactile disk. The division corresponding to that called "third division," or "inferior maxillary nerve" (fig. 1, 6), sends off two nerves to the muscles of the mandible; these are derived from the non-ganglionic origin of the trigeminal: the main part, from the ganglion, is continued forward, sending off a branch to the outer tegument at the base of the mandible; it then enters the mandibular canal (fig. 1, *z*), and is continued forward to the end of the mandible.

The "eighth" nerve arises by two sets of roots from the same macromyelonal tract—the anterior set of three (Pl. XLV. fig. 1, 1), and the posterior one of two filaments (ib. 2): these combine in passing out of the skull, and emerge at the "vagal" foramen, whence the nerve (ib. 3) is continued further than usual before swelling into the ganglion and dividing into the glossopharyngeal (ib. 4) and the pneumogastric (ib. 5; see also figs. 1 & 2 in Pl. XLVI.). I need not go into the further distribution of these nerves, as they cease to mark any part of the skeleton.

Between the origins of the trigeminal and vagal nerves in Pl. XLVI. figs. 1 & 2, are shown that of the "portio dura" of the seventh pair, and the origin of the acoustic nerve.

§ 4. *Cranial Cavity of* Apteryx.

I may here supplement a former Monograph on the Osteology of the *Apteryx* by a notice of the characters and foramina seen in the interior of the cranium. The largest of the foramina is the foramen magnum, which looks downward and backward. The cerebellar protuberance of the occiput projects a little beyond the foramen; it is bounded on each side by a venous canal, which, emerging from the cranium behind the petrosal, grooves vertically the occiput, and again pierces the bone at the upper margin of the foramen magnum. In most skulls of the *Apteryx* the right of these canals with its upper and lower holes is larger than the left. Near the lower border of the great foramen, on each side the condyle, is a minute "precondylar foramen;" in advance and external thereto is the larger "vagal" fossa and foramen. Above this are the minute foramina conducting the acoustic filaments to the labyrinth. These are overarched by a remarkable development of bone within the "tentorium," forming in the dry skull a nearly horizontal plate, 3 lines by 1 line, terminating mesiad in a rounded and slightly thickened border. Beneath the back part of this plate is a large venous foramen. The superior semicircular canal raises a well-defined prominence on the petrosal platform continued into the above-described plate. The macromyelonal fossa is wide and moderately deep. It is bounded anteriorly by the posterior ridge of the trigeminal fossa and by the intervening hind wall of the sella. The foramen ovale leads from the back part, and the foramen rotundum from the fore part, of the fossa. The sella is deep and hemispheroid; it is tapped behind by the entocarotids. The chiasmal tract rises vertically from its fore part with an irregular aperture on each side larger than is needed for the optic nerves. The chief peculiarity of the cranial cavity is the enormous rhinencephalic fossa, divided by the "lamina perpendicularis." The dura mater closing these fossæ is not ossified, so that in the dry skull the turbinals, upon which the olfactory nerves perforate the membrane to ramify, are here exposed. The cranial walls show a thin pneumatic diploë above the paroccipitals, but in the rest of the section they are thin and compact.

§ 5. *Brain of* Dinornis.

Returning to the brain of the *Apteryx*, the side view (fig. 1) is contrasted (in Pl. XLV.) with that of the *Dinornis* (fig. 11), the upper view (fig. 2) with fig. 12, and the under view (fig. 3) with fig. 13.

The *Dinornis* differs in the minor relative size of the cerebrum to the cerebellum, which latter (figs. 11 & 12, *c*) rises wholly behind and uncovered by the hemispheres (*a*). The cerebrum appears to be broader, because it is so much shorter, relatively, than that of the *Apteryx*; its upper surface is much more accentuated. A broad and high longitudinal tract (*a*), next the mid line, is divided from the outer part of the hemispheres; and this is partially subdivided into a posterior (a'') and anterior (a') portion by a shallow depression answering to the "Sylvian fissure."

The optic lobes (figs. 11, 12, 13, *b*, *b*) are, relatively as well as absolutely, larger than in *Apteryx*, corresponding with the indications, given by the orbits or bony beds, of the larger and better-developed organs of vision in *Dinornis*, the species of which we may conclude to have been diurnal; they are visible in the upper view (fig. 12, *b*, *b*) as well as in the side view (fig. 11).

No demarcation of a "pons" can be satisfactorily traced on the cast; but the trigeminal swelling is plain. The length of the macromyelon is 11 lines, its breadth is 9 lines.

The cerebellum shows a pair of low lateral lobes (fig. 11, c') at its fore part, and behind this the depression answering to the upper semicircular canal. The length of the cerebellum is 1 inch 2 lines, its breadth at the lateral lobes is 1 inch. The vertical diameter of the epencephalon (ib. *c*, *d*) is 1 inch 4 lines; the breadth of the mesencephalon (fig. 13, *i*, *b*), taken outside of the optic lobes, is 1 inch; the length to the fore part of the chiasma is 8 lines; each optic nerve (*t*) has a thickness of 2 lines. The breadth of the cerebrum (fig. 12, *a*, a'') is 2 inches 2 lines; its length is 1 inch 7 lines; its depth, or vertical diameter, is 1 inch 1 line. The breadth of the rhinencephalon (*r*) is 8 lines; the length of each lobe in advance of the cerebral hemisphere is $2\frac{1}{2}$ lines. They are relatively less than in *Apteryx*.

The hypophysis, as represented by the cast of the "sella" (figs. 11, 13, *y*) is of considerable size; there is an indication of a better-developed pineal gland (fig. 12, *p*) than in the *Apteryx*.

§ 6. *Trachea of* Apteryx, Struthio, *and* Casuarius.

In the *Apteryx australis* the trachea has a nearly uniform diameter throughout its extent; the rings, from 120 to 130 in number, are entire and cartilaginous. When the windpipe is relaxed the rings alternately overlap, and are overlapped by, each other at their sides, appearing to be alternately narrower on one side than on the other; but when the tube is stretched this appearance is lost, though not wholly, the rings then showing a slight difference of breadth in the axis of the tube at their sides. They become gradually smaller in circumference and diameter in the last twenty, which are less closely attached together than in the Ostrich and Emu.

In the trachea of the Cassowary, for the opportunity of examining which I am indebted to Dr. Murie, the rings, mostly entire as in other birds, vary in depth, *i.e.* in the diameter of the hoop parallel with the length of the tube, and they correspondingly vary in thickness (Pl. XLVI. fig. 5). Their excess in these diameters is shown at about one-fourth down the trachea; they become narrowest and thinnest at the terminal tenth part of the tube, where a solution of continuity of the ring begins to show itself along the mid line of the back part of the tube. The incomplete rings of the bronchi resume the dimensions of those at the beginning and middle of the trachea.

In the Ostrich the bronchial rings are more slender than any of those of the trachea, and rapidly diminish in size as they approach the lungs.

In both Ostrich and Cassowary the tracheal rings examined by me were gristly, or were hardened with a very small proportion of bone-earth.

§ 7. *Trachea of* Dinornis crassus.

The more completely ossified state of the tracheal rings of *Dinornis* has led to their preservation in more than one species; and I have received from time to time specimens of such rings more or less closely associated with parts of the skeleton, in largest numbers with that collection of *Dinornis* remains obtained by Mr. Walter Mantell from the fine dark soil, or morass, at Ruamoa, Middle Island of New Zealand, and purchased for the British Museum.

In working out this matrix from the base of the skulls of *Dinornis crassus*, described in a former Memoir[1], I detached from beneath the position of the palato-nares a group of four bony hoops or rings of an oval form, averaging 9 lines in long diameter, 7 lines in short diameter; the depth of the rim of the bony hoop varied from one line to half a line; its thickness was about a quarter of a line. The outside of the ring is convex and finely rugose; the inside is less convex and smooth.

It is probable, though I cannot hold it as certain, that, because these slender rings were found at or near the position of the upper larynx, therefore they were from the beginning of the windpipe; for the dislocation of the parts of the skeleton in all the individuals so represented in the marshes of Ruamoa, as far as can be gathered from the account given by Mr. Mantell, might well admit of displacement of parts of the bony trachea.

Admitting this doubt as to their precise position in the windpipe, still the probability is so great that tracheal rings preserved in contact with parts of the skeleton were parts of the same bird, that the rings here described may be reasonably referred to the *Dinornis crassus.*

There is, moreover, a significant degree of correspondence between the number of tracheal rings of the type of those attached to the skull, but collected without note of precise relations, probably scattered in the matrix, and the number of individuals of *Dinornis crassus* indicated by bones of the skeleton; that is to say, both tracheal rings and skeletons or bony evidences of *D. crassus* are amongst the most plentiful of the species there found.

The rings or hoops, upwards of 150 in number, provisionally referred to *Dinornis crassus*, are associated together by the character of shape and size. In general they are less slender than those cemented to the skull-base; but they present a certain range in

[1] Part XIII., Trans. Zool. Soc. vol. vii. p. 129.

the thickness, especially the depth, of the wall of the ring. The extreme of the latter, or breadth in the axis of the windpipe, is 3 lines, as at fig. 2, *b*, Pl. XLVII.; but this is partial, the hoop decreasing to 2 lines and $1\frac{1}{2}$ line at part of the circumference, in a few at the small ends of the ellipse, or the lateral parts of the hoop; the more common breadth is from 2 lines to $1\frac{1}{2}$ line (Pl. XLVII. fig. 1, *d*); those found at the base of the skull, and inferred to be from the upper part of the windpipe, were 1 line, decreasing partially to $\frac{1}{2}$ a line, in depth. There is less range of thickness in the elliptical rings of *Dinornis crassus*, as, *e. g.* from $\frac{1}{10}$ to $\frac{1}{8}$ of a line, seldom getting to $\frac{1}{6}$ (ib. figs. 1 & 3). There is a certain range of size and of shape of the ellipse: thus, in fig. 1, *a*, *b*, exceptional instances of subcircular rings are figured; in fig. 3, *a*, *b*, the long axis is 10 lines, the short one 9 lines; in fig. 3, *c*, the long axis is $11\frac{1}{2}$ lines, the short one 8 lines. Most of the rings have intermediate proportions; in a few the ellipse is less regular, one side inclining to flatness. There is a variety also in the configuration of the surfaces of the hoop; instead of the outer surface being convex from the upper to the lower margins, as in the slender rings detached from beneath the skull, it is flat, especially in the broader varieties, in which the inner surface preserves a slight convexity in the same course; in some rings the outer surface is slightly concave from edge to edge (as in fig. 2, *b*).

Of the tracheal rings referred to *Dinornis crassus* some are preserved in groups, cemented in their consecutive arrangement upon and by the matrix. These groups include one of seven rings (fig. 4), two of six rings, one of five rings (fig. 5), two of four rings with part of a fifth (fig. 6), as many of three rings, and more of two rings so kept in natural sequence. In three instances of the "two rings" these show broader and narrower parts of the outer surface, alternating, the extremes being at the small ends of the ellipse, or at the sides of the tube. This character has been noted in recent birds, especially in the Waders[1], the appearance being that presented by the tracheal rings of the present extinct Moa (fig. 7, *a*, *b*, *c*); but the analogy of *Apteryx* (*anteà*, p. 386) led me to test the relation of the appearance to reality.

Succeeding in working out the cementing matrix in one instance, and exposing the inner surfaces of the two interlocked rings, I found, as I had anticipated, that the outward appearance was due in some degree to intussusception, the inner surface being broader where the outer surface was narrower, and *vice versâ*. Nevertheless a slight inequality of breadth is shown in some detached rings at the ends of the ellipse; and it may indicate that they come from a part of the windpipe situated where it was subject to most flexure in the bendings of the bird's neck.

[1] "They are alternately narrower at certain parts of their circumference and broader at others; and in these cases the rings are closely approximated, as it were interlocked. This structure is most common in the Grallatores, where the rings are broadest alternately on the right and left sides."—*Anat. of Vertebrates*, ii. p. 219.

§ 8. *Larynx of* Dinornis crassus?

The portion of a thin, hollowed, shield-shaped piece of bone (Pl. XLVII. fig. 8, *a*, *b*) I take to belong to the upper larynx, and to be part of the thyroid element. To its lower border has coalesced, as is sometimes found in existing birds, the first tracheal bone or hoop (*c*), which, as usual, is incomplete; the coalescence is limited to the two ends of this half ring; the slit of separation between it and the thyroid is 9 lines in extent, giving the breadth of this slender bone as half a line; it projects anteriorly like a folded lower border in advance of the actual lower border of the thyroid, which is the more prominent part on the inner or concave side of the thyroid. One might expect the rings near to or following this to have similar slender proportions, like those worked out of the matrix beneath the skull of *Dinornis crassus*; lower down the wind-pipe they gained in depth.

From another mass of matrix, exhibiting a portion of a broad tracheal ring, I worked out the part of the expanded terminal one, to which, in the entire or recent state of the parts, the bronchi are attached; it answers to that supporting the cross bar shown at *t*, fig. 103, 'Anatomy of Vertebrates,' vol. ii. p. 222, in the Raven, and ranks among the parts of the lower larynx. The specimen shows the contiguous portions of two cavities, meeting at a sharp straight ridge (fig. 9, *a*), 8 lines in extent, which was produced into the cavity of the trachea, dividing the tube from before backward; the concavities on each side are the beginnings of the divisions or the continuations of the trachea into the bronchi. The margins of the expanded bone, continued from one (probably fore) end of the dividing ridge, are rather thickened. Cemented by the matrix to this part of the lower larynx was one, probably the first, of the bronchial bones (fig. 9, *b c*); it is incomplete, varying in breadth from 2 lines to nearly 3 lines, and may have surrounded two-thirds or three-fourths of the bronchus. At the broader part the outer surface is rather convex from the upper to the under margin; at the narrower part this surface is concave. It seems to answer to that part of the lower larynx figured at *a*, fig. 103, *tom. cit.* p. 222.

§ 9. *Trachea of* Dinornis rheïdes?

To a smaller species of *Dinornis*, probably *D. rheïdes*, I refer a series of rings, about 80 in number, similar in shape and general character to those of *Dinornis crassus*, but of a smaller size (Pl. XLVII. figs. 10–12).

The range of variety of size is here rather less. The largest ring yields, in long diameter, 9 lines, in short diameter 7 lines (fig. 11); the smallest gives 7 lines and 6 lines in the same diameters (fig. 10). The average, or common size, is 8 lines in long and $6\frac{2}{3}$ in short diameter (fig. 12); the ellipse is more perfect and constant in the rings of this species, and the concavity from edge to edge of the outer surface of the hoop is more constant and more marked than in *Din. crassus*. The depth of the hoop is greater, relatively, and is maintained through a greater extent of the windpipe, as it seems; this dimension is 2 lines, with slight change at parts of the circumference.

Of this species there is one specimen of a sequence of four rings in the same portion of matrix (fig 12), another piece with three rings, and three or four with two rings. The extreme of depth of hoop is reached at part of the circumference of the ring (fig. 11, *a*, *b*).

§ 10. *Trachea of* Dinornis elephantopus?

The tracheal rings of the third series are remarkable for their great breadth and thickness. There are about 80 of these, of a full elliptical, subcircular, or circular shape, with an average diameter or long diameter of 9 lines. The specimen figured (Pl. XLVII. fig. 13, *a*, *b*) shows the average size or common character of these strong, broad, well-ossified tracheal rings. The exterior surface is rugose, the inner one smoother, both surfaces straight or even from one margin to the other; the margins are flat, as if made by a clean cut, and show irregular perforations, probably vascular, of the osseous tissue. The thickness of the hoop is rarely uniform, the difference being, in several rings, as great as in that figured in 15, *a*; there is also, occasionally, a variety in the breadth at different parts of the circumference of the hoop, though rarely to the extent shown in fig. 16, which, from its small size, may possibly be a bronchial hoop.

§ 11. *Trachea of* Dinornis ingens?

About 70 tracheal rings show an average of size and shape as in that of fig. 17, *a*, *b*, *c*; the extremes in regard to depth of hoop, in this series, are given in figs. 19 & 20. The bone, in all, is of unequal thickness, longitudinally rugose, but unequally so, on the outer surface, smooth within (fig. 18, longitudinal section). On the rougher part of the ring the bony substance stands out in the form of granules or ridges, the latter running in the direction from one margin to the other (figs. 19 & 20, *b*, *b*). These margins (figs. 17 & 19, *a*) are flat or "truncate," as in the smaller rings (figs. 13–15, *a*) of the present robust type; but here the margin is more uneven, with risings and depressions, somewhat irregular, but on the whole at right angles to the outer and inner surfaces.

In this series were specimens of two partially confluent rings, or of a broad hoop twisted upon itself spirally, so as to simulate two hoops. Of these specimens one is represented at fig. 21, *a*, *b*, a second at fig. 22; fig. 23 shows more plainly a partial confluence of the two bony rings. Seven rings of the average size of those provisionally attributed to *Dinornis ingens* (Pl. XLVI. fig. 6) occupy an extent of the trachea equalling that which includes thirty-nine in *Casuarius galeatus* (ib. fig. 5).

§ 12. *Trachea of* Dinornis robustus?

I have finally to notice the largest specimens in the present collection, which exemplify the most extraordinary degrees of thickness and strength of bone which have been hitherto observed in the windpipes of Birds.

I think it not improbable that an osseous hoop like that represented in fig. 24, *a*, *b*, might, if received as a solitary fossil, have passed rather for a section of the shaft of a pneumatic limb-bone, being as large, for example, as such section of the femur of a Cassowary, but thicker in the walls. He must have been a bold, as well as acute, palæontologist who would have pronounced it one of the rings of a bird's windpipe. I have now, however, received upwards of thirty specimens, averaging the dimensions of that of fig. 24. They are, most of them, rather more elliptical, less circular, than the smaller hoops of a like type (figs. 17–23). The long diameter averages, as in fig. 24, 1 inch 2 lines, the short diameter 1 inch, outside measure; the area, which is a more regular ellipse, gives $10\frac{1}{2}$ lines and 9 lines in the two diameters. The breadth, or we may now say the length, of the hoop's wall, *i. e.* from the upper to the lower margin, averages 9 lines and $7\frac{1}{2}$ lines, not being uniform all round; the difference of thickness is greater, viz. from $2\frac{1}{2}$ lines to $\frac{1}{2}$ a line (fig. 24, *a*, and fig. 32).

The contrast between the outer and the inner surfaces of the tracheal hoops in *Dinornis* becomes greater as these increase in size. In the present series, which may belong to *Dinornis robustus*, the irregular longitudinal striation prevails over the external surface of the bone; but there are other characters.

At one or two parts of the circumference a part of that surface (figs. 24, 26, 28, ×) projects beyond the rest, usually from the middle third part between the upper and lower borders; these elevations, or the elevation, if it be single or continuous, are limited to one side of the hoop, and to that which is most convex or least flattened. The degree of elevation is slight, from a fourth to a sixth of a line; the surface is smoother than the parts above and below. These elevations I take to indicate the interval between the surfaces of insertion or attachment of fibrous substance connecting one ring to the next in a more special manner than the general external investment of the hoops, the fibrous character of which may be indicated by the general longitudinal striation of the external surface. The smoother part of that surface is usually opposite the side showing the broad and low elevation. Besides the foregoing accentuations of the outer surface, many of the hoops show coarser granulate outgrowths at the rougher part of the bone.

In almost all of the present series of rings the longitudinal lay of the outer surface, from one margin to the other, if it is not straight, tends rather to convexity. The longitudinal lay of the smooth inner surface is more uniformly straight; but there is a feeble transverse rise, or linear impression, indicative of a tract on the inside corresponding to the elevation on the outside of the hoop.

In the present, as in the preceding series, there are differences of length, breadth, and thickness of the wall of the hoops; the two extremes of the first dimension are shown in the subjects of figures 25 & 26. There are also six instances of confluence of two hoops; in no received example is co-ossification of the tracheal rings carried further. Fig. 27 shows two of the shorter variety of hoops coalesced at the flatter and rougher half of their circumference (*b*), the activity there of the ossifying process being further exemplified by an unusual degree of granulate outgrowths simulating an exostosis: the more convex part of each hoop (*a*), where the line of separation remains open, is comparatively smooth. The two rings (fig. 28, *a b*) have completely coalesced—the original separation, showing them to have been of the long variety, being feebly, though sufficiently, indicated. These also show a markedly flatter side of the ring where the bone is thickest and most irregular. It is to this increase of osseous substance that the flattening is due, the smooth inner surface of the same part following the course of the elliptical section of the air-passage. Lengthwise these anchylosed hoops show a greater longitudinal convexity of the smoother side, and a more feebly longitudinal concavity of the opposite side; but this indication of a bend of the windpipe is better marked in the next anchylosed pair of hoops (fig. 29), although they are shorter, showing the common size. In these, at the convex part of the bend, the coalescence is incomplete.

Figure 30 shows two coalesced rings, where the hoops thin off behind and the bony texture is exposed by abrasion. This texture is coarse, and, with the character of the truncate margins and of the rough parts of the outer surface, gives the hoops or cylinders a cork-like appearance.

Sections of these tracheal rings (fig. 31, *D. ingens*?, and fig. 32, *D. robustus*?) show the varying thickness of the bone at opposite parts of the cylinder, the smoothness of the inner surface, and the denser character of the osseous texture at the thicker part of the wall of some of the rings.

§ 13. *Trachea of* Aptornis defossor.

With a sternum, pelvis, and some other parts of the skeleton of *Aptornis defossor*, more entire than those described in my Memoir No. XV., and subsequently received, were a few rings of the trachea, of elliptical shape, averaging 7 lines and 5 lines in the two diameters (Pl. XLVI. fig. 7), with a depth of the hoop of $1\frac{1}{2}$ line. These rings show a pair of narrow notches, one at the upper, the other at the lower margin, at opposite sides of the hoop, at its shorter diameter (ib. *a*, *c*). In the instance of two of these rings in connexion, the partial and reciprocal overlapping or intussusception was defined by or took place at these notches (ib. *b*).

§ 14. *Muscles of the Mandible and Hyoid of the* Apteryx.

The illustrations of the myology of the *Apteryx* in my second paper on this bird[1] were mainly devoted to the muscles of the trunk and limbs; I now, therefore, supply figures (Pl. XLVI. figs. 1–4) in which are shown some muscles of the eye, the jaw, and the tongue, either undescribed or briefly referred to in that Monograph.

The origin of the "constrictor colli" (Zool. Trans. *tom. cit.* pl. 31. *a*), by a "broad

[1] Part II. (Myology) Trans. Zool. Soc. vol. iii. p. 277, pls. 31–35.

fasciculus from the outer part of the superoccipital ridge" (ib. p. 228), is shown at *a*, fig. 3. It is reflected back, to expose the homologue of the "biventer mandibulæ" (γ), a powerful muscle which arises tendinous from the outer and anterior marginal ridge of the paroccipital, swells into a fleshy belly, which again contracts to its insertion into the slightly deflected angle of the mandible.

The external or posterior "temporalis" (α) and the internal or anterior "temporalis" (β) have their origins exposed in fig. 3, Pl. XLVI., and their entire course shown in fig. 4, ib. The external muscle derives its origin from the lower and lateral part of the parietal as far back as the mastoid (8)[1]. The origin of the internal portion continues the curved line forward from the parietal to the postfrontal. The fibres of the external portion pass obliquely forward, external to those of the anterior portion, to be inserted into the fore part of the outer surface of the marginal coronoid elevation of the mandible. The fibres of the anterior portion (β, fig. 4) descend less obliquely, and more directly embrace, by their insertion, the long and low, sharp, straight coronoid ridge in *Apteryx*; the hinder fibres descend vertically, and are continued backward to the hind end of the ridge. Both portions, like the more collective mass of carneous fibres of the temporal in Man and Mammals, pass behind the horizontally extended arch of bone formed by the zygomatic portions of the squamosal (27) and the malar (26). This relation I deem worthy the attention of the unbiased student of the homologies of the bones marked respectively 8, 27, 26, in fig. 4, and in the illustrations of the skulls of *Dinornis* &c. in preceding Memoirs. If the hind end of 27, where it joins the tympanic (28) as in Man and Mammals, were to expand into overlying junction with the mastoid (8) and parietal (7), it would also contribute to the surface of origin of the temporalis muscle. By adopting the homology propounded by Cuvier and Hallmann of the bone (8) as with the "temporal" or "squamosal" of Mammals, the anatomist falls into the necessity of introducing a new bone into the cranium of the bird, and of completing its zygomatic arch by a "quadrato-jugal."

From the posterior third of the lower border and inner surface of the zygomatic arch rises the masseter muscle (η, fig. 3, Pl. XLVI.), answering, in regard to its origin and the forward inclination of the fibres as they descend, to the deep portion of the mammalian and human masseter: the insertion is into the lower half of the outer side of a short tract of the mandible behind the insertion of the "temporal" muscles.

The "orbicularis palpebrarum" (fig. 3, *c*) sends some of its hinder superficial fibres over the part of the zygoma giving origin to the masseter, which are lost in the superficial fascia of that muscle. I noted the great strength of the "orbicularis palpebrarum" in my first Memoir on the Anatomy of the *Apteryx* (Trans. Zool. Soc. vol. ii. p. 294).

[1] As in Man, the temporal muscle is described as extending its origin "from the curved line on the frontal and parietal bone above to the mastoid portion of the temporal behind."—GRAY's '*Anatomy, Descriptive,*' &c., 8vo, 1858, p. 200. The "temporalis externus" in birds answers to the posterior portion of the mammalian "temporal muscle."

In fig. 3 a bristle is represented passing through the "punctum lacrymale" and along the lacrymal duct into the nasal chamber, where it terminates between the second and third turbinals. In fig. 4 are shown three of the ligaments of the lower jaw. The "occipito-mandibular ligament" (*m*) is attached above to the paroccipital ridge (4), crosses the back part of the "membrana tympani," but behind the "meatus auditorius," to be fixed into the external and posterior articular ridge of the mandible. The "tympano-mandibular" ligament (*n*) is attached above to the back part of the articular cup for the "squamosal," and below to the anterior and external articular ridge. The "zygo-mandibular ligament" (*o*) is attached to the slightly expanded hind end of the zygomatic element or representative of the squamosal, and below to the outer side of the mandible between the temporal and masseteric insertions; some fibres of the masseter are derived from both these ligaments, respecting which I may quote the remark from my first Memoir on *Apteryx*, "that they are an essential part of the mechanism of a beak which is destined to be forcibly thrust into the ground, and used in a variety of ways to overcome considerable resistance" (*tom. cit.* p. 264).

The short struthious tongue of the *Apteryx*, described at p. 264 of the first Memoir, is shown at *l* in fig. 1, Pl. XLV. The "mylo-hyoideus" muscle is reflected from its origin (at *h*, fig. 3, Pl. XLVI.) to expose the "genio-hyoid" muscle, which arises from the inner and under part of the mandibular ramus, nearer the angle than the symphysis, and sends backward its fibres to embrace the "thyrohyal" element (*k*) of the tongue-skeleton to near the free hind extremity; the pair tend to protrude or draw forward the tongue. In fig. 3 are also shown the circular fibres of the pharynx and beginning of the œsophagus (*f*), also the commencement of the trachea (*g*).

The portion of the cutaneous system of muscles for which I retained the old term "platysma myoides" (Zool. Trans. *tom. cit.* p. 279, pl. 31. *e*), has its rather strong, but flattened, tendinous origin from the external ridge of the hinder surface of the mandible, shown in fig. 3, and the expansion of its thin sheet of carneous fibres (at *e*) inserted into the skin covering the throat. This pair of muscles must tend, acting together, to support and compress the upper larynx and pharynx.

In both figures (3 & 4) are shown the inserted portions of the "longus colli posticus" (*o***), of the "complexus" (*y*), of the "trachelo-mastoideus" (*z*), and of the "rectus capitis lateralis" (*d*). Full descriptions and figures of these muscles are given in Memoir II., on the *Apteryx*, *tom. cit.* pp. 283–286, pls. 32, 33, 34, & 35.

DESCRIPTION OF THE PLATES.

(All the figures are of the natural size.)

PLATE XLV.

Apteryx australis.

Fig. 1. Side view of the brain, *in situ*, with dissection of nerves and of organ of smell.

Fig. 2. Upper view of the brain, *in situ*, with olfactory and trigeminal nerves.

Fig. 3. Base of brain, with cerebral arteries and origin of nerves.

Fig. 4. Base of brain, the cerebellum exposed by removal of the macromyelon.

Fig. 5. Side view of the brain, dissected to show the corpus striatum.

Fig. 6. Section of cerebellum and of part of cerebrum.

Fig. 7. Cavity of the lateral ventricle of the brain.

Fig. 8. Section of rhinencephala, showing their ventricle.

Fig. 9. Section of the fore part of prosencephala.

Fig. 10. Section, showing the anterior commissure.

Dinornis giganteus.

Fig. 11. Side view of brain.

Fig. 12. Upper view of brain.

Fig. 13. Base view of brain (represented by a cast of the cranial cavity).

PLATE XLVI.

Fig. 1. Dissection of the brain, of the fifth, seventh, and eighth nerves, and of the muscles of the eyeball of *Apteryx australis*.

Fig. 2. Further dissection of the same parts, with the course of the optic nerve.

Fig. 3. Dissection of the muscles of the mandible and tongue of *Apteryx australis*.

Fig. 4. Ligaments and muscles of the mandible of the same.

Fig. 5. Portion of the trachea of the Cassowary (*Casuarius galeatus*).

Fig. 6. Portion of the trachea, including seven tracheal rings of *Dinornis* (*ingens*?).

Fig. 7. Tracheal rings of *Aptornis defossor*.

Fig. 8. Stones from the gizzard of *Dinornis elephantopus*[1].

[1] These pebbles constitute about one-third of the heap of such found within the space encompassed by the ribs and sternum of the skeleton of *Dinornis elephantopus* exhumed from the bog at Glenmark, Canterbury Settlement, Middle Island, New Zealand, of which the sternum is described in Part XIII., Zool. Trans. vol. vii. p. 115. No such pebbles occur, naturally, within a distance of thirty miles of that locality.

I submitted them to the examination of the experienced officers in the Department of Mineralogy, British Museum, and append the following note from Thomas Davies, Esq., Assistant in that Department:—

"The pebbles supposed to have been contained in the gizzard of the *Dinornis* consist exclusively of varieties of quartz more or less crystalline or compact—sometimes amethystine, and also approaching in texture and colour the black cherty variety called Lydian stone or Basanite; the two latter, however, are apparently of more exceptional occurrence. All are much worn, preserving little trace of their original fragmentary outline."

I have received pebbles smoothly rounded by the triturating work of the gizzard of the *Dinornis*, from other localities, under similar relations to the skeleton; their significance in association with bones of the trunk has probably been overlooked.

PLATE XLVII.

Fig. 1. Tracheal rings of *D. crassus*: *a*, *b*, *c*, varieties, full view; *d*, oblique view, from near the head.

Fig. 2. Side views of (*a*) large ring and (*b*) small ring, showing inequality of depth of hoop.

Fig. 3. Full view of subcircular rings, *D. crassus*.

Fig. 4. Group of seven tracheal rings, *D. crassus*.

Fig. 5. Group of five tracheal rings, *D. crassus*.

Fig. 6. Group of four tracheal rings, *D. crassus*: *a*, front view; *b*, side view.

Fig. 7. Groups of two rings, showing appearance of alternate breadth and narrowness of parts of hoop: *a*, front view; *b*, back view; *c*, side view.

Fig. 8. Part of ossified "thyroid cartilage" of upper larynx of *Dinornis crassus*: *a*, outer surface; *b*, inner surface.

Fig. 9. *D. crassus*: *a*, part of the chief bone of the lower larynx; *b*, *c*, upper bronchial ring.

Fig. 10. Tracheal rings of *Dinornis rheïdes*: *a*, *b*, *c*, varieties, in full view; *d*, oblique view.

Fig. 11. Broad variety of tracheal rings, edge views: *a*, broader side; *b*, narrower side.

Fig. 12. Group of four tracheal rings, *D. rheïdes*.

Fig. 13. Tracheal ring of *Dinornis elephantopus* (?): *a*, full view; *b*, side view.

Fig. 14. Broader variety of tracheal ring of the same species.

Fig. 15. Narrow variety of tracheal rings of the same species: *a*, full view; *b*, side view.

Fig. 16. Side view of bronchial ring? of the same species.

Fig. 17. Tracheal rings of *Dinornis ingens* (?): *a*, full view; *b*, front view; *c*, back view.

Fig. 18. Inside view of a tracheal ring of *Dinornis elephantopus* (?).

Fig. 19. Broad variety of tracheal rings of *Dinornis ingens* (?).

Fig. 20. Narrow variety of tracheal rings of *Dinornis ingens* (?).

Fig. 21. Two partially united tracheal rings of *Dinornis ingens* (?).

Fig. 22. Two partially united tracheal rings of *Dinornis ingens* (?), simulating a spiral.

Fig. 23. Two partially united tracheal rings of *Dinornis ingens* (?), simulating a spiral.

Fig. 24. Tracheal rings of *Dinornis robustus* (?): *a*, full view; *b*, back view; *c*, front view.

Fig. 25. Narrow variety of tracheal rings of *Dinornis robustus* (?).

Fig. 26. Broad variety of tracheal rings of *Dinornis robustus* (?).

Fig. 27. Two partially confluent rings of *Dinornis robustus* (?): *a*, smooth united part; ×, rough anchylosed part.

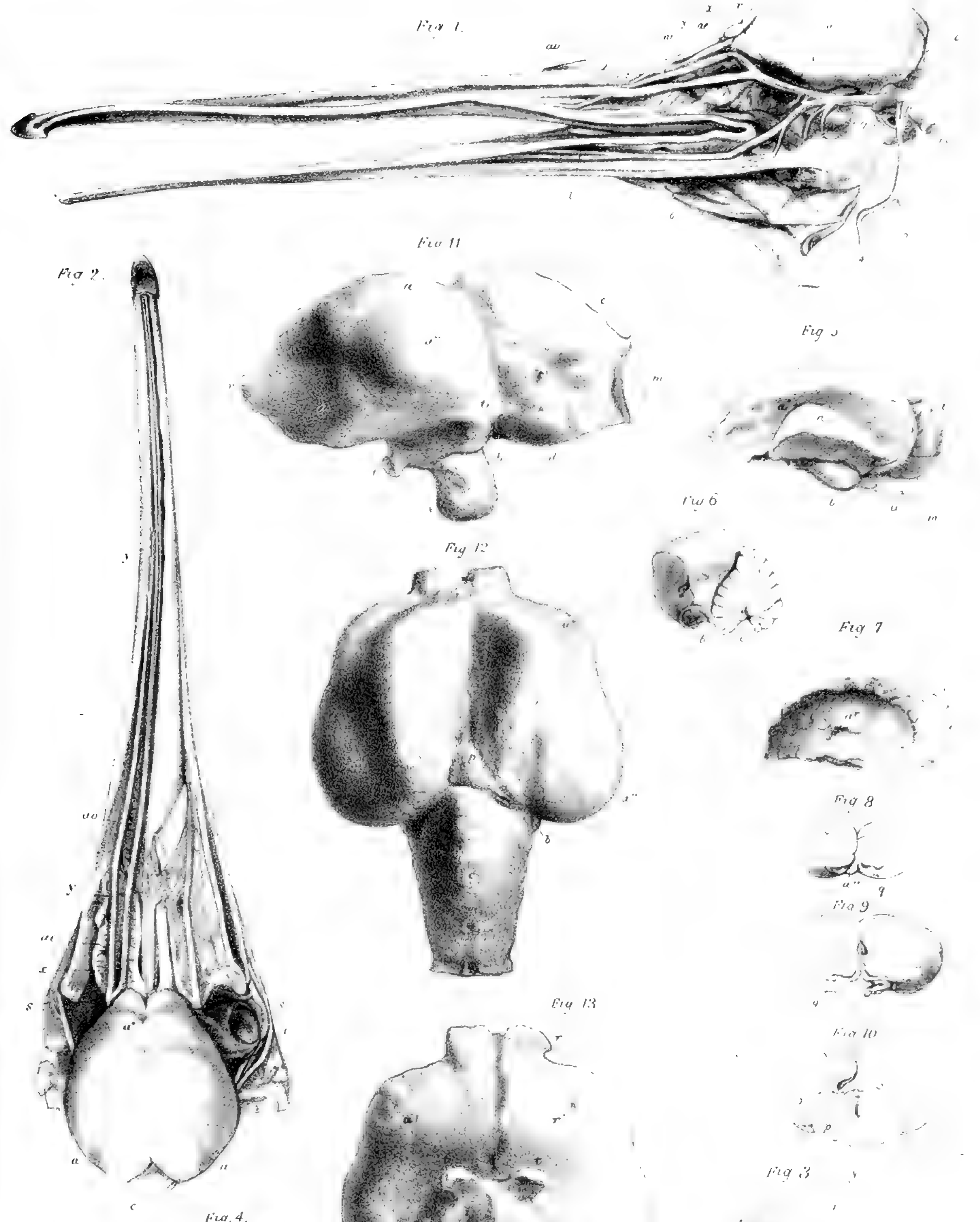
Fig. 28. Two confluent rings of the broad variety of *Dinornis robustus* (?).

Fig. 29. Two partially confluent rings of *Dinornis robustus* (?).

Fig. 30. Inside view of two confluent rings of *Dinornis robustus* (?).

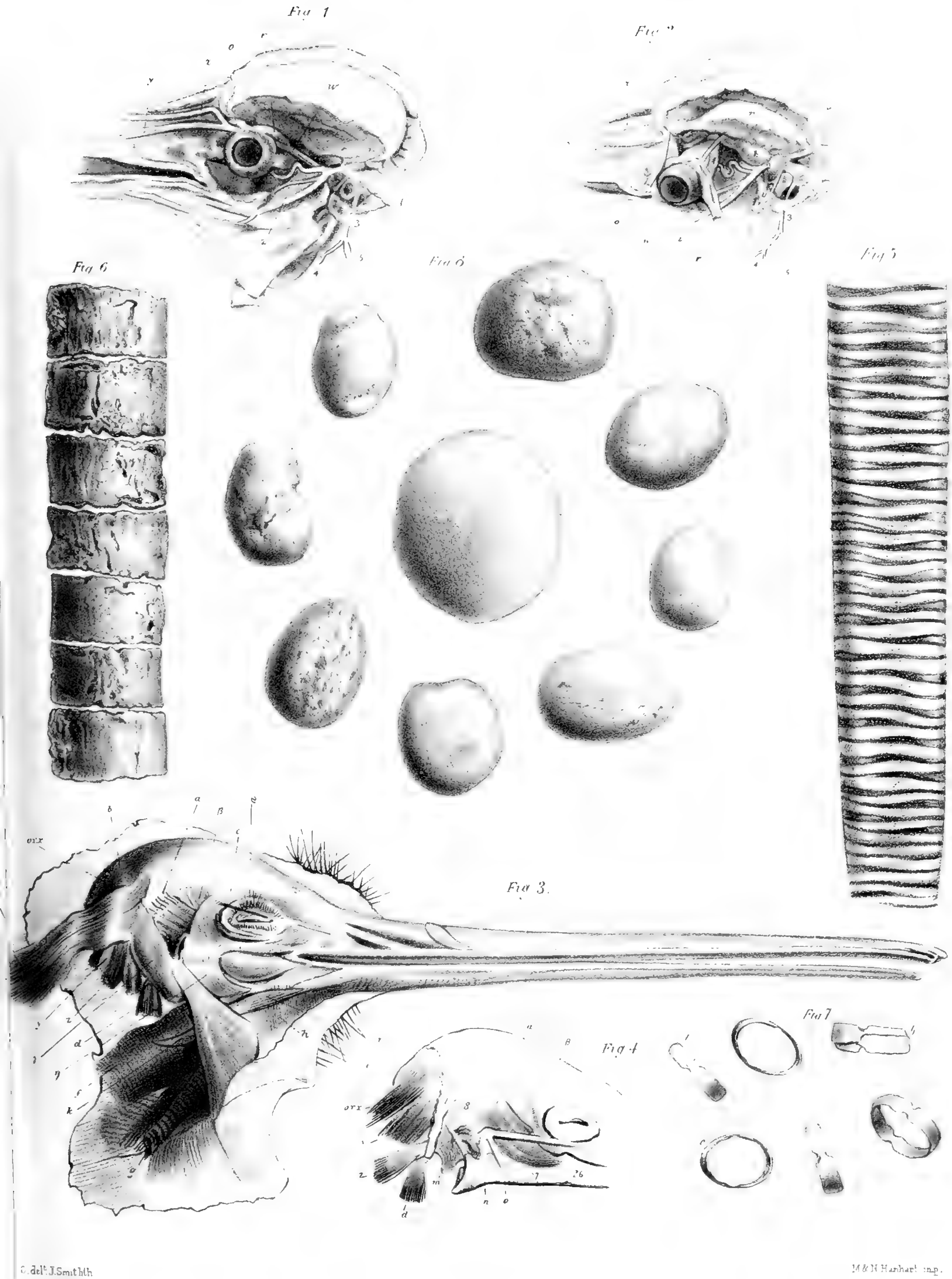
Fig. 31. Longitudinal section, showing inner surface of two confluent rings of *Dinornis ingens* (?).

Fig. 32. Longitudinal section of a tracheal ring of *Dinornis robustus* (?).



R O delᵗ J Smit lith. M & N Hanhart imp

I.10 APTERYX AUSTRALIS II.13 DINORNIS GIGANTEUS.



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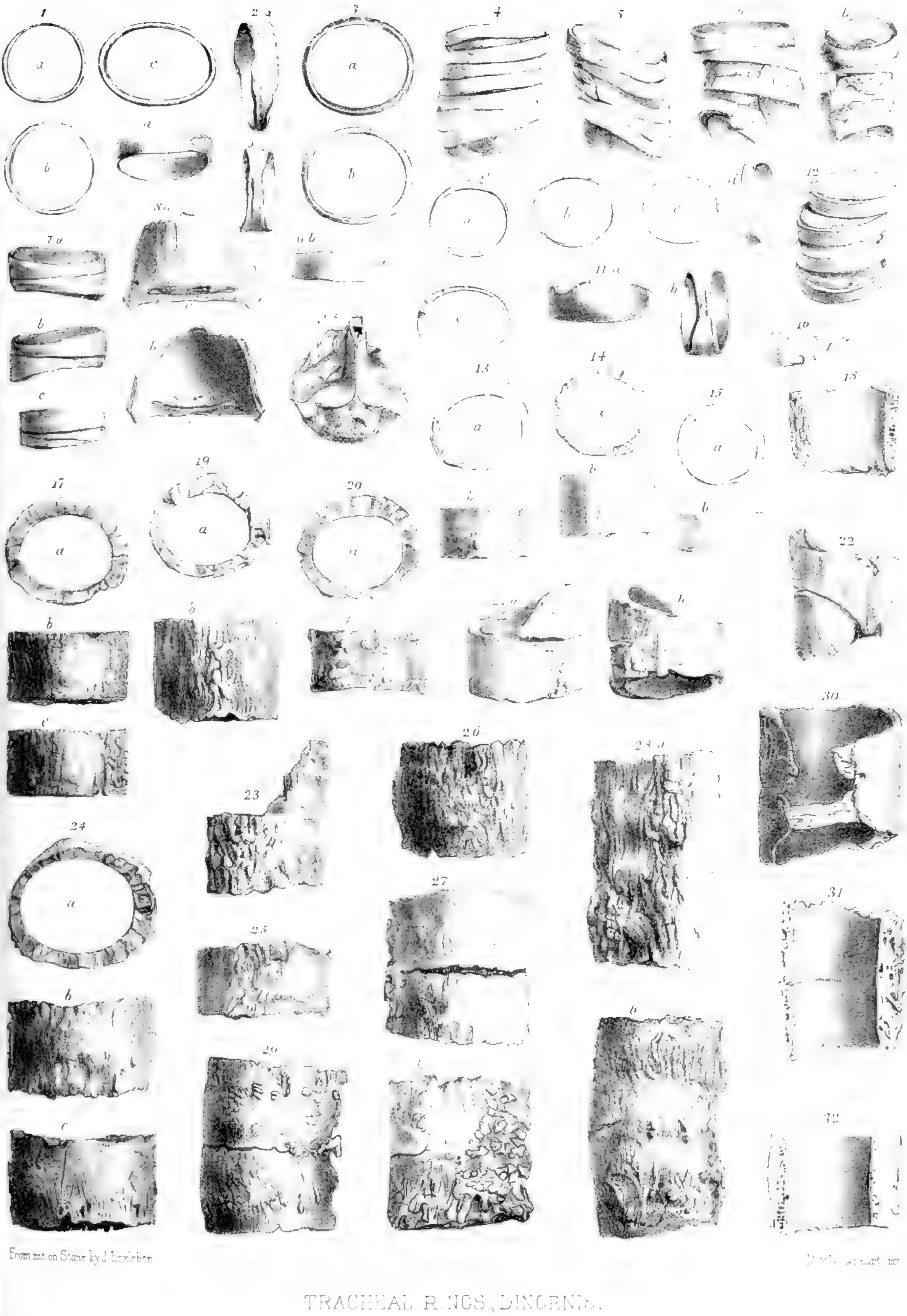
1-4 APTERYX AUSTRALIS 5 CASUARIUS GALEATUS 6 DINORNIS INGENS
7 APTORNIS DEFOSSOR 8 DINORNIS ELEPHANTOPUS



From nat. on Stone by J. Erxleben

M & N Hanhart imp

TRACHEAL RINGS, DINORNIS.

X. *Contributions to the knowledge of* Pectinator, *a genus of Rodent Mammalia from North-eastern Africa.* *By* Professor W. Peters, *F.M.Z.S.*

Read November 1st, 1870.

[Plates XLVIII. to L.]

Introductory Remarks.

PECTINATOR SPEKII was first described in 1855 by Mr. E. Blyth[1], and named in honour of the late Captain J. B. Speke, who discovered this very curious Rodent during his expedition into the Somáli country, where "it inhabits the large cellular blocks of lava on the sea-face side of the northern Somáli sea-coast range, lat. 9° N., and long. 47° E."[2].

Mr. Blyth directly recognized its close affinity to Dr. Gray's *Ctenodactylus massonii* from Northern Africa, from which he distinguished it because it has *four* molars above and below instead of *three*, and "by having the tail and ear-conch well developed, a smaller eye, and apparently a general adaptation for more diurnal and less fossorial habits." He regarded the peculiar group of African Rodents, consisting of *Ctenodactylus*, *Pectinator*, and perhaps *Petromys*, "as a separate family, about equivalent to the Chinchillidæ, to which, upon the whole, the Pectinatoridæ would seem to be more nearly affine than to any other known form."

In 1861 Dr. v. Heuglin, who met with the same animal in the Adail and Somáli country, in the Bay of Tedjúra, between 11° 40′ and 11° 45′ N., gave a diagnosis, with a figure of the whole animal, and a sketch of the skull and teeth[3], and communicated at the same time a description and some interesting additions to Captain Speke's notes on its habits"[4].

Mr. William Jesse, connected as zoologist with the Abyssinian Expedition in 1868, captured several specimens of the *Pectinator*, when proceeding up the passes from Zoulla to Senafé[5]. These have been very kindly forwarded to me for examination by my friend Mr. Sclater, who is always indefatigable in promoting zoological science in the most unselfish and liberal manner.

A more complete knowledge of this Rodent has been a great desideratum; for, although its close affinity to *Ctenodactylus* could not be doubtful, the affinities and

[1] Journal of the Asiatic Society of Bengal, xxiv. p. 294.

[2] Proc. Zool. Soc. Lond. 1859, p. 234.

[3] Nova Acta Acad. Cæs. Leop. Carol. Nat. Curios. xxviii. 1861, p. 1, Taf. 2. figs. 1, 5, & 6.

[4] Petermann's Geograph. Mittheilungen, 1861, p. 18.

[5] *Cf.* Proc. Zool. Soc. Lond. 1869, p. 113.

systematic position of the latter itself have not, until now, been quite settled. In fact, there exists hardly any other genus of Rodents of which the systematic position has given rise to so many difficulties and which requires a more careful examination than these very curious and interesting genera of continental Africa.

Not taking into consideration the opinions of Dr. Gray[1] and Mr. Yarrell[2], who placed *Ctenodactylus* along with the *Arvicolæ*, because at that time attention had not been called to the importance of craniological characters for a more natural arrangement of the Rodents, there exist at least four different systematic views to be mentioned.

A. Wagner[3] places *Ctenodactylus*, together with *Echinomys* &c., in his family of Psammoryctina; Professor Gervais[4] unites them with the Jerboas (*Dipodes*); Brandt[5], in his classical essay on the craniological characters of the Rodents, comes, after a careful examination of the skull, to the conclusion that the group of the *Ctenodactyli* belongs to the subfamily Octodontes (*Octodontina*, Waterhouse); and to Mr. Blyth, as before mentioned, they seem to form a peculiar group, most nearly allied to the Chinchillina. Mr. Waterhouse does not mention the *Ctenodactyli*, in his excellent work on the Rodents, amongst the Hystricidæ; but in a table of the geographical distribution of the Rodents[6] he places the "Section 3. *Ctenodactylina*" in his family Muridæ (composed of *Myoxina*, *Dipodina*, *Ctenodactylina*, and *Murina*) between the *Dipodina* and *Murina*.

The collection of Mr. Jesse contains five specimens, in a more or less good state, preserved in alcohol, besides an imperfect skeleton and a tolerably good skin[7]. For comparison, the Berlin Museum has of *Ctenodactylus* two stuffed specimens, one in alcohol, and a separate skull.

External Characters.

According to all accounts the appearance and behaviour of the little animal in its natural state is very like that of a Squirrel, it being very lively in its movements, and generally carrying its bushy tail aloft[8]. However, in its somewhat clumsy form of body, less prominent eyes and ears, and shorter limbs, as also in size, it more resembles a Guinea-pig.

The ears are rounded, as broad as high, externally well clothed with soft hair,

[1] Spicilegia Zoologica (1830), p. 10; List of Mammalia, 1843, p. 117.

[2] Proc. Comm. Zool. Soc. Lond. i. 1831, p. 48.

[3] Archiv für Naturgeschichte, 1842, i. p. 1; Schreber, Säugethiere, Suppl. iii. 1843, p. 353.

[4] D'Orbigny, Dict. d'Hist. Nat. 1848, xi., Rongeurs, p. 203; Hist. Nat. d. Mammifères, 1854, i. p. 373.

[5] Untersuchungen über die craniologischen Entwickelungsstufen der Nager, 1854, p. 259.

[6] The Physical Atlas of Natural Phenomena, pl. 28 (communicated by the author).

[7] The bottle sent to me with the specimens contained besides:—1, a specimen of *Crocidura sericea*, Sundevall, from Waliko, near the river Anseba; 2, *Mus musculus*, L., from Zoulla camp; 3, *Mus gentilis*, Brants, from the sand-plains of Zoulla.

[8] According to Mr. Jesse and Mr. Blanford (Observations on the Geology and Zoology of Abyssinia, Lond. 1870, p. 281). Dr. v. Heuglin, on the contrary, says that, when running, the *Pectinator* keeps its tail in a horizontal position, and that only when sitting is this organ erect and applied to its back.

which becomes more rigid and forms a fringe at the margin of the ear; internally, only towards the hinder part, sparingly provided with short hair. The whole ear-conch cannot be said to be more developed than in *Ctenodactylus*; but the antitragus, entirely wanting in *Ctenodactylus*, is, although very small, distinguishable; and the anthelix, which forms in *Ctenodactylus* a simple arched prominence, with hairy margin, is much lower, naked, and more of the human form, anteriorly bifurcate. In this latter respect (the development of the anthelix) the *Ctenodactyli* differ entirely from *Dipus* (*ægyptius*), *Chinchilla*, and *Habrocoma*, and show a greater affinity to the *Echinomyes*. The eyes are of moderate size, three times as distant from the end of the snout as from the ears, and separated from each other by a large interspace. The snout is protruding, and the cleft of the mouth small, as in most of the Rodents, particularly in the Rats, *Echinomyes*, and *Chinchillæ*. The upper lip is not cleft, nor hairy behind the incisors, as in *Dipus*, but merely notched, as in *Echinomys* and *Chinchilla*, and has a mesial naked[1] narrow groove descending from the small triangular rhinarium between the falciform nostrils. Above the nostrils is to be seen the same transverse fold of skin which has been observed in the *Chinchillæ*. The moustaches are formed by seven longitudinal rows of long bristles, partly much longer than the head, the longest measuring 8 centimetres.

The fur of the body is of moderate length, about $1\frac{1}{2}$ centimetre long, and, although very soft, less so than in the *Chinchillæ*.

Pectinator has, like *Ctenodactylus*, only two lateral teats, one on each side, 1 centimetre behind the elbow when the humerus is laid backwards. In this respect the *Ctenodactyli* are also more allied to the *Chinchillæ* and the *Echinomyes* than to the *Dipoda*, which have a pair of teats between the fore legs, and one on the inner side of the hind legs. The external sexual parts at first sight do not differ very much in the different sexes, the clitoris of the female being perforate, and hardly less protruding than the penis of the male. The vagina is separated from the anal aperture only by a narrow isthmus; and the testes form prominences externally, at the sides of the base of the penis.

The extremities are in form and proportion exactly like those of *Ctenodactylus*. Both the anterior and posterior limbs have externally only four toes, the single-jointed thumb being perfectly concealed by the skin. The upperside of the hands and feet is closely covered with short adpressed hair, which becomes longer and setaceous towards the end of the fingers and toes, thus overreaching the strongly curved pointed claws. As in *Ctenodactylus*, two rows of bristles on the two inner toes of the hind feet are particularly strong and comb-like. The palms and soles are naked, and of a black colour. There are three large patches behind the base of the fingers and toes, two roundish ones beneath the carpus, and two longish ones beneath the metatarsus. The patches under the ends of the toes are transversely furrowed. The last finger and toe

[1] In the *Chinchillæ* also this groove is naked, and only appears hairy in dried specimens.

are the shortest, next them the first, and the longest one is the second. The claws of the fingers are smaller, but of the same form as those of the toes.

The tail is depressed, and does not attain quite half the length of the head and body together. It is, except at the base, where the fur is like that of the body, well covered with stiffer hair, which gradually increases in length as it approaches the end of the tail, reaching a length of 5 centimetres.

The upper parts are ashy-grey, delicately suffused with black; the sides lighter greyish; the underside from chin to tail, the inner side of the extremities, and the upperside of the hands and feet greyish white; the lips, the two lower rows of the moustaches, a small patch behind the base, and the stiff hair in front of the ears white. The upper rows of the moustaches and the claws are black. The stiff hairs of the tail have their bases orange-yellow, then a very large black ring, a subterminal large greyish-white ring, and the points black. All the soft fur of the body has the greater, basal part lead-coloured; that of the upper parts has a large subterminal yellowish-grey ring, and the extreme end black—except some longer hairs with long black points. The hair of the under parts is lead-coloured, with white points.

	Male. millims.	Female. millims.		Male. millims.	Female. millims.
Total length	250	270	Length of hand, with longest finger	21·5	23
From snout to base of tail	160	190	Length of first (second) finger	11	11
Length of head	50	60	Length of second (third) finger	13	14
Greatest breadth of head	27	30	Length of third (fourth) finger	13	14
Distance of eyes from end of snout	26·5	28	Length of fourth (fifth) finger	9·5	9·5
Distance of eyes from the ears	9	10	Length of finger-nails	2·8	2·8
Distance of eyes from each other	21	21·5	Length of thigh	35	35·5
Length of eyelids	6·5	6·5	Length of tibia	39	39·5
Height of ear	16·5	17	Length of foot, with longest toe	38	38
Breadth of ear	16·5	17	Length of first (second) toe	11	12
Length of tail, with hair	90	90	Length of second (third) toe	14	16
Length of tail, without hair	50	50	Length of third (fourth) toe	14	16
Length of humerus	26	30	Length of fourth (fifth) toe	12·5	13
Length of antibrachium	26	30	Length of nails of toes	2·6	3·3

Dentition.

The incisors are entirely like those of *Ctenodactylus*, the upper ones very much curved, in a horizontal transverse section nearly triangular, longer than broad, diverging and pointed behind. Their smooth anterior convex side is hardly distinct from their short outer side; the roots are short, not passing beyond the intermaxillaries. The lower incisors are more projecting and straighter, in a transverse section rounded, as broad as long; their roots do not reach behind the second lower molar.

The molars not only differ from those of *Ctenodactylus* in their greater number, $\frac{4.4}{4.4}$ instead of $\frac{3.3}{3.3}$, but also in their more complicated form. Both series of molars are much less distant from each other, and less convergent in front than in that genus—the interspace between the last molars of *Ctenodactylus* being twice as wide as, in *Pectinator* only a little wider than, one of these teeth. The first upper molar (which is wanting in *Ctenodactylus*) is the smallest; it is not half so large as the second one, and has its crown of an irregular quadrate form with pointed angles; the second is hardly smaller than the third, and has a deeply indenting fold of enamel only on the outer side, being thus similar to all the upper molar teeth of *Ctenodactylus*. The third and (the largest) fourth molars have a deep indenting fold on either side; and the fourth has, besides, on the outer side a small posterior second indentation. The first lower molar is nearly triangular, and much smaller than the corresponding upper one; the second has, like all the lower molars of *Ctenodactylus*, only one indenting fold of enamel on either side; but the third and fourth molars have two folds on the inner side, and one on the outer side.

In both genera the molars are imperfectly rooted, which constitutes a difference not to be overlooked between them and the *Octodontes* and *Chinchillæ*[1].

Skeleton.

I have first to point out the cranial differences of *Pectinator* from *Ctenodactylus*, which, although very important, are hardly more striking than those to be found between the different genera of Chinchillina.

The whole skull of *Pectinator* is more flattened and has the upper profile less arched; the free orbital process of the malar beneath the lachrymal is more pointed; the temporal fossæ are narrower and less deep; the interparietal is broader behind than in front, and also absolutely broader than in *Ctenodactylus*, separating the parietal from the supraoccipital; the zygomatic arches are less expanded; the fossa lachrymalis of the lachrymal is less deep; the semicanal of the maxillary is prolonged backwards by a fronto-maxillary fissure, as in *Lagostomus*, almost as far as the ala parva of the sphenoid; the palate between the molar teeth is much narrower, hardly wider behind than in front; and the postpalatal emargination is much deeper, extending as far as the middle of the last molars. The tympanic bullæ are also comparatively larger than in *Ctenodactylus*; but the meatus auditorius externus has the same direction, and is in the same manner elongated by an inferior semiannular osseous appendage, as in *Ctenodactylus*.

Compared with other Rodents, the skull of *Pectinator* shows still more than that of *Ctenodactylus* the distance of this group from the *Dipodes*, and their close relationship to the *Hystricidæ* of Waterhouse. The shortness of the lower part of the intermaxillaries, and the short-rooted incisors, render the more lengthened snout much more similar to that of *Habrocoma*, *Chinchilla*, and *Lagotis* than to that of *Dipus*, *Scirtetes*, and *Pedetes*. The triangular infraorbital openings, in form and size, resemble rather

[1] It has been asserted that the *Dipodes* are provided with rooted molar teeth; and I find this so in the restricted group of *Dipus*, but not in *Pedetes*, which has rootless molars.

those of *Echinomys*. The zygomatic process of the maxillary is much more like that of *Lagotis* than that of *Dipus* or *Scirtetes*, its upper root being very narrow and not enlarged, and the lower having its base horizontal and not vertical. The malar bone, although very low, is provided with a very short inferior angle, corresponding with the characteristic lower zygomatic process of *Echinomys*; and its maxillary process is, notwithstanding its posterior hamulus, much more like that of *Lagotis* than that of *Dipus*[1]. The posteriorly rounded frontals and pointed externo-anterior angles of the parietals are shaped exactly as in *Habrocoma*. The sharp supraorbital margin reminds one of *Pedetes*, but also of *Echinomys*. The underside of the snout and the large foramina incisiva are, carefully compared, more like those of *Habrocoma* and the Chinchillina; the palate and the basis cranii, on the contrary, show a greater affinity to *Echinomys*; and the meatus auditorius externus, differing from that of the Chinchillina and the Dipodina, is in direction and form more similar to that of *Habrocoma* and *Echinomys*. The cranial cavity is very like that of *Habrocoma*, and differs, therefore, very much from that of the Dipodina. The great extent of the interparietal bone is a peculiarity of the *Ctenodactyli*, when compared with the skulls of the related genera.

The lower jaw differs entirely from that of the Dipodina, and agrees best with that of the Chinchillina, except that no distinct coronoid process is to be seen. As in *Chinchilla*, the pointed angular portion of the lower jaw is, on account of the shortness of the roots of the incisors, less distinctly placed on its outer side than in *Echinomys* and the *Octodontes*. *Petromys*, on the contrary, has the coronoid process and the position of the angle of the same form as *Habrocoma*, and ought, therefore, probably not to be united with the *Ctenodactyli*, but with the *Octodontes*.

The spinal column is (in two skeletons) composed of 7 cervical, 12 thoracic, 7 lumbar, 4 sacral, and 19 caudal vertebræ.

The cervical part is similarly developed to that of *Echinomys*, *Habrocoma*, and *Chinchilla*. It is therefore very different from the broad, very short, or even coalescent[2], corresponding portion of *Pedetes* and *Dipus*, and is alone sufficient to prove that the *Ctenodactyli* cannot be naturally placed with the Dipodina, as has been proposed. The atlas and axis, and also the other cervical vertebræ, are more like those of *Habrocoma* than of *Chinchilla* or *Echinomys*, although the atlas has, as in *Chinchilla*, its outer sides less concave, and a short ventral spine. The second, third, and fourth vertebræ are provided with a ventral backwards-projecting keel.

The thoracic vertebræ are also totally different from those of the Dipodina, and in their gradually increasing spines more similar to those of *Habrocoma*, although in number more approaching those of *Echinomys*. They are, of course, in form also similar to those of *Echinomys* (*cayennensis*) and *Chinchilla*; but these genera have the spines much

[1] Only *Dipus* (*ægyptius*), and not *Scirtetes* (*spiculum*), is provided with an orbital process of the malar somewhat resembling that of the *Ctenodactyli*.

[2] *Dipus* (*ægyptius*) has four cervical vertebræ (the second to the fifth inclusive) coalesced.

longer, and the spine of the second (*Echinomys*) or third thoracic vertebra suddenly very much developed. In *Pectinator* the spines gradually increase and are reclined until the (ninth) diaphragmatic or central vertebra. The spines of the last three thoracic vertebræ are, like those of the lumbar vertebræ, directed forwards. All the thoracic vertebræ have a median ventral ridge sloping backwards.

The shape of the short spines of the seven lumbar vertebræ is also more like that of *Habrocoma* than that of *Echinomys* or *Chinchilla*; but the oblique processes (anapophysis, Owen) differ from those of all these genera in their short and compressed form, more resembling those of *Spermophilus* (*citillus*).

Four vertebræ coalesce to form the os sacrum, only the first of which is joined to the iliac bones[1]; it differs by its narrowness, or by the shortness of the transverse processes, from that of all other allied genera, and indicates in this respect a certain affinity to the *Arvicolæ*.

The caudal vertebræ have also very short transverse processes. Only the anterior five are provided with short spinous processes. The first chevron bone is attached to the third, and the last to the thirteenth caudal vertebra.

Both *Pectinator* and *Ctenodactylus* have, like *Spalacopus*, only six pairs of ribs joining the sternum, the other six being false ribs. From the second to the sixth the ribs are comparatively broader than in any other genus belonging to the Hystricidæ, Muridæ, or Dipoda.

The sternum is much more flattened, and comparatively broader, than in any other Rodent. In its general form, principally of the manubrium, and in the development of the lateral and a pointed median episternal appendage, it comes nearest to that of *Chinchilla*. It is composed of five, or, from the coalescence of the fourth and fifth, only of four bones.

The scapula has the bifurcate acromion characteristic of the Hystricidæ, and resembles in the length of the base of its spine much more that of the *Chinchillæ* than that of *Echinomys*, *Habrocoma*, and *Spalacopus*. But in general form, and in the position of the spine nearer and more parallel to its lower margin, it comes nearer to that of *Sciurus* and *Spermophilus*.

The form of the humerus is in general the same as in *Chinchilla*, *Echinomys*, *Spalacopus*, and *Habrocoma*; and it has the foramen supracondyloideum placed in the same manner; its anterior crest descends beyond the middle of the bone, as in *Habrocoma*. The bones of the forearm are also hardly different from those of *Habrocoma*. The carpus is composed of four bones in the first, and of five in the second row, the os intermedium being placed between the lunatum, multangulum minus, capitatum, and the metacarpus of the index. The metacarpal and the single phalanx of the thumb are very short, and of the same length. The four other fingers are normally developed, each with three phalanges.

[1] In *Habrocoma*, *Chinchilla*, and *Echinomys* the second sacral vertebra is also partly united with the iliac bones.

The pelvic bones are in shape intermediate between those of *Chinchilla* and *Habrocoma*, therefore very different from those of *Dipus*. The femur resembles rather that of *Habrocoma* than that of *Chinchilla*, but has its outer crest much more developed, as in *Ellobius* and *Lemmus*. The tibia, although much shorter, is similar to that of *Chinchilla*, but has its sharp crests much more developed, as in *Ellobius* and *Lemmus*. The thin bony plate which forms the fibula, is more like that of *Habrocoma*. The seven tarsal bones and the metatarsals do not offer any remarkable peculiarity of form. All the phalanges of the toes are well developed, except those of the first toe, which has only a single, very small basal phalanx.

	millims.
Total length of skull	46
From anterior end of the præmaxilla to the foramen magnum	40·5
From anterior end of the præmaxilla to the foramen incisivum	5·8
Length of nasals	18·8
Length of the foramina incisiva	7
From posterior margin of the foramina incisiva to the posterior margin of the palate	8·3
Width between the orbits	12
Breadth of palate	2·7
Length of interparietal	8·3
Breadth of interparietal	14·5
Extreme width of zygomatic arches	26·5
Length of upper molar series	9·1

	millims.
Length of lower molar series	9·1
Length of the spinal column	187
Length of the cervical portion	19·5
Length of the thoracic portion	38·5
Length of the lumbar portion	41
Length of the sacral portion	17
Length of the caudal portion	74
Length of scapula	23
Breadth of scapula	10
Length of base of the spine of the scapula	16
Length of humerus	29
Length of radius	22·5
Length of ulna	28·5

	Metacarpal. millims.	1st phal. millims.	2nd phal. millims.	3rd phal. millims.	millims.
Length of first finger	1	1	....	....	....
Length of second finger	6·3	5·2	3·7	2·3	....
Length of third finger	8	5	3·5	2·3	....
Length of fourth finger	7·7	5	3·4	2·2	....
Length of fifth finger	5·5	4·5	3·2	2·1	....
Length of pelvis	....	....	....	....	37·5
Length of pubic symphysis	....	....	....	....	6·5
Length of femur	....	....	....	....	34
Length of tibia	....	....	....	....	36·5
Length of fibula	....	....	....	....	36
Length of tarsus	....	....	....	....	10·5
Length of calcaneum	....	....	....	....	8·5
Length of first toe	4	1·1	....	....	....
Length of second toe	12·4	7·2	1·7	2·5	....
Length of third toe	13·6	7·4	5	2·8	....
Length of fourth toe	14·5	7·2	4·7	2·8	....
Length of fifth toe	12·2	6·3	4·4	2·5	....

Dr. v. Heuglin observes that he very often saw Pectinators lying on the rocks, and with their bellies so much flattened that they were hardly to be distinguished from the rocks. He supposes, therefore, that their abdominal muscular system is endowed with a peculiar extensile power; however, it does not show any striking peculiarities.

Brain and Organs of Sense.

The brain (Pl. L. figs. 7–10) of *Pectinator* is very differently shaped from that of *Dipus*, flatter and longer, more like that of *Habrocoma*, to judge from the cranial cavity of this latter genus. The cerebrum is lozenge-shaped, without any vestige of circumvolutions, with the anterior longer borders concave; the lobus hippocampi below is hardly distinguished by a flat horizontal furrow. The corpora quadrigemina are exposed between the hemispheres and the cerebellum. The hypophysis is nearly quadrangular, with pointed angles. I have no opportunity of comparing it with the brains of other genera of the family of Hystricidæ of Waterhouse. But it will be seen that there is a very great difference between the brain of *Pectinator* (*Habrocoma*, *Chinchilla*) and that of the Porcupine[1]. The difference is indeed so great, that, in a classification based on the formation of the brain, it would be hardly possible to leave them together in the same family.

The eyelids are hardly separated at the inner commissure by a small notch, and are provided with very short black lashes. The caruncula lachrymalis and the plica semilunaris are little developed. The eyeballs are of moderate size, their transverse diameter not exceeding 8 millims. The lens is nearly spherical, anteriorly much less convex than posteriorly; its axis is 5 millims. long, its transverse diameter 8 millims.

The annulus tympanicus (Pl. L. fig. 11), which in the Dipoda is very little elevated, is, as in the Hystricidæ, very prominent, and with its lower margin united to the bulla by radiating long lamellæ. As in nearly all the Hystricidæ[2], the malleus and incus are coalescent, and the head of the malleus is large, elongate, club-shaped (Pl. L. fig. 12), and, on the middle of its inferior side, concave. In this respect also the *Ctenodactyli* show a very important divergence from the family Dipoda. The cochlea is elongate, as in *Chinchilla*, *Echinomys*, *Petromys*, *Habrocoma*, *Cavia*, &c., and forms a little more than four windings, the first of them being very much longer than the rest. Likewise the proportions of the semicircular canals are more similar to those of the Hystricidæ than of any other family of Rodents.

The nasal cavity is very like that of *Chinchilla* and *Habrocoma*, in consequence narrower, and the conchæ less complicated than in the Dipodina.

[1] *Cf.* Owen, Anatomy of Vertebrates, iii. p. 110, fig. 77.

[2] *Cf.* Hyrtl, Vergl. anatom. Untersuch. über das Gehörorgan des Menschen und der Säugethiere. Prag, 1845. Taf. iv. figs. 29–34.

Digestive Organs.

The mucous membrane of the roof of the mouth forms a triangular pointed elevation in front, two transverse ridges before, and five irregular ridges between the molar teeth (Pl. L. fig. 15).

The tongue (fig. 16) is elongate, with a rounded point. Its upper surface is covered with very minute homogeneous papillæ, and provided with only two papillæ vallatæ. The sublingual glands are lengthened and of moderate size, the submaxillary and parotid glands very large.

The hyoid (fig. 17) forms a nearly straight transverse bone, compressed in the antero-posterior direction, with a nearly straight upper and a concave lower margin. The anterior horns are articulated, the posterior immovably attached by an intermediate cartilage, and articulating with a process of the thyroid cartilage. It resembles, therefore, much more that of *Mus* than that of *Dipus*, and is very different from the arched hyoid, with a spine-shaped anterior process, of *Chinchilla*, *Echinomys*, &c.

The fauces are very straight; and the palate has no uvula. The pharynx and œsophagus are narrow, and have together a length of 60 millims. The œsophagus opens, as is usual in the Rodents, into the middle of the upper curvature of the simple stomach (fig. 18), which measures about 50 millims., and is at both ends nearly of the same volume. It contained only small pieces of triturated vegetables[1]. The small intestine begins with a dilated duodenum, and has a length of 145 millims. The large intestine is puckered, and is 550 millims. long, of which the lower part, with the rectum, for a length of 25 millims., is much narrower. The cæcum (fig. 19) is 45 millims. long, and about 17 millims. in diameter.

The liver (fig. 18) is, in different individuals, of very different size. The pyriform gall-bladder is placed in the fissure of the middle lobe; the right lobe has a distinct lobulus caudatus and lobulus Spigelii; the left lobe is undivided and flattened, with a sharp margin.

The spleen is lengthened, flattened, and nearly tongue-shaped. The pancreas is, as usually in Rodents, flattened and branched, but less expanded than in *Mus*, and apparently more like that of *Chinchilla*, which latter, however, I have not been able to examine in a perfect state. Towards the duodenum it becomes larger, but at the same time less compact.

Heart and Organs of Respiration.

The heart (fig. 17) has an oval form, a length of 15 millims., and a width of 9 millims.; the apex of the left ventricle is very prominent. The aorta (*a*) gives off a truncus communis, which, after having emitted the right subclavian, divides into the two carotids, while the left subclavian originates as a separate stem. Two upper venæ cavæ, a right and a left one, enter into the right auricle.

The epiglottis shows on the middle of its free margin a little rounded prominence.

[1] Heuglin says that *Pectinator spekii* feeds on buds, leaves, bark, and perhaps also on grain.

The thyroid cartilage (fig. 17, *th*) is narrowed in the middle, being here only 2 millims. long, has its superior border with three emarginations, and on each side a short process to meet the posterior horn of the hyoid bone. The cricoid cartilage (*cr*) is, as usual, much higher behind than in front. The thyroid glands (*gl*) are lateral, not connected with each other, flat and lengthened.

The trachea (fig. 17, *tr*) has twenty-four cartilaginous half-rings, and divides into a shorter right and a longer left bronchus. It has a length of 19 millims. The left lung is divided into two lobes, each of them having a secondary incision on the middle of its anterior margin. The right lung is divided into four lobes. In shape the lungs correspond exactly with those of *Chinchilla*, and nearly also with those of *Echinomys*.

Organs of Excretion and Generation.

The kidneys (fig. 22, *r*) are, as in all Rodents, simple, and regularly bean-shaped: they are 15 millims. in length and 10 millims. in width. The right kidney is, for about half its length, in advance of the left. The suprarenal bodies (*s.r*) have a length of 6 millims. and a width of 2·5 millims.

The generative organs resemble most those of *Chinchilla* The testes (fig. 23, *t*, *t*) have their position on each side of the angularly bent penis. The tortuous vasa deferentia open into the urethra distinct from the ducts of the greatly developed vesicular glands. The prostatic glands terminate in the urethra where it begins to be covered with a fusiform muscular layer, which extends itself as far as the heart-shaped bulbus urethræ. Immediately behind the bulbus are to be seen the large rounded Cowperian glands (*Cp*). the ducts of which are of moderate length[1]. The glans penis (*gl*) is very similar to that of *Chinchilla*, has a longitudinal slit on its underside, and a terminal folded point covered by two small lobes. The ossicle sustaining the glans has a length of 11 millims.

In the female (fig. 22) the two uteri are distinct, except at their end, where they are externally united for about 3 millims., each of them, however, opening separately into the vagina. According to Professor Owen's observations, an exactly similar form of the female organs is to be found in *Lagostomus*[2]. The clitoris has the same form, only on a smaller scale, as the penis of the male, and is perforated by the urethra, which, therefore, opens quite separate from the vagina.

According to Dr. v. Heuglin, the female *Pectinator* is pregnant in the month of September or October, and contains then two or three fœtus. This corresponds with the small number of teats, of which, as I have mentioned already, there is only one on each side of the body.

[1] Professor Gegenbaur (Grundzüge der vergleichenden Anatomie, Leipzig, 1870, p. 883) names these glands, which evidently correspond to the Cowperian glands in man, "Tyson'sche Drüsen," and gives the name of Cowperian glands to the prostatic glands.

[2] Proc. Zool. Soc. London, 1839, p. 177.

Conclusions.

1. *Pectinator* differs from *Ctenodactylus* not only in its greater number of teeth and longer tail, but also in the different structure of the ears and the skull.

2. The *Ctenodactyli* (*Ctenodactylus* and *Pectinator*) cannot be associated with the *Dipodes*, their relation to them being not greater than that of the *Chinchillæ*, *Octodontes*, and *Echinomyes*.

3. They show in nearly every part of their structure their near relationship with the last-named groups, and deviate from them only in a very few points (the form of the hyoid bone, of the sacral and caudal vertebral column, of the development of the crest of the humerus and femur), in which, however, they do not show any inclination towards the Dipodina, but rather some affinity with the Murina.

4. They form a peculiar group of the Hystricidæ, as understood by Waterhouse, which in some points is more allied to the *Chinchillæ*, in other points to the *Octodontes*.

5. *Petromys* is not to be associated with the *Ctenodactyli*, but with the *Octodontes*.

DESCRIPTION OF THE PLATES.

PLATE XLVIII.

Pectinator spekii. Natural size.

PLATE XLIX.

Pectinator spekii. All figures of the natural size.

Fig. 1. Skeleton.
Fig. 2. Skull, from above.
Fig. 3. Skull, from below.
Fig. 4. Left side of the lower jaw.
Fig. 5. Cervical and part of the thoracic portion of the vertebral column.
Fig. 6. Sternum, episternum, clavicles, and costal cartilages.
Fig. 7. Pelvis.
Fig. 8. Femur.

PLATE L.

Fig. 1. Left ear of *Ctenodactylus massonii*, Gray. Natural size.
All the other figures belong to *Pectinator spekii.*
Fig. 2. Snout, in front.
Fig. 3. Teat of the left side (*m*), *in situ.*

Fig. 4. Sole of the left hand.

Fig. 5. Sole of the left foot.

Fig. 6. Inner toe of the left foot, to show the rows of bristles. Magnified.

Fig. 7. Brain, from above; 8, from below; 9, from the side; 10, from behind; *qu*, corpora quadrigemina; *h*, lobus hippocampi; *hy*, hypophysis.

Fig. 11. Annulus tympanicus, with membrana tympani of the left side.

Fig. 12. The coalesced malleus (*m*) and incus (*i*), with the tensor tympani (*ms*) of the left side. Magnified.

Fig. 13. Stapes of the left side. Magnified.

Fig. 14. Labyrinth of the left ear. Magnified.

Fig. 15. Mucous membrane of the roof of the palate.

Fig. 16. Tongue, with the opening of the larynx.

Fig. 17. Hyoid bone, respiratory organs, heart, and trunks of blood-vessels: *h*, hyoid bone; *th*, thyroid cartilage; *cr*, cricoid cartilage; *gl*, thyroid glands; *tr*, trachea; *a*, aorta; *s*, *s*, subclavians; *c*, carotids; *v*, *v*, *v*, venæ cavæ; *p*, arteria pulmonalis.

Fig. 18. Liver and stomach.

Fig. 19. Cæcum, with the end of the ilium and the beginning of the colon.

Fig. 20. Spleen.

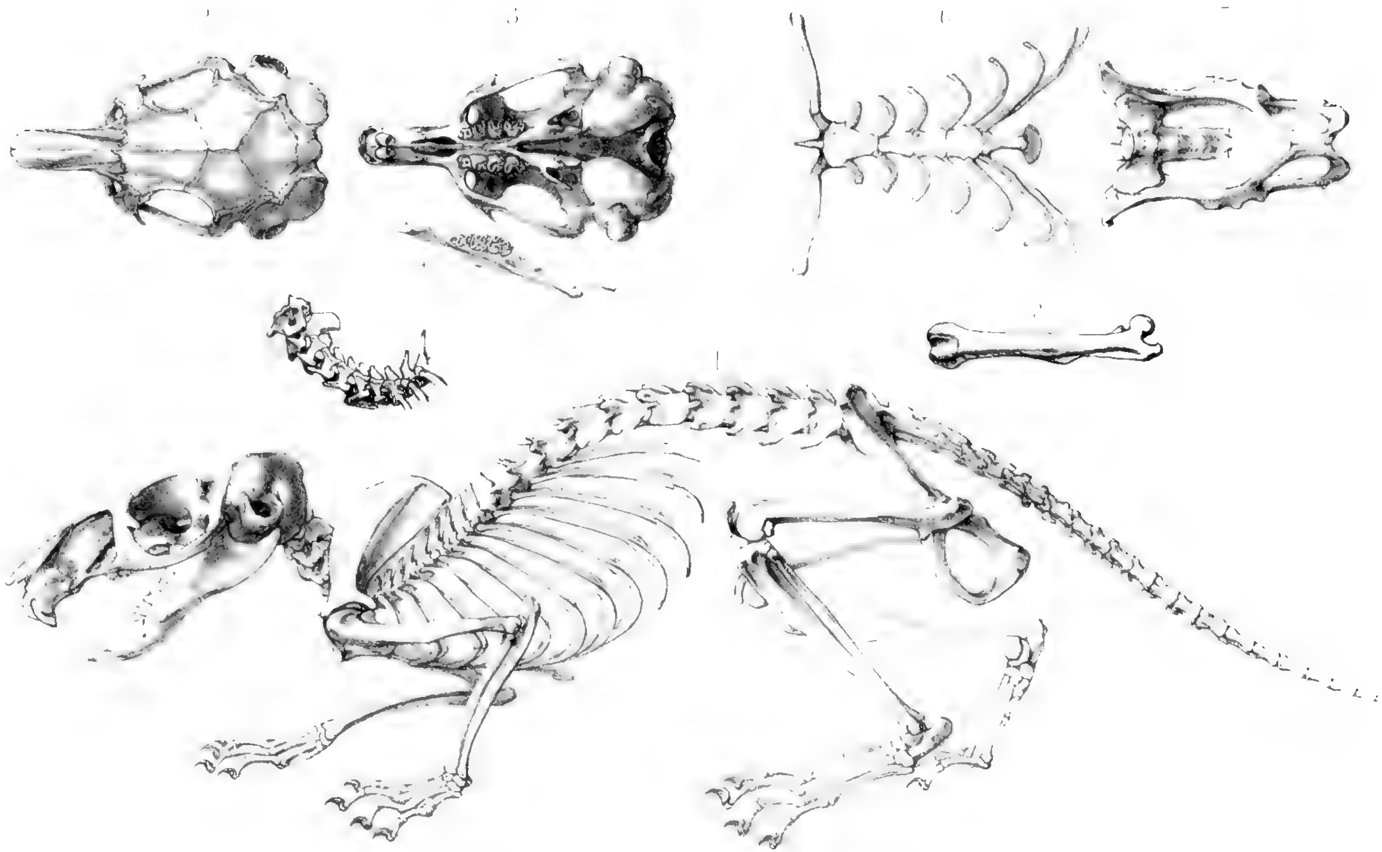
Fig. 21. Pancreas.

Fig. 22. Urinary and female organs: *r*, kidneys; *s.r*, suprarenal bodies; *ur*, ureters; *v*, urinary bladder; v^1, urethra; *cl*, clitoris; *o*, ovaria; *f*, fimbriæ; *ut*, uterus; *vg*, vagina; *x*, anus.

Fig. 23. Male organs: the penis is everted, to show the form of the bulb. *t*, *t*, testes; *df*, vas deferens; *v.gl*, vesicular glands; *pr*, prostatic glands; *Cp*, Cowperian glands; *b*, bulbus penis; *gl*, glans.

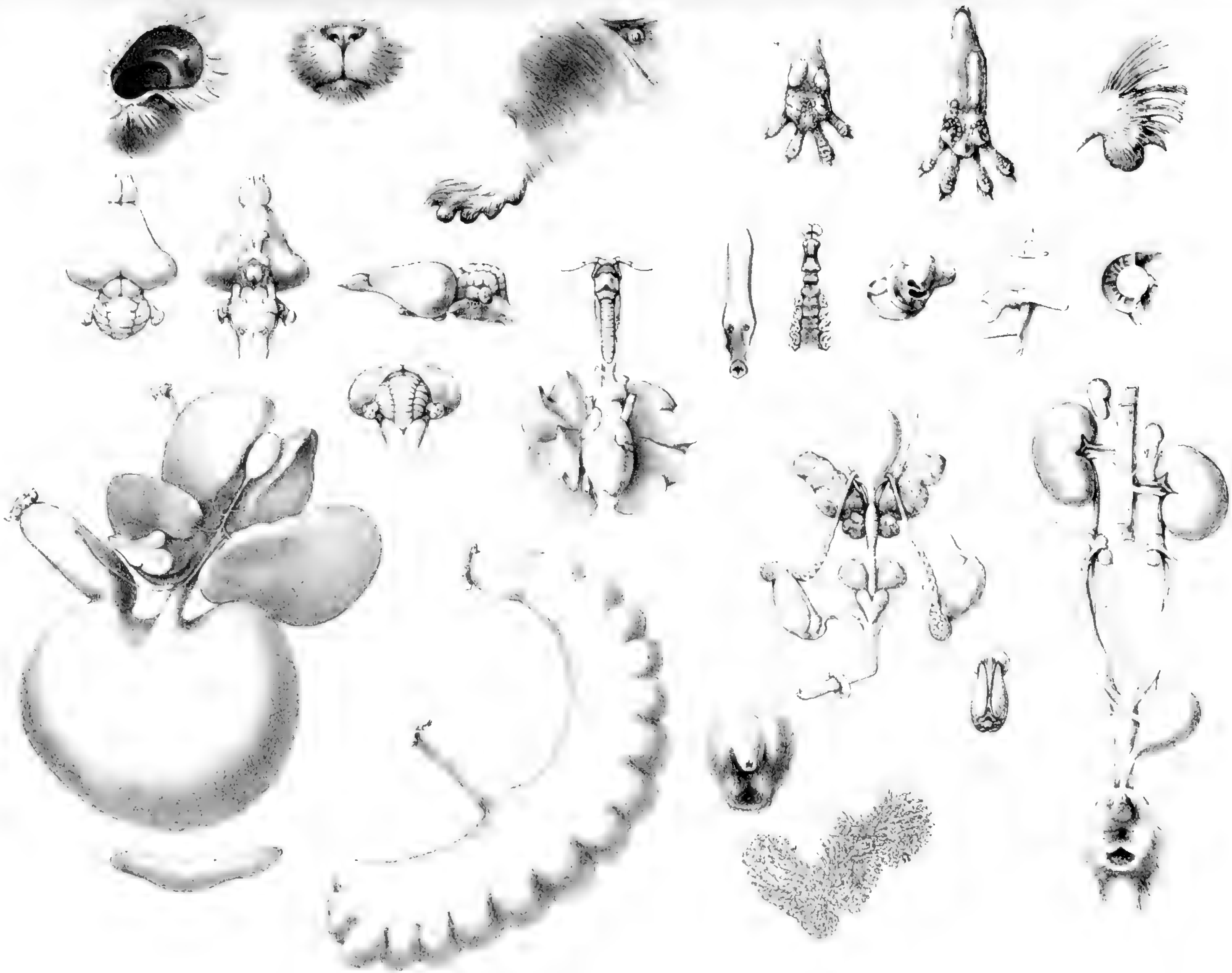
Fig. 24. Glans penis, magnified.

Fig. 25. External male organs, *in situ*: *p*, penis; *t*, *t*, testes; *x*, anus.



J. Wagner del. et lith.

PECTINATOR S



PECTINATOR AND CTENODACTYLUS.

XI. *Researches upon the Anatomy of the Pinnipedia.*—Part I. *On the Walrus* (Trichechus rosmarus, *Linn.*). *By* James Murie, *M.D., F.L.S., F.G.S., &c., late Prosector to the Society.*

Read June 23rd, 1870.

[Plates LI. to LV.]

Contents.

I. Preliminary Notice.

In the 'Histoire Naturelle' (1765, tome xiii. p. 358) of the great French master of Zoology, Count Buffon, will be found an account of the Morse or Marine Cow, the Wallross of the Germans and Dutch of that period. But this historical brochure is further enriched (p. 415) by an anatomical description of a fœtal animal from the pen of the zealous and worthy Daubenton. Sir Everard Home in 1824 communicated a paper to the Royal Society (Philos. Trans. p. 233) containing some curious anatomical facts and deductions respecting parts of a Walrus brought home by the Arctic voyagers. Von Baer, a name to be revered amongst biologists, published, in the 'Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg' for 1838[1], a very elaborate and learned monograph on the Walrus, based on a young living animal brought to St. Petersburg in the winter of 1829. This treatise (for such it may be designated) deals but briefly on the internal structural organization, which, however, he seems to have examined pretty thoroughly, intending apparently to reserve his observations for a future time. I am not aware that he ever brought forward these, although he mentions the myology and venous system as having interested him. The gist of his memoir consists of:—chapters on the early and later zoological researches and history of the animal, and on figures depicting it; observations on the living specimen, its manner of breathing, feeding, &c.; a comparison of it with other marine mammalia; habits in a state of nature; the recent and ancient geographical distribution (illustrated by a chart); procreation; and, lastly, a word on the systematic position of the Walrus.

The same author[2] had already (in 1833) laid before the Academy a paper "On the

[1] Sciences Naturelles, tome ii. (6th series) p. 97, "Anatomische und zoologische Untersuchungen über das Wallross (*Trichechus rosmarus*) und Vergleichung dieses Thiers mit andern See-Säugethieren. (Gelesen den 6. Nov. 1835.)"

[2] Mém. de l'Acad. St.-Pétersb. 1835, tom. ii. p. 199. "Ueber die Geflechte, in welche sich einige grössere Schlagadern der Säugethiere früh auflösen."

Blood-vessels of the Limbs of Marine Mammals," in which those of the Walrus are described and figured. At the Scientific Meetings of our own Society, held respectively on the 8th and 22nd November, 1853, two short but interesting communications on a *Trichechus rosmarus*, which lived a few days in the Gardens, were read:—one "On its Anatomy," by Professor Owen; the other by Dr. J. E. Gray, "On the Attitudes and Figures of the Morse." The works of Arctic voyagers teem with narratives and descriptions of this creature in its native haunts; and zoologists in number have treated on its characteristics. The osteology has been elucidated by Pander and D'Alton, Cuvier, DeBlainville, and many others; and the peculiar dentition has evoked keen discussion and remarks from a host of writers. But as the scope of the present notice is confined mainly to the soft structures and memoranda on the outer aspect, I refrain specific mention of volumes and papers other than those above mentioned, unless in allusion to points which better follow in the body of the text. Von Baer's collation of authorities, indeed, precludes the necessity of much addition on my part.

The young male Walrus upon which the following observations were made was that which the Society purchased in the latter end of 1867, and which only lived in the Gardens some seven weeks or thereabouts. Mr. Bartlett, P. Z. S. 1867, p. 819, has, with his usual felicity, commented on the habits and feeding of this creature; and the pathological conditions witnessed, with the discovery of immense numbers of a new species of Entozoon (the *Ascaris bicolor*), which is characterized by Baird, are recorded in the P. Z. S. 1868, p. 67.

Figures drawn from life, with passing remarks thereon, were issued by several publications of the day—among others 'The Field,' 'Land and Water,' and the 'Illustrated London News;' and to these I refer those interested in the current literature of the specimen in question.

II. On the Outward Characters.

1. *Colour.*—The Morse received into the Gardens in 1853, depicted with others in a group by Wolf[1], as likewise that here described, were both of a tawny brown colour. This is in agreement with what most travellers and naturalists have stated, though Fabricius[2], quoted by Von Baer[3], and, I suppose, credited by Gray[4], says the colour varies with age, black when young, afterwards brown or yellowish-brown, and lastly, when old, white. The St. Petersburg specimen closely resembled ours. My friend Mr. R. Brown[5], who has made repeated voyages to the Northern Seas, avers, "I have seen several young Walruses in all stages, from birth until approaching the adult stage, and never yet saw them of a black colour. . . . All I saw were of the ordinary brown colour, though, like most animals, they get lighter as they grow old." It is strange that

[1] Wolf and Sclater, 'Zool. Sketches,' vol. i. pl. 18. [2] Fauna Grœnlandica, p. 5. [3] *Loc. cit.* p. 134.

[4] Catalogue of Seals and Whales in the British Museum, 2nd edit. (1866), p. 36.

[5] "Pinnipedia frequenting the Spitzbergen and Greenland Seas," P. Z. S. 1868, p. 428.

observers should be at variance in such a patent fact as that of colour; but I suppose that as the skin is much darker on emergence from the water, and probably most so in juveniles, this may account for the discrepancy. Although the rule may not be applicable in all cases, yet in the greater number of instances it would seem as if the Phocidæ, or Earless Seals, in their earlier stages are whitish, inclining to yellowish or a darker tint with advancing age; whilst contrariwise the Otaridæ[1], or Eared Seals, at birth are very dark, assuming a lighter shade according to the stage of growth. The limited group Trichechidæ, exemplified by the Walrus, stands midway between these as regards progressive variation of colour.

2. *General Configuration and Manner of Walking.*—To those familiar with the huge plump overgrown carcass of an adult live Walrus, no doubt the Society's accession of "Jemmy" appeared a poor representative of the great northern Sea-horses; nevertheless to those unacquainted with the living form, it conveyed a fair notion of those queer-looking Pinnipedia. The size of the creature, only slightly larger than the Sea-lion (*O. jubata*), previously an occupant of the same yard, yielded advantages, inasmuch as a comparison of the two was thereby enhanced. Several common Seals (*Phoca vitulina*) in the adjoining compartment further supplied the means of appreciating the external structural modifications.

The absence of the great canine teeth or tusks, so singularly characteristic of the adult, immediately impressed the visitor with the animal's imperfect development; but the massive bristly muzzle pronounced unmistakably the parentage. The head, body, and limbs were absolutely and proportionally more massive than in the *Otaria*, and the general aspect shaggy, loosely set, and forbidding. At first, as has already been recorded, it advanced with the belly awkwardly dragging on the ground, pushing itself along by, rather than supporting the body on, the limbs, not after the manner of Seals, by jerking abdominal movements, but absolutely crawling as a child would in its infancy[2]. Afterwards, however, it acquired greater strength of limb, and in consequence altered its mode of progression.

Dr. Gray (see paper cited) has brought together and reproduced in telling woodcuts some ten of the most remarkable figures displaying the attitudes of the Morse. As he justly observes, " most of the oldest figures were purely imaginary; " and certainly those of Gesner (1560), Olaus Magnus (1568), and Martens (1675) are laughable caricatures. Even Buffon, as Von Baer and Gray show, was ignorant of, or had neglected, Hessel Gerrard's (1613) very natural-like representation of an old and a young animal, and gave in his 'Histoire Naturelle' little else than a Seal with a pair of tusks. Von Baer

[1] See illustration and text concerning *Otaria jubata*, P. Z. S. 1869, pl. vii.

[2] The accompanying woodcut from the pencil of Mr. Wood, p. 416, gives a fair idea of the attitude here spoken of, and the general *tout ensemble* of the creature. Through the kind intercession of Mr. Tegetmeier the proprietors of 'The Field' have liberally granted the use of the woodblock, which I take this opportunity of acknowledging.

(pp. 124–130) critically reviews the delineations of these older authors, referring to that of Pallas and the well-known one in Captain Cook's third voyage (tab. vi.), and he afterwards himself graphically describes his own observations on the living specimen at St. Petersburg.

A perusal of these latter convinces me that he scrutinized with accuracy, and recorded his inspection in no slip-shod manner; in truth, he saw with the eye of an anatomist, and was not negligent in zoological deduction. My own remarks upon the whole corroborate his; but I have had one advantage not enjoyed by him—namely, living Earless Seals (*Phoca*) to compare with side by side, and antecedent study of an Eared Seal (*Otaria*), to ground a basis of comparison.

The intervertebral cartilages in our young animal were uncommonly large; and as the bony epiphyses also were incompletely united, these, as well as the lax condition of the surrounding soft structures, gave to the body great, and, indeed, unusual, flexibility. On arrival at the Menagerie, apparently from want of use, the creature for some time having been confined to a box, it had difficulty in supporting its heavy frame in walking; but as it grew stronger on the legs it marched about the yard in true plantigrade fashion. The fore limbs are thrust forwards in succession; and the hind limbs, with a somewhat simultaneous movement from the pelvis, are likewise called into action at separate intervals of time. Von Baer has faithfully noted that the Walrus, though approaching, is opposed to the digitigrades, as the manus, from the wrist, and the pes, well nigh from the ankle, form horizontal supporting buttresses. Most commonly the fore limbs are passed forwards from the carpus as a pivot, the outer or radial border forming the advanced limb-margin, whilst the toes are thrown outwards and backwards, the pollex in front, or almost at right angles to the chest. The hind feet are swung or move on a radius from the heel; for the femoral and tibial regions, though to some extent outwardly movable, are checked, or do not pass beyond a certain point. Thus the foot lags outwards at the end of the step, and on the heel or inner ankle being hitched forwards the toes flap bellywards, but not quite under it, and the toes never overlap the fore foot, as sometimes occurs in *Otaria*. During these successive movements the shoulders stand high, and the rump is bent downwards, or has a very shelving arch, the tail and the broad membrane fixed to the heel almost touching the ground, and draggling from side to side as each leg is called into action. Occasionally, when a quicker kind of hobbling pace or canter is adopted, the pelvis and hind feet are more or less jerked forward together; but even then the feet do not touch the ground quite simultaneously.

My friend Mr. Brown (*l. c.* p. 432) asserts that they walk "hind flippers heel first," and "fore flippers toes first." The Society's animal in verity did not so progress; but I fancy that by the above expression it is meant that the front toes and the heel respectively are the first points of motion or pivots. If otherwise, the composition of the bony parts and attachments of the superincumbent tissues would admit of such a posture only by their being strained into an unnatural position so far as the free action of the joints are concerned.

The locomotion of the Sea-lion (*Otaria*) on *terra firma* resembles in most respects that of *Trichechus*; but the latter has the ankle-joints freer, consequently the hind foot possesses greater power of step. To make up for this deficiency, however, *Otaria* is remarkably nimble in the use of the linked hind quarters and legs.

Capt. Beechey[1] says, "the gallop[2] of a Sea-Horse is probably the most awkward motion that is exhibited by any animal, from the great difficulty they experience in bringing the hind feet forward, and the great disproportion between the length of their bodies and their legs."

When straddling about in the enclosure, it never seemed to have such a long laterally compressed body as is most markedly the case in the Sea-lion; on the contrary, it exhibited great breadth of body compared with its length.

When the very lean carcass, however, was skinned, the shape altered manifestly. It came out of its tegumentary envelope far more like *Otaria* than with the felt on. Still differences can be named: for instance, the neck is shorter in proportion to the body than in it; the laryngeal prominence is less protuberant, consequently this affects the contour-line of the neck; the thorax, though deprived of its massiveness by absence of skin, is yet not quite so laterally compressed or narrow; the fore limb looks shorter, because of the reduction of the pollex, this digit in *Otaria* being of enormous length, even as compared with its ally *Trichechus*; and, lastly, the hind feet, either expanded or contracted, are more dumpy. The Seal (*Phoca*), when on the ground, has a totally different comportment from either; for as it stretches its hind limbs stiffly backwards and tucks its fore ones alongside its chest, the body acquires an elongate cylindrical shape.

3. *Dimensions.*—Before discussing other matters appertaining to the exterior build, I subjoin some measurements taken from the dead body:—

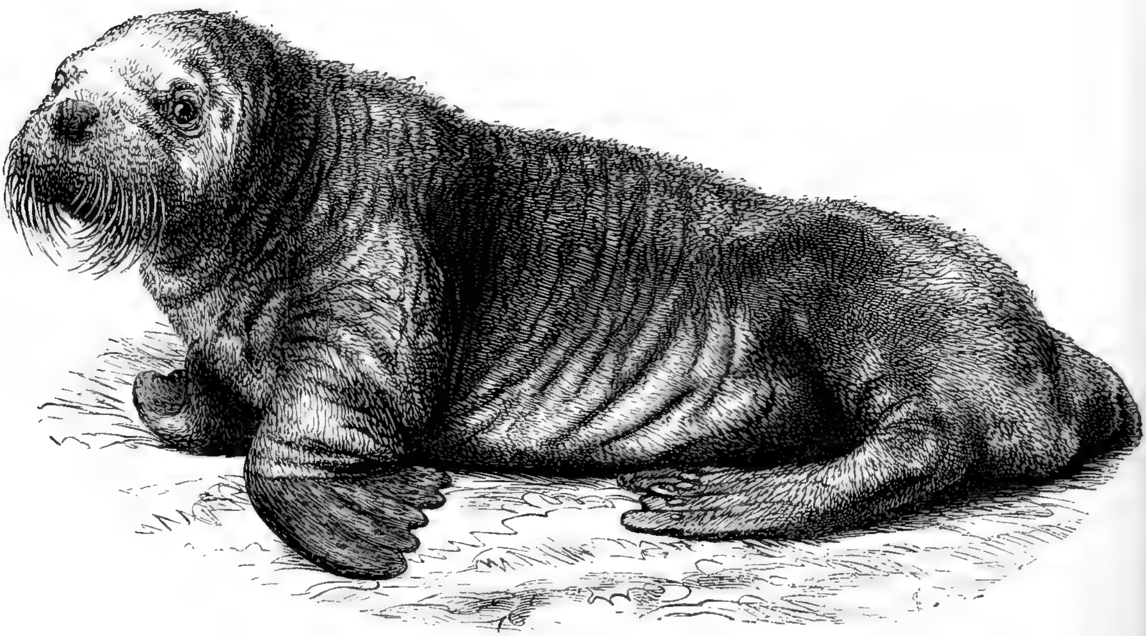
	ft.	in.
1. Extreme length, viz. from the muzzle to the tip of the hind extremity when this is stretched backwards	7	9½
2. Length from the muzzle to the tip of the tail	6	6
3. Length from the muzzle to the shoulder joint	2	1
4. Girth round the neck in front of the shoulder	2	4
5. Girth round the thorax behind the anterior limbs	4	3
These last two measurements are only approximative, by reason of the loose condition of the skin and subcutaneous tissues.		
6. The greatest stretch or transverse diameter of the fore limbs when the body is laid back downwards	4	8

[1] Voyage of H.M.S. 'Blossom,' 1825–28.

[2] "Gallop" does not perfectly express the action; physiologically speaking, it is a canter. The former differs from the latter in the fore feet being both put to the ground at the same time, which is not the case with the Walrus. *Vide* Johannes Müller's 'Physiologie.'

As previously ascertained, the *Otaria* was a foot shorter than the above length, no. 1. With no. 2 there was a corresponding diminution; but as respects no. 3 the *Otaria* was relatively the longer of the two. The measurements 4 & 5 cannot satisfactorily be compared. The increment of nuchal length in the latter tallies with the impression the eye perceives, namely that the Walrus is a more bull-necked Pinniped than the southern species of Eared Seals.

Fig. 1.



Trichechus rosmarus, ♂, juv.

4. *Skin-folds.*—A notable peculiarity in this young animal, and one which Dr. Gray, on seeing the creature, specially desired should be, if possible, photographed, was the curious wrinkled condition of the skin. The remark of many was that nature had provided too big a coat to fit the body comfortably, and hence creases and folds innumerable, along with the roughened coarse hair, gave a much rougher shaggy appearance to the body than most published figures bring out. The cutaneous wrinkles and furrows varied in height, depth, and direction in the several regions of the body, and altered considerably according to the position assumed. Those of the head, neck, and limbs shall be specified separately in the respective descriptions of these parts. Of those of the body the accompanying woodcut (fig. 1) represents the general aspect as a whole, whilst figs. 8, 11, & 12, Pls. LIII. & LIV., also illustrate different portions as typifying the significant feature in question. Briefly, it may be said of the

sides of the body (that is, from the shoulders to the rump, including the buttocks and sacral region) that skin-furrows run in parallel, oblique, and intercrossing lines. Thus diamond- or lozenge-shaped islands of skin-folds, some more acutely elongated than others, cover nearly the whole bodily frame. On the belly, however, the folds and furrows are chiefly longitudinal, and to a great extent are wanting in the said diamond sculpturing. In the axillary (fig. 9, Pl. LIII.) and inguinal regions the dermal plicæ alter to minute, fine, and parallel striæ, of which more hereafter.

Neither of the allied forms, Otariidæ and Phocidæ, exhibit the lozenge-shaped markings above described; nor do any of the other families of the Carnivora possess in such a high degree this rugose condition of the skin. In young, fat, and plump puppy dogs there is looseness of the integument and often overlapping folds of an irregular character, but nothing to compare with those alluded to in the Walrus.

Some Pachyderms, particularly the Elephant, manifest similar skin-corrugations, and quite as diamond- or lozenge-shaped as in the Walrus, but of course stiff and unwieldy ridges compared with the latter.

In certain Cetaceans (Balænopteridæ) there are great longitudinal belly-ridges[1] which obliquely interdigitate; but these do not put on the diamond-shaped figuring distinguishing *Trichechus* in its juvenile and, may be, adult condition. The stuffed skins found in museums of large or full-grown Walruses give no idea whatsoever of the characteristic in question; and the figures published by authors of works of travel and natural history are at best sadly deficient in definition as respects the actual form and dermal contour-lines of the body.

If it be asked what purpose is served by this loose-fitting and highly channelled garment of the Walrus, it may be suggested that for the immense size which the creature afterwards obtains, compared with its earlier bulk, some provision is needed admitting of distention of the tegument concomitant with growth. No doubt in some measure this may be true; but why it should be necessary in the case of *Trichechus* and relatively deficient in the Eared and Earless Seals &c., it is not so easy to explain. I have several times had an opportunity of inspecting the young of the Polar Bear (*Thalassarctos maritimus*), an animal ultimately attaining dimensions rivalling the Walrus; but no such marked provision was apparent. Another plausible reason may be assumed, namely, that periodically the Walrus becomes very fat, and during such times the elastic capacity of the skin allows of sufficient storage-room for the superabundant adipose tissue. But on this point it is worth while to quote Mr. Lamont[2], who says, "The Walrus has not nearly so much blubber in proportion to his size as the Seal: thus a Seal of 600 lbs. will carry 200 lbs. or 250 lbs. of fat; an ordinary Walrus may weigh 2000 lbs., but his fat will not exceed that of a Seal; a full-sized old bull Walrus must

[1] See illustration of these in P. Z. S. 1865, p. 208, fig. 1, *a, b*; also recently by Professor Turner in Trans. Roy. Soc. Edinb. vol. xxvi. pl. 5, figs. 1 & 4 (*B. sibbaldii*).

[2] 'Seasons with the Sea-horses,' Lond. 1861, p. 71.

weigh at least 3000 lbs., and such a Walrus will produce, if very fat, 650 lbs. of blubber, but seldom more than 500 lbs., which latter was, I think, about the maximum quantity yielded by the most obese of our victims." Very different was the condition exhibited by the Society's specimen, in which, as I have remarked (P. Z. S. 1868, p. 68), "not a particle of subcutaneous fat was present; and the mesentery and other abdominal parts, usually containing fatty substances, were equally destitute of such." Indeed I may say I never met with a leaner fleshy brute; but the pailful of *Ascaris bicolor* taken out of the stomach went far to account for deprivation of fat. Whatever be the bearings of the case concerning tegumentary folds, Von Baer (p. 133) hints that his subject was loose-hided; and Brown (p. 428) mentions that the skin of old animals is generally wrinkled and gnarled: indeed, from what most travellers say, the great laxity of the Walrus's skin characterizes both old and young.

5. *The Head.*—No really good and faithful portrait of the head, displaying the minutiæ of skin and the manner in which the bristles are set in the Walrus, is to my knowledge published[1]. Hence I have reason to think that the large profile view (Pl. LI. fig. 1) photographed by me from the recently dead animal, and most carefully delineated on stone by Mr. Smit, will be found to possess unusual accuracy. This illustration, as well as figs. 2, 3, 4, & 5, Pl. LII., of which three are also from photographs, and lithographed by Mr. Berjeau, renders it less necessary that I should dwell at length on the peculiarities of the head of the Walrus in youth; nevertheless some remarks may not be inappropriate, especially as the aspect of a thing itself conveys certain impressions which even in a photograph are wanting.

As observed in nature, then, the head is longer than the neck, and the cranial vault has not the same flattened appearance as that of *Otaria jubata*. The snout or muzzle is abruptly truncate.

The eye has pretty nearly a median position on the side of the head; its orbital ring seems prominent and tumid, giving, along with the relatively small bloodshot eye, quite a different expression to the large staring-eyed Sea-lion.

I had thought the intense redness of the conjunctival membrane was due to pathological lesion, but find that Von Baer noticed similar "sugillation" in his specimen; and, besides, several voyagers (for instance, Martens in 1675, and Lamont in 1861) call special attention to the red eye of the Walrus. This unusual condition, therefore, must be a natural one, the physiological reason of which I am not prepared to give.

There are no apparent eyelashes. In the state of contraction the palpebral fissure appears as a narrow slit 1 inch long. The anterior canthus is distant $3\frac{3}{4}$ inches from the nasal opening.

Though destitute of ears, however, there is a protuberance, or a semilunar skin-fold

[1] Brown, P. Z. S. 1868, p. 432, adverts to the drawings of Herr von Yhlen, 'Svenska Expeditionem til Spetsbergen år 1861,' pp. 169, 308, as being very good. I have not, however, been so fortunate as to get a sight of these, although I have searched several of the London libraries for the volume in question.

above and overlapping the patent meatus auditorius externus. When examined by the hand a cartilage is felt inwards, but no pinna can be pressed outwards. The ear-hole is distant $2\frac{1}{2}$ inches from the posterior canthus.

There is great mobility of the muzzle; and as to the stiff moustache-bristles, these curve in different directions according to the tonicity of the parts and their state of muscular contraction. When the nostrils are relaxed they drop forwards and the bristles curve inwards. At such times the nares are apart fully $1\frac{1}{2}$ inch; but when they are contracted a septum 0·6 of an inch wide only divides them. Occasionally, when alive, I observed the animal retract its upper lip, as a dog would in snarling; and this caused a deep furrow in the facial region. This change in the features gives quite a different expression to the physiognomy.

The mystacal bristles, which are neither more nor less than a further developed stage of the long tactile hairs on the upper lip of Carnivora, the common Cat for example, more bristly in their nature in the Seals, reach the maximum of abundance and magnitude in the Walrus. Lamont's vivid remark is so trite that I cannot forbear quoting it; he says (p. 145), "The upper lip of the Walrus is thickly set with strong, transparent, bristly hairs, about six inches long, and as thick as a crowquill; and this terrific moustache, together with his long white tusks, and fierce-looking, blood-shot eyes, gives *Rosmarus trichecus* altogether a most unearthly and demoniacal appearance as he rears his head above the waves." The intimate structure of these bristles has been described by other authors; my figures (Pls. LI., LII., & LV.) sufficiently convey a notion of their appearance in the young animal, so that further verbal allusion is unnecessary.

When seen in front and from above, the face has a most curious expression, recalling to mind that of the cranium of an Elephant rather than the Walrus's ally *Otaria*. The auricular regions then acquire a prominent aspect, as do the orbits. The great breadth of the muzzle also comes out better. The face is entirely hairy to the roots of the bristles. In our specimen there was a round scar, the size of a halfpenny, in the middle line between the nostrils and the eyes.

On the lower surface of the muzzle and chin (fig. 3, Pl. LII.), the upper lip passes one inch beyond the lower lip, and the snout, with its adpressed bristles, one to two inches beyond that. A portion of the upper rosy lip, in this view, is seen thrust upwards or puckered outside the canines. These upper canine teeth, which grow to massive tusks in the adult and aged Walruses, in ours had little more than protruded beyond the mandibular lips. The chin and anterior portion of the throat are very hairy; this diminishes backwards; and on the throat the almost hairless skin is thrown into longitudinal and parallel narrowish flat-topped rugæ.

Dimensions and Relative Proportions of the Head.

	inches.
Length from the muzzle to the apparent occiput	15
Girth at the occiput	$27\frac{1}{2}$
Girth at the ear-openings (a pinna is wanting)	$25\frac{1}{2}$
Girth at a point vertical with the eyes	22
Girth at the posterior end of the lip-bristles	$19\frac{1}{2}$
Girth at the muzzle anterior to the lower lip	$19\frac{1}{2}$
Apparent vertical depth of head in a line cutting ear-hole	$7\frac{1}{2}$
Apparent vertical depth of head at the eye	6
Apparent vertical depth of head 1 inch behind muzzle	6
Apparent vertical depth of the truncated extremity of upper lip	3
Apparent vertical depth of same, including the mandible	$3\frac{1}{2}$
Breadth of the snout (comprising the adpressed bristles)	$6\frac{1}{2}$
Distance from the snout to the middle of the eye	6
Distance between the two eyes, following superficial curve	8
Distance between the two ear-holes, following superficial curve	$11\frac{1}{2}$

6. *Pectoral Limb, and Comparison with that of Seal.*—There is a family resemblance between the fore foot of the Walrus, the Seal, and the Sea-lion, inasmuch as they are each modified swimming-paws, yet they differ in several particulars. As regards shape the two former present the closest agreement; but in manner of attachment and use the Seal stands alone.

In all, the free portion of the limb is broad and flat.

In the Walrus the pectoral fold of skin reaches the elbow, and the tegument of the axillary region is soft and elastic. In front of the shoulder it appears to extend to below the neck of the humerus. Like the axillary portion, the hide at this part is also very pliable, forming great folds or becoming smoother, according to the movements of the limb and body of the animal. The freedom of this limb of the Walrus permits pronation and supination to a great extent.

In the common Seal the axillary membrane proceeds as far as the distal end of the fifth metacarpal. This gives a greater width of membrane and limits the action of the paw, which cannot be pushed forward and has no such rotary movement as in the Walrus. The skin in front of the flipper or fore paw reaches to the middle of the forearm.

From the above it results that the attachments of the skin at the root of the fore limb in the Walrus, both before and behind, allow much greater freedom of movement than in the common Seal; and as this extremity can be thrown further out from the body, it enables it to twist the palm downwards and forwards, *i.e.* with plantigrade effect, as in the Sea-lion (*Otaria*).

In the Walrus the humerus, radius, and ulna can be so placed that they meet at an acute angle, the lower limb of which is in a great measure free. The digits, on the other hand, can together be turned backwards at a sharp angle with the radius and ulna, so that the bones of the limb altogether form an S-shaped figure.

In the Seal the antibrachium and digits bend on each other more angularly, thus <.

It may be remarked, however, that the juvenile condition of the Walrus caused the metacarpal bones and digits to have greater flexibility than might be the case in a more adult animal.

In the act of swimming the Walrus evidently can use its fore limb as far as the elbow, with a kind of rotary movement of the manus and antibrachium; but in the Seal the rotary action takes place only at the wrist, and above that a sort of confined ginglymoid or back and forward movement.

The nails of the pectoral extremity of the common Seal are long, and pass beyond the web.

In the Walrus, as in the Sea-lion, the nails are small, and do not project beyond the webs. The digits of the two latter also terminate in long spatulate cartilages—that of the pollex in the Walrus being of medium length and strength, whilst its magnitude in *Otaria* is something immense.

In the Morse the digits are subequal in length, the pollex slightly the largest and longest; the interdigital web or membrane is fluted when contracted. The diminution of the distal spatular cartilages and concomitant increment of the nails in *Phoca* convert its paw into a differentiated instrument on land or in water. By the extraordinary elongation of all, but especially of the pollicial cartilage, and strengthening of its basal phalanges, besides development of the palmar and dorsal fascia into strong unyielding aponeurotic ligament, the great oar-like flipper of *Otaria* is after all nothing but evolution from the more Bear-like manus of *Trichechus*.

Having placed the carcass of the animal on its back and stretched the pectoral extremities outwards, I noted the following appearances. The chest and pectoral extremity to the wrist are of a pale almost flesh-colour, and nearly devoid of hair compared with the body generally. In this posture all marked brachial wrinkling disappears; there is, however, abundance of very warty rugæ, resembling in many respects the palm of the human hand, only larger. What was very marked were scattered white circular spots averaging 0·2 inch in diameter. These I was inclined to regard as circumscribing cutaneous glands, though they bore analogies to the superficial markings usually found around abraded large hair-roots. The former is more likely to be their nature. Occupied with the inspection of other parts, I omitted further investigation till the operation of flensing was completed.

An old Walrus is mentioned by Brown (*l. c.* p. 428) as being "quite spotted with leprous-looking marks, consisting of irregular tubercular-looking white cartilaginous hairless blotches," which he took for cicatrices of warlike adventure. I conclude from this and hints dropped by travellers and others[1], that skin-disease affecting the said glandular spots is of no uncommon occurrence among these creatures, and is often mistaken for healed cutaneous wounds.

The palmar surface or sole of the manus is not unlike a parlour shovel in figure. There is a great callous, roughened, and warty pad at the proximal end or ball of the hand; and this, from discoloration incident to use, is of an intense dark brown or almost black colour. From the radial margin, where it is stoutest and roughest, it trends towards the base of the fifth digit. Circumscribed digital pads, as in Carnivora, there are none; but furrows and ridges traverse obliquely forwards from the pollicial to the opposite side.

Further on I shall have occasion to question the statement that the hind foot of the Walrus acts as a sucker to attach itself to the slippery ice. Here, dealing with the fore foot, and looking for adaptation to a purpose, we can at least see three apposite subordinate functions whereby this foot is well suited to the ice-bound regions which the Morse inhabits:—First, its great breadth, whereby it may act as a snow-shoe, or on uneven ground gain power of purchase by increase of its area. Secondly, its remarkable rough and warty palmar surface affords above every thing a stay and firm leverage on slippery ground; no stocking or wisp of straw used by man to bind round the foot when on smooth ice can equal nature's provision of coarse tegumentary papillæ. Thirdly, the angle at which the carpo-metacarpal joint is set, and the very odd manner of foot-implantation on the ground, namely, semiretroverted, evidently make it an easier task to go forwards or upwards on a smooth surface than to retrograde.

Beneficence and Design are doubtless everywhere scattered broadcast, but who can say that those seeming coadaptations are alone what the instrument subserves in the great scheme of Creation. Are they indeed after all ends to a purpose? for of species of the aquatic Mammalia few or none have ever been studied with any thing like precision or care concerning their habits in a state of nature. Much observation is still wanting in this field.

The precise limb-measurements are as undernoted:—

	inches.
From the shoulder-joint to the extreme end of first digit	$23\frac{1}{2}$
Girth of the limb close to the body, or 9 inches from its distal end	$17\frac{1}{2}$
Transverse diameter of the swimming-paw at wrist-joint	$7\frac{1}{2}$
Transverse diameter of the swimming-paw at the digits (crossing-nails)	9
Thickness of the manus at the wrist-joint	$2\frac{3}{4}$
Length, following curve of anterior border of pectoral limb	$17\frac{1}{2}$
Length, following curve of posterior border (*i. e.* from axilla)	$22\frac{1}{4}$
Length from elbow-joint to the tip of the fifth digit	$12\frac{1}{2}$

[1] *Vide* a short paper on the Walrus, by Dr. J. Bernard Gilpin, Proc. and Trans. Nova-Scotian Institute of Nat. Science, vol. ii. pt. 3, 1868–69, p. 123.

On comparison with measurements taken to the same points in *Otaria*, I find that the young *Trichechus* is relatively and absolutely shorter-limbed. The brachial girth close to the body is almost identical. The greatest diameter or breadth presents agreement; but *Otaria* has rather the advantage. The Morse has the thickest manus. The anterior curved and free margin has a length greatly in favour of the Sea-lion; but in the posterior concave or axillary border the reverse obtains. Thus it results that the available area for impulsion in water is less in the Walrus than in the Eared Seals; and this is in accordance with what is known of their swimming-power, which is far inferior to that of the Otaries.

7. *Ventral Region.*—Strictly speaking, the Walrus possesses no free tail, as do the Phocidæ and Otariidæ; for a broad web of skin stretches across from os calcis to os calcis, enveloping the caudal representative. This remarkable elastic membrano-tegumentary expansion, reminding one of the more delicate web similarly situated in Bats, has posteriorly, when the legs are outspread, a wide semilunar border with little if any medio-caudal projection. What appears as a tail when the limbs are approximated (Pl. LIV. fig. 12, *t*), is in reality fibroid tissue and skin; for the caudal vertebræ stop short about an inch from the free margin.

The opening of the anus is within $1\frac{1}{2}$ inch of the tip of the tail, the latter, as has been said, being outwardly well nigh obsolete, so much covered is it by the caudo-leg membrane. Even when examined belly upwards the anal aperture is not freely exposed, being covered or overlapped by a kind of duplicature of the said loose expanse of skin (*af*), which, indeed, forms part of the ordinary rectal folds often met with in this region. There is an indistinct linear raphe present, most marked close to the rectum. The skin in the region posterior to the anus and fold has a punctated character, arising from the distribution of cutaneous glands (Pl. LIV. fig. 13, *g*). Narrow, linear, transverse or oblique rugæ are also present at this part. The ventral surface of the diminutive tail appears raised above the adjoining membrane, and in the present instance was cicatrized, evidently the healed scar of a former wound.

The external orifice through which the penis protrudes in erection shall be described along with the organs of generation. Some 5 inches forwards from the anterior border of the aperture, the umbilicus (fig. 14, *um*, Pl. LIV.) is met with. This is a deepish pit, with an elevated roundish projection of bare skin as large as a shilling in circumference, and, besides minute circular rugæ, is marked by a dozen or thereabouts of deep radiating furrows and ridges.

Professor Owen notes (*l. c.* p. 104), as does Daubenton in the fœtus (*op. cit.* p. 420), that there are four mammæ in the female—two abdominal, and two inguinal. I observed the same number of teats in this young male; they were buried, however, in depressions, and not elevated as in the adult male *Otaria*. The two posterior teats were situated opposite the anterior border of the opening for the penis, but at $5\frac{1}{2}$ inches outward distance from it. The anterior pair were 9 inches in advance of them.

8. *Pelvic Limb, and Comparison with that of Seal.*—According to whether the hind foot is opened or closed so does the appearance of the free portion of the limb vary. Dorsally, when closed (see fig. 10, Pl. LIII.), it is long, parallel-sided, with the first and fifth digits conspicuously elongated, and the three shorter median ones overlapping each other as well as those on either side. The fifth digit is the largest of all, in this respect agreeing with *Phoca*, but differing from *O. jubata*, where the first or great toe attains the maximum dimensions. If figs. 2 & 4, pl. iv. Phil. Trans. 1824, be compared with the present fig. 10, it will be seen that the first and fifth digital extension are incurved. This is quite a possible circumstance, as beyond the bony phalanx there is a soft cartilaginous tip. I must state, however, both from a study of the live animal and manipulation of it when dead, that incurvation and close proximity of the ends of the first and fifth digits is an unnatural position for them to assume, and only results from alteration of the textures or from force.

The amount of loose interdigital membrane is very considerable, so that when expanded the foot is fan-shaped. The dorsal surface is smooth compared with the plantar one. The sole, indeed, like that of the manus, is rough and gnarled. From the os calcis forwards to the proximal ends of the digits there are several deep transverse furrows, and, besides, innumerable smaller sinuous gyrations, forming altogether a scabrous pad. This rough rasp-like condition has not been delineated by Home (*l. c.* pl. iv. figs. 3 & 4); but he correctly represents a fleshy ridge running from behind forwards between the third and fourth digits. Of the concavity or disk whereby adhesion by suction to the ground is performed, and by this mechanism the Walrus is enabled to support its gravity in progressive motion, I coincide with Von Baer, who regards Sir Everard Home's notion as untenable. No one who has ever seen the Walrus walk, or the *Otaria* climb (and they are both capable of the latter extraordinary movement), could for a moment suppose that by a pedal vacuum, as in a fly's foot, the massive Pinnipedian was sustained.

Returning, however, to the general aspect and tegumentary attachment of the entire pelvic limb, I shall, as in the pectoral extremity, institute a comparison of it chiefly with that of the Seal (*Phoca*).

In the Walrus the hind quarters seem shorter than in the Seal, apparently because of the different proportion between the femur and the tibia and fibula, the greater comparative length of the femur in the Walrus producing an expanded breadth opposite the iliac bones as the animal thrusts the femur outwards; this at times also gives a less-arched form to the hinder parts in the Walrus, whereas in the Seal, from the tibia and fibula being more fixed, there is a greater lateral compression at the sacral and distal end of the caudal region. In the Seal the ossa calcium, or rather heels, approach close to the tail, and cannot be thrust outwards far from it, whereas in the Walrus, while they can be pushed in towards the tail with ease, or even join one another, they at the same time can be separated as much as, or even more than, a foot distant from each other.

The tail in the Walrus reaches only to the heel. In the Seal it projects considerably beyond it, even as much as 4 or 5 inches.

The free membrane joining the tail to the limb reaches no further than the os calcis in the Walrus, and the foot then can be turned at a right angle to the heel. In the Seal the same caudal expansion or sheet of integument reaches considerably beyond the os calcis, as far even as the proximal end of the metatarsals. The membrane likewise goes towards the middle of the foot, in this manner binding the soles together, so that when these are expanded they face each other and prevent all movement of a plantigrade kind.

It is thus with difficulty the two hind feet can be dragged out at right angles with the body, the natural movement being a kind of sculling one towards each other, the soles facing one another mesially.

The hind foot in the Walrus is in some respects like that of the Sea-lion, both, for instance, in its manner of attachment and in the movements of the parts one on the other.

In them the caudo-limb membrane only extending to the heel allows great laxity of movement. Besides rotation, pronation, and supination, the feet can be thrust backwards in the long diameter of the body, somewhat in the same manner as obtains in the common Seal.

The hind foot (pes) in the Walrus, as previously stated, can be twisted forwards and used as a support in walking, similar to the method of progression of the Sea-lion; nevertheless there is noticeable a slight difference in the mode of action. The Walrus is often seen to thrust its toes more below the belly, whereas the Sea-lion drags them flappingly outwards, and its great long toes at times even overlap or strike against the fore limbs. This latter was not observed in the Walrus, the toes appearing to be shorter and less rigid.

The nails on the pelvic limb of the Walrus are larger than those of the fore foot. The sole is bare and the dorsum covered with short hairs as far on as the proximal phalanges.

The development and disposition of the nails of the hind limb is a very trenchant character, distinguishing the three genera of Pinnipedia already so often referred to. In *Trichechus* they are altogether diminutive, subequal in size, and, from the short distal phalangeal cartilages, moderately, and indeed the three median ones rather, near the toe-tips. In *Otaria* the two outer ones are but rudiments, whereas the three mesial ones are large and strong: they are placed at a considerable distance from the points of the digits. In *Phoca* the nails assume a claw-like size and figure, are situated quite at the digital extremities, and the middle three are much smaller than the outer two.

The measurement of our Walrus's hind foot yielded the following results:—

	inches.
From the os calcis (at the point to which the caudal flap of skin reaches) in a straight line along the sole of the foot to the tip of the fifth digit, which is the largest in size	$17\frac{1}{2}$
The same measurement carried to the distal end of great toe	$16\frac{1}{2}$
From the knee-joint to the tip of the fifth digit	$26\frac{1}{2}$
The free part of the pelvic limb, in a straight line	$17\frac{1}{2}$
Girth at the proximal end or round the os calcis	$13\frac{1}{2}$
Extreme breadth at termination of digits when these are forcibly distended	13
Diameter of same when closely contracted and overlapping	$5\frac{1}{2}$
Diameter of limb at the proximal end of the carpal bones	4

In *Otaria* the free part of the pelvic extremity is coequal with the above. The girth at the proximal end of the calcaneum is in favour of the young Morse.

III. Dentition and Cavity of the Mouth.

1. *The Teeth.*—My remarks on the teeth may be brief; for on this subject a host of writers[1] with more experience and greater opportunities of observation than myself have discussed in detail the immature and adult dentition of the Walrus, both as regards their numbers and homologies.

The entire set of teeth in both jaws numbered twenty-four, viz. fourteen superiorly, and ten inferiorly (see figs. 6 & 7, Pl. LII.). Each upper canine protruded $1\frac{1}{2}$ inch beyond the gum, was inclined outwards and gently backwards, and had an antero-posterior diameter at the root of $\frac{6}{10}$ inch. Ordinarily they were well nigh hidden by the lips; but as shown in fig. 3, chin view, they peered forth from the angle of the mouth surrounded by a partial erection of the labial mucous membrane. These canines, as previous observers have noted, were situated outside the more regular dental arch. The latter consisted of six teeth on either side, placed at subequal distances from each other; the anterior and posterior pairs were mere denticles, the rest of very moderate dimensions. In the mandible no symphysial teeth were visible; and of the five ramal teeth on each moiety the hindermost and penultimate were little more than tubercles.

2. *Palate.*—This is boat-shaped, and deeply concave both antero-posteriorly and transversely; but especially is this the case in its anterior half or thereabouts. The length from the mesial or anterior incisive denticles backwards to the fauces is 5 inches, and the greatest breadth is close upon 2 inches. The anterior palatine foramen pierces the tissues opposite the second large molar tooth. The mucous membrane, with its periosteal substratum lining the roof of the mouth, is very

[1] Retzius, the Cuviers, Rapp, Deslongchamps, Wiegmann, Stannius, Owen, Jaeger, Gray, De Blainville, Peters, Huxley, Gervais, Flower, and others.

moderately rugose. The transverse rugæ are low, irregularly sinuous, and do not traverse quite across; in other words, there is a very slight longitudinal and irregular mesial ridge, on either side of which wavy elevations meet at unsymmetrical, slightly obtuse or right angles. The three most anterior ridges are best marked, those posterior are less distinct, and they become very faint and indistinct behind. Seven more or less complete eminences ranged athwartwise can be defined; the intervening spaces, much broader than the ridges, are comparatively smooth. Posterior to the ridged superficies the smoother palatal membrane reaches to the tips of the hamular processes of the pterygoid bones, these latter being each an inch long; but this area has no solid basis of bone beneath. The fleshy palate in other Pinnigrades agrees in the main with the above; the Bears present greater ridging, and Feline Carnivora still more so.

3. *Tongue and Pharynx.*—Regarding the fœtal specimen of Morse, Daubenton, p. 420, remarks, "La langue étoit échancrée à l'extrémité comme celle du phoque." This observation I cannot corroborate; for I find the tip of the tongue comparatively smooth and rounded (fig. 29, Pl. LV.), not dorsally grooved, bifid, and terminating with free jagged papillæ, as is markedly the case in *Phoca* and *Otaria.* Throughout the dorsum there are innumerable diminutive rasp-like conical or filiform papillæ (*fl*), and towards the root larger-sized flat fungiform (*fg*) elevations; but relatively the entire tongue presents a smoother surface than the allied genera of Seals, and thus approximates to the plantigrade Carnivora.

A widely V-shaped range of circumvallate papillæ (*cv*), altogether six in number, are situate posteriorly; and the surface in proximity with these is smooth.

The postfaucial region, both below and at the sides, is beset with flat, large, and broad heart-shaped papillary structures, which are wanting in the vault, where a smoother surface indented with many crypts exists.

The mucous membrane of the pharyngeal cavity has longitudinal, uneven or warty, narrow and parallel rugæ. These folds, as they pass into the œsophagus, are more linear and less corrugated.

No difference worthy of special mention, as compared with *Otaria*, obtains in the disposition and attachment of the muscles of the tongue and hyoidean region. As in that genus, the constrictors of the pharynx in *Trichechus* have great thickness and volume; and the subdivisions of the fibres corresponds to those separately named human muscles of some of the older authors, Valsalva[1] and Douglas[2] for example. The fleshy bundles of fibrillæ, it may be observed, are remarkably coarse and strong.

IV. The Viscera and Generative Organs.

1. *Relative Position of Viscera.*—Daubenton (*l. c.* p. 419) mentions that in the fœtus examined by him the great omentum was short, and hidden by the stomach. Such

[1] 'De Aure Humana,' Bononiæ, 1704. [2] 'Myographiæ Comparatæ,' London, 1707.

was the condition of the Society's late specimen; and moreover this membrane did not contain a particle of fat. The same writer states that the stomach was entirely to the left, and describes the relations of the other parts. I may shortly allude to the disposition of the viscera as I found them, which the diagrams, figs. 19 & 20, Pl. LV., will help to elucidate. When the abdomen is opened, as in fig. 20, a portion of the liver is seen to occupy the anterior region; but this viscus really stretches into both hypochondriæ; behind it, right in the middle, is the great siphon-shaped stomach, and beyond the convoluted intestines a portion of the bladder peering in front of the symphysis. A moiety only of the spleen is seen in the left hypochondrium, near the stomach, and on the opposite or right side, where the intestines have been thrust slightly aside, some of the mesenteric glands and a piece of the right kidney.

The small intestine, after a sharp turn, crosses from right to left hypochondrium beneath the large-sized mesenteric glands and the spleen, and over the left kidney, forming hypogastric convolutions. Circuitously crossing and recrossing, it reaches the cæcum, which is covered by the pancreas, and fixed quite beneath the stomach. The great intestine at first is likewise covered by the pancreas and cardiac end of stomach, and in loops proceeds towards the fundus of the bladder, where the rectum commences.

The relative positions of the abdominal viscera thus present a general agreement with those of the Otary, with this difference, that the stomach in the former occupied a large visible area, or, *in situ*, was less covered by the liver than met with in my dissection of the latter.

2. *Alimentary Canal, Glands, &c.*—The length of the œsophagus was not ascertained; it is a thick-walled tube with internal linear corrugated plicæ.

In the fœtus, no more than half a foot long, dissected by Daubenton, the small intestine was $2\frac{1}{2}$ French feet from the pylorus to what he notes as the cæcal appendage, which was only represented by a rudimentary tubercle; the large intestine was 4 inches in length. In the Society's first female specimen, 4 feet long, investigated by Professor Owen (1853), the entire gut, including the cæcum, measured 76 feet $1\frac{1}{2}$ inch, whereof the small intestines were 75 feet, the great intestines 1 foot, and the cæcum $1\frac{1}{2}$ inch. The young male under immediate consideration was a somewhat older and larger animal than the latter.

According to Daubenton[1], Owen[2], and Huxley[3] the many-lobed liver resembles that of Seals. My observation corroborates this to a certain extent; but in three genera of Pinnigrades examined by me I note certain differentiating characters. The entire mass and thickness of the liver, as might be expected, is absolutely the greatest in *Trichechus*, and as regards secondary or superficial fissures it presents intermediate gradation between *Phoca* and *Otaria*. In the latter it is sculptured and furrowed to a remarkable degree, less so in the second, and least in the first mentioned. The

[1] *Op. cit.* p. 420. [2] P. Z. S. 1853, p. 104. [3] The Lancet, May 5th, 1866, p. 494.

larger lobes in the Walrus are more rounded in outline than in the other two genera, where they are rather triangularly figured and taper-pointed.

The cystic lobe of Owen is deeply bifid, the right moiety more elongated than the left. Between them the pyriform gall-bladder is bound down by three separate folds of membrane, but it does not lie in a sunken fissure. The cystic duct is an inch long, and then receives an afferent from the left, and about a quarter of an inch below that another from the right. Two inches further on it partly penetrates the wall of the intestine, where, enlarging into a capacious duct, it continues for $5\frac{1}{4}$ inches more, at last piercing the mucous coat, and opens into the intestine by a very minute orifice.

The said enlargement of the ductus communis choledochus extends as a small *cul-de-sac* backwards from where it first penetrates the serous intestinal coat; and this portion of it is smooth-walled within; but further on, as it narrows, it becomes transversely trabecular. Though relatively capacious, this inflation of the intestinal portion of the bile-duct is not peculiar and alone met with in the Walrus, as stated by Home.

The pancreas is large, broad, and flat, and with the usual glandular structure, of a yellowish or cream-colour; the duct as mentioned.

The mesenteric and abdominal lymphatic glands, as in the Pinnipedia generally, are numerous and of considerable dimensions; and within the folds of the mesentery exceedingly large lymphatic vessels are displayed. Indeed these lymphatic channels, convergent from the intestines towards the glands, are a remarkable feature, so distinct and large are they. Physiologically it may be inferred that assimilation is very rapidly effected in the Walrus, as doubtless is the case in the Seals, also fish-eaters, and equally remarkable for their voracity and speedy digestion.

3. *Urino-generative Apparatus.*—The *kidneys*, as mentioned by Owen and Daubenton, are very compound, and composed of a vast series of lobules. In *Phoca* and *Otaria* the renal organs are similarly made up of adnate renules; but the three allied forms differ with respect to the relative size of these, and their being more or less adherent. In *Otaria* the lobules, especially externally, are more compactly set together, so that the surface presents only undulating manifestations of lobulation; the lobules also, although not individually counted, appear less numerous, and proportionally larger in size, than in the two other genera. *Trichechus* offers an intermediate character in these respects, the kidney of course being absolutely the largest. In *Phoca*, besides smaller renules and more defined marks of separation, there are also extensive wide venous ramifications or plexuses within the capsule, and unconnected with the cortical vascularity.

Anterior to the renal arteries and to the inner margin of the kidneys the small *supra-renal glands* are found, as depicted in fig. 19, Pl. LV.

The *penis*, ordinarily, is contracted within its abdominal sheath, but has no marked flexure or loop, as in Ruminants. The anterior boundary of the external opening or aperture (Pl. LIV. fig. 14, *ap*) of the sheath is situate some 5 inches behind the umbilicus (*um*), and its posterior border at 19 inches distance from the anus. Of elongate oval contour, $2\frac{1}{2}$ inches in antero-posterior, and 1 inch in transverse diameter, its puckered edges are capable of great distention. Radiate, semicircular, and anteriorly longitudinal grooves and ridges start from and surround the raised lips of the orifice.

Two long and strong fleshy bands, the *retractores penis* (fig. 17, *R.p*), pass from the neighbourhood forwards to the foreskin in front, and at the sides of the os penis. Only a small portion of the bone (*os*, fig. 17) is shown; but it appears similar to that figured of the adult by De Blainville in his 'Ostéographie,' Atlas, tome 2, pl. vii.

A powerful glistening aponeurosis or flattened tendinous ligament (fig. 17, *l*) lies on the dorsal surface of the bone; it arises from its proximal, and is inserted into its distal end; expanding forwards it is connected partly with the subcutaneous tissues of the prepuce, and mingles with the terminal fibres of the retractors of the penis. The glans anteriorly, as in *Otaria*, is truncate, and in the fore-shortened view (fig. 16, *g*) presents an oval contour, $1\frac{1}{2}$ inch in vertical and 1 inch in horizontal diameter, at the lower extremity of which a nipple-like pendulous portion of the corpus spongiosum projects. The meatus urinarius (figs. 16 & 17, *mu*) opens at the tip of this. The os penis (*os**) comes forwards to the very front of the glans, is abruptly truncate as in *Otaria*, and likewise is covered by a layer of mucous membrane, superficially roughened and pitted. This portion of it is almond-shaped, narrow end down, partially surrounded, excepting below, by a deep sulcus (*s*), which itself is outwardly bounded by the tumid fleshy and rugose glans (*g*). The glans penis (fig. 17, *g*) altogether is about $1\frac{1}{2}$ inch long, and somewhat laterally compressed; its cuticular covering bears fine transverse wrinkling; this is continued into the longish preputial fold (*p*) coextensive with the sheath already spoken of.

The corpus spongiosum (fig. 17, *cs*) is small in calibre, and only slightly visible in the side view and behind. The urethral bulb (*b*) is of fair size in this respect, contrasting with the moderate dimensions of the somewhat laterally compressed cylinder of the corpus cavernosum (figs. 17 & 18, *cc*), which latter is longitudinally curtailed by the presence of the bone.

Immediately behind the bulb the penis lessens in girth, but again widens at its prostatic portion. Cowper's glands are absent; and the small prostate (fig. 18, *Pr.*), very slightly protuberant outwardly, is imbedded within the urethral walls, close to the neck of the bladder.

The vasa deferentia, on entering the pelvic cavity, proceed to and separately pierce the prostatic portion of the urethra; and as there are no vesiculæ seminales, they terminate in two minute orifices or ejaculatory ducts (*e.d*) in an elongated mesial ridge, representative of the sinus pocularis, which runs forward in front of the prostate gland.

In this case the manner in which the obliterated urachus entered the urinary bladder is worthy of mention; to wit, it formed within the viscus.

The ureters (*u*, figs. 17 & 18, Pl. LIV.) open by small semilunar slits about 1 inch apart at the fundus, a short distance behind the neck. A ridge of membrane is continued from each, which join at the ejaculatory ducts.

V. Vascular and Respiratory Systems.

1. *The Heart.*—Such a careful and accurate description of the heart has already been given by Owen[1], that repetition on my part is unnecessary; but I may mention the appearances of this organ after having been fully distended with plaster of Paris by my former colleague and friend Dr. J. Bell Pettigrew[2]. The preparation made by him is now exhibited in the Gallery of Physiology, in the Hunterian Museum. Altogether the heart is of immense size. The base of the ventricles is quite a foot across, the length from root to apex 8 inches high, and 13 or 14 inches if measured to the summit of the arch of the aorta. The tip of the right auricle, as Owen remarks, comes forward; but the rest of the auricular cavity is rather thrust backward. The post-caval or descending vena cava is double in this specimen, though found single in the animal cut up by Owen.

The coronary or great cardiac vein is very large, and follows the mesial ventricular furrow obliquely towards the apex.

2. *Arterial Distribution.*—The aortic arch and vessels springing therefrom verify Owen's observations. The arch has a capacious thick-walled dilatation opposite the obliterated ductus arteriosus, where it diminishes very rapidly in calibre, as it forms the descending aorta. The innominate artery, the right and left common carotid, and the left subclavian vessels are derived separately from the summit of the arch. The innominate artery is wide, and about $1\frac{1}{2}$ inch long. The internal mammary branch and the vertebral artery are sent off nearly opposite each other; the former, from the lower border, descends into the thorax outside the inferior vena cava; the latter, starting from the upper border, rather behind, proceeds obliquely outwards and upwards, crossed by the pneumogastric nerve as it goes to the chest.

Immediately beyond the vertebral a large suprascapular artery comes off from the upper border of the innominate, and, crossing the lower cervical plexus, trends outwards and upwards to supply the muscles of the neck and the back of the scapula. The continuation of the innominata is by a wide subclavian. The right carotid, starting rather in front of the right subclavian, obliquely curves over the root of the trachea, and runs forward in the neck; the left, which springs almost adherent and, if any thing, behind the right, goes up the neck in a nearly straight direction.

The left subclavian, half an inch apart from the last, nearly equals the innominata in diameter as well as in length. The left internal mammary and the vertebral arteries start contrariwise from the parent trunk, almost in the same manner and position as on

[1] P. Z. S. 1853, p. 104.

[2] Late first Assistant in the Hunterian Museum, now Pathologist to the Edinb. Roy. Infirmary, and Conservator Roy. Coll. Surg. Edinb.

the right side; $1\frac{1}{2}$ inch further on, the left subclavian splits into a large ascending branch, and a main trunk is carried on towards the axilla. The upper suprascapular and equally wide transverse cervical have, all things considered, great calibre, needful to supply the vast muscles clothing the neck.

Comparing the vessels derived from the arch of the aorta in the Phocidæ and Otariidæ with those of the Trichechidæ, I find that the two former have three great trunks springing from the arch, whereas the latter has four. In the common Seal and the Sea-lion the short, wide innominate gives off the right carotid, which in the Walrus comes from the summit of the arch itself, in near proximity, however, to the innominata.

The distribution of the arteries of the forearm in the Walrus have been both figured and described by Von Baer[1]. Those observed by me were much in accordance with the diagrammatic view he gives. The axillary, a wide stem, gives off a large subscapular and derivative circumflex branches. One or two arteries leave the brachial below the neck of the humerus, and are distributed partly to the triceps, passing beneath the internal anconeus to the elbow-joint and muscles on the ulnar side of the forearm. These with other twigs doubtless are homologous with the superior and inferior profunda and the ulnar anastomotic. Dipping deeply in the lower humeral groove the brachial goes under the brachialis anticus muscle, and on reaching the forearm splits into several branches; but a main radial and lesser ulnar are perceived. Von Baer distinguishes a deep artery with several anostomotic branches and loops (which I take to be the anterior interosseous), and to the radial side of the radial trunk a long, but narrow, vessel which runs to the wrist parallel with it. These latter I did not dissect with care, though, from what I saw, I believe our specimen possessed similar peculiarities. His ramus volaris and ramus dorsalis I noted, and moreover examined the delta-like superficial palmar arch, which freely communicates by many twigs with the deeper arterial distribution. The second, third, and fourth interdigital spaces have forked branchlets, and the first a single one, chiefly supplying the ulnar side of the pollex.

Among noteworthy points in the vascular distribution of the fore limb of the Walrus these are to be observed:—1st, the great calibre of the axillary trunk previous to giving off the subscapular, circumflex, and other muscular branches of the upper humerus; for the immense shoulder-masses of flesh giving that wonderful swimming-power to the pectoral extremity require sanguineous nourishment accordingly; 2nd, considerable diminution of calibre below that point; 3rd, the unity of land-mammalian type as regards offshoots from the main trunk, although the flattening and lateral extension of the member has much modified the relation of parts; 4th, the tendency to rete mirabile in the antibrachium and wrist.

The descending thoracic and abdominal aorta is very small relatively to the arch; for the massive fore limbs and strong muscles of the neck drain much of the blood, whereas

[1] Mém. de l'Acad. de St.-Pétersb. 1835, tom. ii. p. 201.

the hind quarters are comparatively feeble and less needfully demand large blood-supply. No intercostal flexures, as in the Cetacea and Sirenia, were observed. The branches usually the product of the cœliac axis, and nourishing the stomach, spleen, and pancreas, are of considerable capacity, as is the mesenteric. The renal arteries diverge nearly at right angles to each other.

The iliac vessels divaricate at the sacrum almost on a level with the brim of the pelvis. The trunk sent into the pelvic basin was not followed; but the femoral passes, as in *Otaria*, beneath the abdominal muscles over the bone above or to the lumbar side of the anterior inferior spinous process, below which it reaches the groin. It pierces both the adductor longus and magnus; and branchlets are freely distributed to the other muscles and the back of the knee.

On reaching the sole of the foot, to the inner side of the calcaneum the artery, along with the veins and nerves, is invested by a strong fascia, and, from what I could see without unravelling the individual vessels, has a somewhat plexiform arrangement analogous to the manus. I could trace, however, a larger-sized vessel (the internal plantar artery?) upon the surface of the deep plantar fascia and the interossei, which split into three or four branches; and these ultimately forked in the interdigital spaces. A separate external plantar branch ran to the outer side of the fifth digit.

The arterial channels of the pelvic limb, among other peculiarities, are characterized. —1, by their moderate size as compared with those of the thoracic member; 2, the abnormal position of the femoral, correlated with the altered condition of the femoral region; 3, the manner in which the femoral burrows amongst and pierces the several adductor muscles; 4, partial plexiform arrangement in the lower leg and sole; 5, general similarity of the plantar to the palmar arch and ultimate digital distribution.

3. *The Larynx and Lungs.*—I have given in Pl. LV. three views of parts of the larynx and hyoidean regions, and from these shall demonstrate some of the more important points of the organ of voice. Having taken out the parts *en masse* and sent them to the College of Surgeons, they were mounted as a preparation before I had the opportunity of closely examining them. As, however, they have been carefully dissected, there is no difficulty in the way of a comparison being rendered between their structural condition and that of the Eared and Earless Seals.

The hyoid bone has been figured and commented on by De Blainville[1] and others; and as it is not exposed in the preparation, I omit further reference to it.

In discussing whether the Walrus blows or spouts through its nostrils in the manner of Cetaceans, which Martens[2] and subsequent writers had averred[3], Von Baer[4] very justly discards the supposition; and I may remark that the animal gambolling in our large tank bore living evidence to the latter truth. He shows that the constitution of the parts are entirely at variance with such a function, as the arytenoid cartilages are very

[1] 'Ostéographie,' Atlas, tome ii. pl. 10.
[2] 'Voyage to Spitzbergen,' 1675.
[3] Pennant and Oken, as referred to by Von Baer.
[4] *Loc. cit.* p. 139.

diminutive, relatively and absolutely, as compared with those in Whales. Moreover he pointed out, as has since been noticed by Huxley[1], that the epiglottis is very rudimentary indeed, though conforming to the Pinnipedian type. In our specimen it is seen to be remarkably short, stumpy, and somewhat of a horseshoe-shape; in fact, when retroverted it can scarcely cover the glottidean aperture; but no doubt shrinkage in spirit has reduced it, though likewise the neighbouring parts are also contracted. The rima glottidis is both narrow and short, and the oblique furrows of moderate depth; in figure these clefts resemble those of *Otaria*; and, as in that genus, the smooth rounded projections formed by the arytenoid and Wrisbergian cartilages are large and prominent. The upper or external laryngeal pouches appear deepish.

The bottled preparation does not suffice for a very detailed description of the cartilages of the larynx; but this much is seen:—The thyroid cartilage laterally is upon the whole smoother than in *Otaria*, oblique ridging being well nigh obsolete. The alæ thus viewed have a partial hourglass-contour, the lower or cricoid emargination being deepest. The inferior or descending cornu is relatively broader and more rounded than in the Eared Seal; likewise the pomum Adami has a higher (anterior) position, and the conspicuous cartilaginous elongation bounding the upper notch in *Otaria* is shorn off, or more obliquely rounded, in *Trichechus*. The front or superficial aspect of the thyroid cartilage even more strongly denotes the gradation from Pinnipede to Fissipede Carnivorous type, the upper notch possessing a wide V-shaped outline, the lower notch bayed, with rounded angles, and the alar bridge broad and flattish.

Of the relatively larger cricoid cartilage, the superficial tracheal emargination is shallow, wide, and not so angular as in *Otaria*; the inferior border is more convex, and the crico-thyroid smaller.

According to Professor Huxley, "the rings of the trachea are entire, but many run into each other in front and behind." The same observer says there is an accessory trunk to the right bronchus; if present in our specimen it was not noted. The very ample and elongate lungs (fig. 19, Pl. LV.) agree with Daubenton's description; and their notched or serrate anterior margin, alluded to by Owen, was partially visible in the upper lobes.

VI. Of the Myology.

Having already very fully described and figured the muscles of the Sea-lion (*Otaria jubata*), to which the Walrus is closely allied, as much in its fleshy locomotive structures as in other points of taxonomic value, I consider it unnecessary again to descend to all particulars. Instead of reiteration, therefore, it may be taken as granted that in the muscular system of the two animals there is as close a correspondence as variety in the osseous frame admits of. That is to say, excepting the skull, the other bones present resemblances; and as the attitudes assumed by both creatures are not unlike, the muscles concomitantly are developed after the same type. Once for all, then, it is to

[1] Hunterian Lectures, reported in 'Lancet,' May 5, 1866, p. 494.

be understood that I shall only specify deviations, describe afresh points obscure in *Otaria*, or state the parts unexamined; otherwise agreement is implied. Incidentally I may refer to muscular distribution in the Seal (*Phoca*); but throughout I purposely avoid a full comparison of the three forms in question.

1. *Muscles of the Skin, Cranium, and Spine.*

Equally as in the common Seal and Sea-lion, the panniculus carnosus in the Walrus is most extensively developed, but in the latter it has the coarsest fibres. There is a broad portion covering the buttocks, an ample layer on the sides of the body and abdomen, and, lastly, the shoulder-fibres lie over the deltoid and trapezius even in greater quantity than in *Otaria.*

Of the cutaneous fleshy layer representing the platysma, this is dispersed on the neck of the Walrus more abundantly than in the Eared or Earless Seals.

The rather increased development of the dermal muscle of the shoulders and neck in the Walrus seems in harmony with the looseness of the skin and its greater flexibility in those regions in this animal. In *O. jubata* the part which covers the hips is uncommonly strong; and accordingly it is in this creature that the more springy action of the sacral regions takes place, in the hobbling canter which it occasionally performs. But doubtless the youthful stage of the *Trichechus*, and consequent imperfect development or laxity of the muscular tissues, stood in the way of the latter tucking forwards its hind quarters so nimbly. In the Walrus, however, the continuation of the abdominal fibres by fascia into the groin, and their membranous extension towards the anal fold, the distal end of the tibia, and to the heel, are excessively coarse and thick. This disposition of the superficial tissues or aponeurotic layer of the groin and caudo-tibial region appears at least to serve a twofold purpose—namely, connect the retractile efforts of the abdominal parietes with those of the semifixed lower leg, and defend the testicle from injury, as it lies upon the surface of the gracilis and semitendinosus muscles.

As might be anticipated from the enormous muzzle and exceeding flexibility of the vibrissæ or, rather, stout bristles inserted into the upper lip, the facial muscles, as a whole, are proportionally vast. They, indeed, form a fleshy mass of extraordinary thickness and great strength, separable, as in *Otaria* and *Phoca*, into several well-defined layers, which as a group chiefly play upon the nostrils and upper lip. In *Trichechus*, moreover, the number and magnitude of the infraorbital and facial nerves agree with the wonderful motor and semitactile power displayed in the structures to which they are disseminated.

The size and force appertaining to the narial muscular group are most unusual, and far surpass those of most short-snouted mammals other than the Seals, excepting, it may be, the large aquatic Hippopotamus. In the living Walrus, which I had many opportunities of watching, it was curious to observe the manner of closure and dilatation of the nares. In coming out of the water, or under other circumstances where a full inspiration takes place, the dilatatores narium act sharply and drag the alar fibro-cartilages with a jerk outwards, producing a wide oval orifice to each nasal opening. Then, as respiration becomes easier, the nares assume the appearance delineated in fig. 5, Pl. LII. After a time, or when reentering the water, a quick sudden closure of the nostrils is effected by muscular action, when the alar fibro-cartilages and their appendices are thrown inwards and upwards, effectually obliterating the outer nasal openings, which are reduced, as depicted in fig. 4, *an*, Pl. LII., to two obtuse angular slits. Whilst the above is the more pronounced mode of action, yet, under quieter conditions, these steps of dilatation and closure occur more gradually, though the process is similar to what has been described.

Finally, the mystacal bristles are characteristically affected by all motor changes of the muzzle. Usually they lie adpressed or overriding each other with an inward curve; but under other circumstances, as in feeding, they move *en masse*, and form a natural screen or sieve, whilst the creature by a succession of sucks and gulps strains its soft molluscan food. Besides simultaneous movement of the bristles, due to the inherent force of the great naso-labial group of muscles, each bristle individually possesses a certain amount of special motor power by reason of a pencil of muscular fibres at its root. These fibrillæ are developments equivalent to the cutaneous muscles met with in the skin of Birds, Hedgehog, &c. In the Walrus (see fig. 27, *m*, Pl. LV.) they are interwoven with a plexiform arrangement of fleshy fibres which cross between and bind the roots of the bristles together; this matrix communicates deeply with the massive naso-labial group of muscles; and by a consentaneous action the movements above spoken of are produced.

Essentially similar structures are found throughout the Carnivora, and extra development of the structures passes by a gradation throughout the Seals to its maximum in the Morse.

In the Eared Seals (*Otaria*) there are virtually no recognizable inherent muscles of the pinna, though there are a few faint fibres which might be classed with these; but I am rather inclined to consider them homologues of the so-called auricular group of human anatomy. My reason for this opinion is founded on the fact that in the Walrus, though strictly speaking earless, there are three well-defined and, indeed, comparatively large, fleshy bundles, whose situation and origin partially agree with the auricular muscles. Professor Humphry[1] has arrived at the same determination with regard to the fasciculi present in the Seal, where, however, an attollens and attrahens are very rudimentary indeed as compared with those of *Trichechus*.

The first, attollens (*atl*, fig. 26, Pl. LV.), or superior auricular, is a long narrow band which arises upon the surface of the occipito-frontalis and temporal muscles, and, directed obliquely downwards and forwards, ends in a pointed manner on the upper

[1] Journ. of Anat. and Physiol. 2nd Ser. No. 2, May 1868, p. 296, "On the Myology of *Orycteropus capensis* and *Phoca communis*."

and rather posterior surface of the terminal bulbous portion of the auditory canal, or *f*-shaped tubular cartilage.

The second, attrahens (*atr*, fig. 26), or anterior auricular, is throughout rather broader but very little shorter than the preceding. It arises from the tissues below the hinder segment of the zygomatic arch, and, with an upward and backward slant, terminally fixes itself to the under anterior border of the auditory coil or expansion.

The third muscle, lying behind the last mentioned, is the shortest but by far the strongest. It has origin by a stoutish tendon from the upper surface of the zygoma; and, ascending almost vertically, its roundish fleshy belly is inserted into the inferior angle of the upper bend of the auditory canal and into the front of the perpendicular portion. The origin of this muscle is not, as in Man, from the mastoid region; nevertheless it corresponds most nearly with the posterior auricular or retrahens aurem (*ret*, fig. 26).

As regards action, the upper muscle retracts as well as raises the meatus auditorius, whilst the lower pair drag the cartilaginous tube forwards and downwards. It may be, though, that by a combined action of the investing fascia the posterior auricular gently pulls the circular bulb of the meatus slightly backwards.

It is very remarkable that such auricular muscles should be so well developed where, in the absence of a large expanded concha, sound is seemingly not so needful a requisite to be caught as in many of the land-Mammalia. Because deficient in external aural apparatus, the Walrus must not be supposed to be dull of hearing; on the contrary, his powers in this respect are acute rather than otherwise. Perchance an enlarged pinna in a watery element would not render the vibrations more susceptible of impress on the internal acoustic apparatus; yet there can hardly be a doubt that the external auditory canal is betimes modified in its curvature by the said fleshy strips. In Cetaceans, *e. g. Lagenorhynchus*, where the ear-hole is extremely minute and rigid, I have found similar homologues of auricular muscles.

Unlike the *Otaria*, the Walrus possesses a slight median tendon in the digastric muscle. The tendon, however, occupies only the inner side of the muscle.

Of the short muscles on the ventral surface of the neck, all are of large size. The rectus anticus major springs by fleshy digitations from the diapophyses of the sixth, fifth, fourth, and third cervicals, and increases in thickness as it approaches its basioccipital insertion. In some respects this resembles what obtains in Man. The rectus anticus minor has origins from the diapophyses of the third and second cervical vertebræ, passing forwards to the basioccipital. The longus colli may be regarded as consisting of two divisions. The anterior or upper portion is separated readily into four or more slips. These arise fleshy from the ventral surface of the bodies of the cervical vertebræ, betwixt the seventh and second, and are inserted, partly fleshy and partly by tendon, into the anterior transverse processes. The second or posterior portion bears considerable resemblance to the condition found in *Otaria*, and proceeds on to the bodies of the anterior dorsal vertebræ.

The deep short muscles situated at the back of the neck, as a whole, resemble those of the Sea-lion (*Otaria*); nevertheless, though large in this animal, they are surpassed in size in the Walrus. It may be noted respecting the rectus posticus major, that besides being attached to the axis it extends backwards, and has attachments to the five posterior cervical zygapophyses, and even as far as the first dorsal superior articular process.

The Walrus also has a moderate-sized muscle, representing that depicted by me in the Otary, where it is so well developed; this arises in the former from the fourth as well as third cervical vertebra, and is inserted into the atloidean transverse process.

In Cuvier's 'Planches de Myologie' the apparent representative of this muscle in *Phoca vitulina* (pls. 172 & 173. fig. 2, *o*) is termed the "long antérieur du cou (prédorso-atloïdien)," or, as I infer, is taken for an anterior portion of the longus colli. In the two first-mentioned genera the longus colli was quite distinct from the belly in question.

The trachelo-mastoid is an extensive muscle, which seems in the Walrus to correspond with the same fleshy structure in Man, only of course vastly more developed. It arises from the zygapophyses of the anterior five dorsal vertebræ, and from the analogous processes of the whole of the cervical vertebræ. Posteriorly the muscle is divided more or less into slips; but anteriorly it becomes thicker, and finally is inserted, by a strong tendon, into the inferior outer side of the paramastoid process.

Besides fleshy slips sent to the sixth, fifth, fourth, and third cervical vertebræ, the longissimus dorsi in *Trichechus* has extra slips to the seventh and the second cervicals.

In the Morse the spinalis dorsi goes to the spine of the sixth cervical vertebra, whereas in the Sea-lion it reaches no further than the first dorsal spine.

Splenii.—These, comparatively, are not nearly so large as in the Eared Seal. What answers to the splenius capitis is thin but broad; it arises backwards about as far as the fourth or fifth dorsal spine, and, becoming slightly thicker in the neck, is inserted into the occipital region. The representative of the splenius colli seems to be only a thin narrow slip, coming from the fifth and sixth dorsal spines, and inserted, to the outer side of the occipital region, towards the paramastoid.

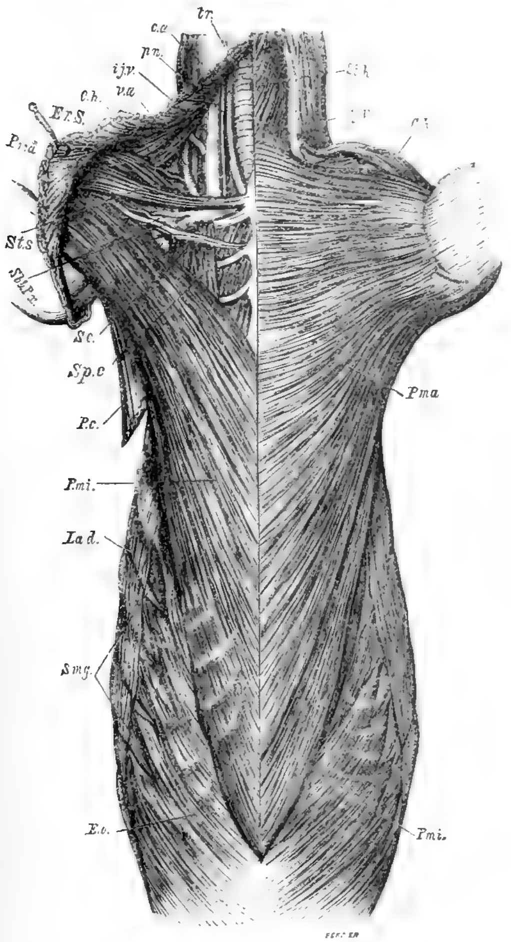
What I take as the homologues of the complexus and biventer cervicis differ somewhat from what obtains in *Otaria*. The complexus appears to arise from the zygapophysis of the fifth anterior dorsal vertebra, and, as it proceeds to be inserted into the spine of the occiput, is joined by the next-mentioned muscle. What answers to the biventer cervicis is a longer, narrower, and thicker slip arising from the zygapophysis of the seventh dorsal.

Rhomboidei.—Precise limiting divisions between the rhomboideus capitis, rhomboideus major, and rhomboideus minor are with difficulty made out in *Trichechus*, as, to a certain extent, is the case in *Otaria jubata*.

If, however, in the former animal the posterior portion be taken as the rhomboideus minor, then it agrees with the description of this muscle in the latter animal. It does not, however, pass backwards beyond the vertebral border of the scapula, but dips into the upper portion of the fold formed by the serratus magnus.

What has been homologized by me as the rhomboideus capitis in the Sea-lion is also in the Walrus large, but it presents the following differences:—Its fibres do not reach beyond the posterior half of the vertebral border of the scapula, and it is inserted into the innermost (uppermost) half of the scapular spine.

Fig. 2.



Dissection to show the Muscles of the Chest and the Vessels &c. of the Axillary and Sterno-cervical Region.

*Pma, Pma**. Pectoralis major, entire on left side, and humeral portion reflected on right. *Pmi.* Pectoralis minor. *P.c.* Portion of panniculus carnosus, divided near the axilla. *La.d.* Latissimus dorsi. *E.o.* Part of external oblique, exposing digitations with *S.mg.* serratus magnus. *Sp.c.* Supracostal. *Sc.* Scalenus. *St.s.* Sterno-scapular. *Ep.S.* Epi-subscapularis. *C.h.* Cephalo-humeral. *St.h.* Sterno-hyoid and thyroid.

e.j.v. External jugular vein. *tr.* Trachea. *c.a.* Carotid artery. *pn.* Pneumogastric nerve. *i.j.v.* Internal jugular vein. *v.a.* Vertebral artery. *Sb. & P.x.* Subclavian vessels and brachial plexus.

An anterior strip of this rhomboideus capitis, but on its outer side, and from 1 to $1\frac{1}{2}$ inch broad, is somewhat distinct or has a furrow or cellular interspace of separation from the apparent main muscle. Its scapular attachment is the third fourth of the spine, reckoning from the vertebral border; and the slip runs on to the occiput in union with its neighbouring broader portion.

Superficial Layers, Throat-, and Thoracic Muscles.

As regards the cephalo-humeral (woodcuts 2, 3, & 4, *C.h.*), it is very large, and reaches but does not overlap the trapezius. Its insertion is into the head of the humerus. A somewhat triangular pencil of fleshy fibres is continued as far as the middle of the humerus, near the deltoid ridge. This part may, indeed, represent a portion of the compound deltoid found in some animals.

The sterno-mastoid in the Walrus has no semidivision as in the Sea-lion, but is clearly a single muscle and of moderate breadth. It arises sternally, as in the latter, but is inserted by a roundish tendon into the paramastoid in front of the levator claviculæ. Between the attachment to the head of the sterno-mastoid and the anterior lower border of the cephalo-humeral, a portion of the omohyoid is seen to cross the neck.

There is a long and ribbon-shaped muscle in close relation with the cephalo-humeral, which latter covers it until within a few inches of its insertion. With an origin from the paramastoid posteriorly, the muscle in question is inserted into a minute fibrous transverse band, which here represents a rudimentary fibrous clavicle, inasmuch as it lies opposite the shoulder-joint.

Another distinct and separate, but also longitudinal, muscle arises by a tendon from the atlas, and proceeds to the spine of the scapula near the acromion process.

The former of these two muscles just described may be regarded as the homologue of a cleido-mastoid, and the latter, although fixed to the scapula, be the representative of the so-called levator claviculæ. Besides the last mentioned, a true levator anguli scapulæ is found, similar to what obtains in *O. jubata*.

The trapezius is double (woodcut, fig. 3, Tz^1 & Tz^2). The posterior portion corresponds with the condition found in *Otaria jubata*; but the anterior differs in its running quite over the shoulder-joint, and being inserted by aponeurotic fascia into the neck of the humerus and deltoid ridge; as it glides over the shoulder it covers the small second division of the deltoid. Prof. Humphry's remark[1], that the trapezius and deltoid in the common Seal may be regarded as one muscle, is in some senses not inapplicable in the case of the Walrus.

As is the rule in Carnivora, the insertion of the latissimus dorsi, or that portion of it designated humero-dorsalis by Prof. Haughton[2], is, with the panniculus carnosus and deep layer of the pectoralis, into the humerus. Its costal origin, as in the Otary, is from the hindmost seven ribs; and it interdigitates with six slips of the rectus abdominis. The second portion of the grand dorsal (lombo-humérien), described by Duvernoy[3], Humphry[4], and Haughton[5] in *Phoca*, and termed scapulo-costalis by the latter, is not so clearly separated in *Trichechus*.

There is a serratus posticus anterior which is comparatively well developed, broad

[1] Paper cited, p. 298.

[2] "Notes on Animal Mechanics—Muscular Anat. of Seal," R. I. Acad. 23 May, 1864.

[3] Mém. du Mus. d'Hist. Nat. t. 9. 1822, p. 60. [4] *Loc. cit.* p. 297. [5] *Loc. cit.* p. 39.

though thin. This arises by a fascia with a few muscular fibres interspersed from about opposite the fourth to the eighth dorsal vertebra, and, forming five broad but tolerably distinct slips, is inserted into the fifth, sixth, seventh, eighth, and ninth ribs, between the tendons of the sacro-lumbalis and those of the external oblique.

The serratus magnus sends digitations to eight ribs. The highest, as in *Otaria*, is more or less separate, and is inserted into the dorsum of the scapula between the angle and spine on the vertebral border.

In *Trichechus* the scalenus anticus springs from the transverse process of the atlas, and is inserted by one slip into the third rib, and by another into the fourth rib; the latter partly covers the cartilage.

The supracostal muscle (woodcut, fig. 2, *Sp.c*) nearly agrees with the position it has in the Eared Seal. It extends rather further outwards, however; and the fibres spring from the intercostal interspace and second rib, and reach backwards to the fourth costal cartilage.

The levatores costarum are only fourteen in number—namely, one less than in the Sea-lion.

Besides having muscular slips from the third to the seventh ribs, as obtains in *O. jubata*, two extra portions of the triangularis sterni proceed to the eighth and ninth rib-cartilages in the Morse.

Muscles of the Pectoral Limb.

Between the Walrus and the Sea-lion there is a marked distinction as regards the pectorales. Both animals, as likewise the Earless Seals, have a somewhat similar elongated powerful expanse of fleshy fibres attached to the thorax; and all have the superficial layer of muscle inserted low on the arm; but the boundaries of the muscular areas and separation into layers do not agree.

In *Trichechus* a thick fleshy pectoralis major is well defined (see woodcut, fig. 2, *Pma*). The basal origin (for it is of an unequal-sided triangular contour) extends 3 inches anterior to the manubrium, and reaches backwards to the posterior border of the ensiform cartilage or xipho-sternum. The muscular fibres converge towards the axillary region and the elbow, and at the latter point terminate in a transversely arched manner in a thick aponeurotic sheet, which is carried on and is continuous with the superficial fascia of the forearm.

A second, deeper layer to the above, or pectoralis minor (*Pmi*), meets its fellow of the opposide side in the middle ventral line, and there extends from the fourth rib-cartilage to about six inches behind the ensiform cartilage. Its border overlies the costal digitations of the external oblique muscle; and it is itself hidden by the previously described pectoralis major, excepting a narrow strip of its outer edge. There are no directly transverse fibres as in the upper pectoral, but all assume a forwardly oblique direction as they pass to be inserted into the whole length of the shaft of the humerus. This powerful retractor of the limb is evidently that which Meckel[1] doubtfully regards as a pectoralis minor. Cuvier considers the pectoralis minor to be absent in Carnivora; but in his and Laurillard's 'Planches de Myologie' the following divisions of the pectorales are designated and lettered[2]:—*j*, grand pectoral, portion sternale (sterno-humérien); j^1, portion costale et même ventrale; j^2, portion profonde dite moyen ou petit pectoral. In their illustrations of *Ursus americanus* and *Canis familiaris*, subdivisions of the two latter are specially marked, as well as another presently to be described. The said segmentation of the pectoralis doubtless corresponds to the variations and abnormalities found in Man by numerous anatomists; more particularly, however, of late have they been referred to by Messrs. Wood[3] and Macalister.

A third, very much smaller, narrow thoracic strip of muscle, which may be mentioned in connexion with the pectoralis, is one which is found in the Otary, Seal, and other animals, as well as the Morse. It has origin from the manubrium or præsternum, and, passing band-like at nearly right angles outwards to the humerus, is fixed in front and to the outer ridge of the bicipital groove.

To interpret the homology of this muscle, I may at once refer to the very ably reasoned paper of Professor Rolleston in the 'Linnean Transactions,' 1868[4], and to the various memoirs therein quoted. According to his reading I presume it would represent a *subclavius*, otherwise absent in the Morse. That it is the homologue of the so-called sterno-scapular muscle present in several Ungulata, Rodentia, and Carnivora there is less room for doubt, though having a humeral insertion, which is not uncommon. Whilst I agree with Rolleston as to the close and often obvious connexion of the pectoralis major and minor (in this respect opposed to Pagenstecher's views[5]), and also that the pectoralis secundus or levator humeri of birds is not an altered or derivative pectoralis minor, I am not so clearly convinced of the identity of the sterno-scapular and subclavius muscles. Unless these two are perfectly identical, it is probable that the epicoraco-humeral of Mivart[6] may be the homologue of the former of these two, and not necessarily the latter. With these remarks, it is not my intention at present further to discuss the moot points so ably sustained in the Oxford professor's paper.

What I have described in *Otaria jubata* as the first part of the deltoid muscle is identical in *Trichechus rosmarus* (woodcut, fig. 3, D^1); but there is no slip joining the supinator longus; these two muscles, however, are united very closely by fascia on the

[1] Anat. Comp. vol. vi. p. 251.

[2] *Vide* Liste des Muscles.

[3] In his papers, Proc. Roy. Soc. 1865–68.

[4] On the "Homologies of certain Muscles connected with the Shoulder-joint," vol. xxvi. pt. 3. p. 609.

[5] For which consult 'Der Zoologische Garten,' 1867, and Rolleston, *l. s. c.*

[6] "On some points in the Anatomy of *Echidna hystrix*," Trans. Linn. Soc. vol. xxv. p. 383; and P. Z. S. 1867, p. 778, "Myology of *Iguana tuberculata*."

deltoid ridge. The second portion of the deltoid, barely separated by a line of demarcation from the first, is otherwise exactly the counterpart of that of the Sea-lion.

Dorso-epitrochlear (woodcuts, figs. 3 & 4, *D.ep*).—This muscle (apparently the M. tricipiti-accessorius of Professor Haughton in the common Seal[1]) is in the Morse almost entirely separate, and does not overlap the first head of the triceps as in the Otary. It arises from the scapula, between the infraspinatus and teres major, at the inferior posterior border of the bone, and passes down, only as a moderately broadish fleshy band, on the surface of the scapular division of the triceps towards the olecranon process; but it is attached to that bone by fascia alone; for its muscular fibres are continued on to the posterior border of the forearm as far as its middle, where they are fixed to the antibrachial superficial fascia over the muscle.

The triceps (woodcuts, figs. 3 & 4, T^1, T^2, T^3) is almost identical with that of *O. jubata*, the scapular head, however, as above mentioned, being outwardly less covered by the dorso-epitrochlear.

In the Walrus, as in the Sea-lion, there are well-developed anconeus externus (woodcut, fig. 3, *A.e*) and anconeus internus (woodcut, fig. 4, *A.i*) muscles present. The latter is occasionally found as an abnormality in Man. Mr. Wood, in his interesting "Variations in Human Myology"[2], names it "anconeus epitrochlearis;" but it had already been recognized in Cuvier and Laurillard's 'Recueil' as "anconé interne, u^1 (épicondylo-cubitien)."

The infraspinatus overlaps its bony fossa (woodcut, fig. 3, *Isp*). The supraspinatus (woodcut, fig. 4, *Ssp*) has a single insertion.

I have described in the Otary a superficial semidifferentiated portion of the subscapularis in close conjunction with the supraspinatus as traversing obliquely the former muscle, and quite covering its insertion; it is itself fixed into the capsular ligament and inner humeral tuberosity. This, for distinction's sake, I have termed epi-subscapularis. In the Walrus there is a similar superincumbent layer of the subscapularis present (see woodcut, fig. 4, *Ep.s*); the fibres of which, however, are not so curvilinear as in the Otary, rather running parallel with those of the deeper subscapularis, but inserted quite into the top of the ulnar tuberosity.

The humeral insertion of the teres major (woodcut, fig. 4, *T.ma*) is to the inner side of that of the latissimus dorsi.

If present, the teres minor is rather indistinct.

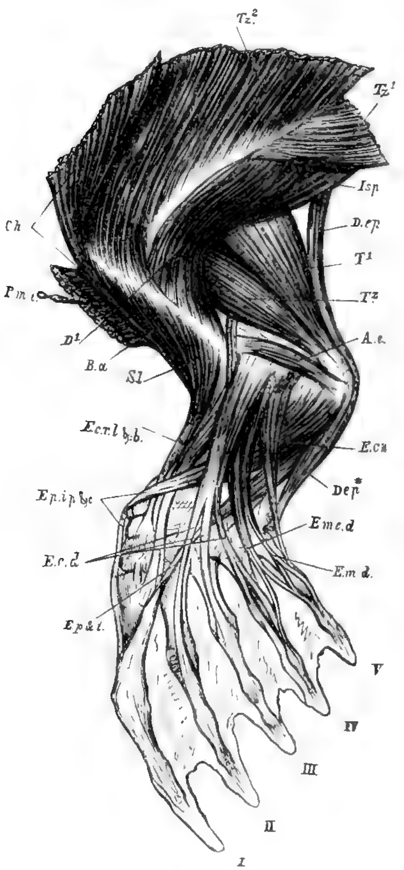
The Walrus differs from the Eared Seal (*O. jubata*) in the possession of a coraco-brachialis, which in the latter is absent, or its place supplied by a slight extension of a portion of the extra supraspinatus. This coraco-brachialis (woodcut, fig. 4, *C.b*) arises by a long narrow tendon from the glenoid capsule, and, forming in the length of the humeral shaft a weak belly, is continued by muscular fibre as far as the distal end of the internal lateral ligament of the elbow. The musculo-spiral nerve pierces the few fleshy fibres present.

[1] *Loc. cit.* p. 40.
[2] Proc. Roy. Soc. 1867, vol. xv. p. 522.

The single-bellied biceps (woodcut, fig. 4, *B*) is remarkably weak.

Of the brachialis anticus it cannot be said to be a double-bellied muscle (woodcut, fig. 4, *B.a*), though its heads, two in number, embrace the humerus on either side of the prominent deltoid eminence. The innermost portion runs up quite to the root of the radial tuberosity, whereas the outer origin arises closely approximated with and deeper than the supinator longus.

Fig. 3.



Superficial view, dorsal aspect, of left pectoral limb.

C.h. Cephalo-humeral. *Tz*¹. First portion of trapezius, its insertion. *Tz*². Second portion of trapezius. *D*¹. Deltoid, main or first portion. *Isp.* Infraspinatus. *D.ep*, *Dep**. Dorso-epitrochlear. *T*¹, *T*². Triceps, first and second bellies. *A.e.* Anconeus externus. *P.mi.* Pectoralis minor, its insertion turned forwards. *B.a.* Brachialis anticus. *S.l.* Supinator longus. *E.c.r.l. & b.* Extensor carpi radialis longior and brevior. *E.p.i.p. &c.* Extensor primi internodii pollicis. *E.c.d.* Extensor communis digitorum. *E.me.d.* Extensor medii digiti. *E.m.d.* Extensor minimi digiti. *E.c.u.* Extensor carpi ulnaris. *E. p & i.* Extensor pollicis et indicis. *I–V.* Digits.

The supinator longus (woodcut, fig. 3, *S.l*), single and laterally compressed, arises from the lower part of the deltoid ridge and the shaft of the humerus below it. Its tendon of insertion is long, but not very broad, and proceeds to the styloid process.

Arising from the outer condyle and without the tendency to a double head of origin exhibited in the Sea-lion, the supinator brevis in the Sea-horse, with a thickish fleshy belly, is inserted on the outer edge of the shaft of the radius, as far as the prominence at the lower end of the shaft.

There is such union between the extensor carpi radialis longior and extensor carpi radialis brevior (woodcut, fig. 3) that what appears but a single muscle represents them both. At the proximal ends of the pollicial and indicial metacarpals an aponeurotic or strong firm tendinous expansion terminates the single tendon of the muscular belly; and this is attached equally to both the above bones.

I have remarked, in the myology of *Otaria jubata*, that there are a double set of extensor muscles of the antibrachium arising from the outer condyle. This is the case in *Trichechus rosmarus*; but that portion of the group to which I have applied the designation of extensor communis digitorum in the former animal, has in the latter the tendons inserted into the proximal ends of the first phalanx, though continued further in a sheath of fascia. The great fibrous interlacement notable in the Sea-lion is not so strong and distinct in the Walrus; the latter consequently has greater flexibility at the wrist. After all, this pliability of the manus may be as much dependent on the young condition of the specimen as on the junction or segregation of the tendons, the less-ossified state of the bones and rigidity of the interarticular cartilages being in favour of such a view.

What represents the extensor communis digitorum (woodcut, fig. 3, *E.c.d*) has a flat, broad, thin belly, which at the distal end of the radial shaft splits into three tendons destined for the second, third, and fourth digits, these being inserted respectively into the distal end of the first phalanx. That to the fourth splits at the wrist; but the separate tendon again joins its fellow at the middle of the first phalanx. The said tendons in the Walrus are altogether smaller than in the Eared Seal. In *Phoca* the the common extensor splits into four digital tendons—an arrangement agreeing with that in most Carnivores.

The second belly, coequivalent with the extensor medii digiti of Wood[1] (*E.me.d*), is likewise a thin, broad, and flat muscle. It is very closely adherent to the above; but intermuscular fascia separates them, and about the middle of the radius this uncommon strong fascia, gaining strength and the appearance of a tendon, is fixed into the ulnar margin of the bottom of the shaft of that bone. The fleshy portion of the extensor medii digiti leaves that of the extensor minimi digiti near the wrist-joint, where it passes through a separate cross loop of binding fascia, and sends onwards a single tendon to the interspace between the fourth and fifth digits, where it splits into four or five short tendons.

In the common Seal, as Duvernoy[2] has noted, the index receives a tendon as well as the median digit; and to the muscle in question he applies the term "extenseur propre de l'index." In the Otary and Morse, however, there is no special indicator[3], the said medii digiti in the former supplying the third and fifth digits with well-developed

[1] Myological papers, Proc. Roy. Soc. 1866 *et seq.*

[2] Mém. du Muséum, t. ix. p. 68.

[3] What Sir Everard Home (Philos. Trans. 1824, p. 239) denotes as an "indicator muscle," I presume is the "long extenseur du pouce" of Duvernoy, and what I allude to as the "extensor pollicis et indicis" of Wood.

tendons. The arrangement of these latter, therefore, is in accordance with what obtains in *Ursus americanus* as depicted in the 'Recueil' of Cuvier and Laurillard. Whether entire suppression of the extensor indicis proprius has taken place in the two last mentioned Pinnipeds, or the so-called extensor medii digiti is but a differently inserted condition of its tendon, I will not pretend to say.

The extensor minimi digiti (*E.m.d*), like the last, is single as far as the wrist, where its tendon splits into two, which lie alongside each other, but on opposite sides of the fifth metacarpal.

That which gives such great power to certain movements of the manus in *Otaria* (to wit, the extraordinarily developed tendon of the extensor pollicis et indicis, Wood)[1] is much less remarkable as regards strength and breadth in *Trichechus* (woodcut, fig. 3, *E.p & i*). In the latter animal it is also observed to divide, or rather present dense tendinous fasciæ running to the outer side of the distal end of the pollicial or first metacarpal bone. Whilst the Seals have nearly the same disposition of pollicial muscle, it is slenderer as to tendon and belly than either of the above. Although the pollex alone receives a tendon in the Pinnigrades, and "long extenseur du pouce" of Duvernoy may be a correct term, yet Wood's name, here used, is expressive, inasmuch as it points to the division of tendon evidently of the similar muscle met with in the Black Bear, Coati, Lion, &c., and to its still greater differentiation or doubling of belly in the Panther and other forms.

The fore limb of *Trichechus* diverges from that of *Otaria* and *Phoca* in possessing representatives of the extensor ossis metacarpi pollicis, extensor primi internodii pollicis, and extensor secundi internodii pollicis, the last forms having only one distinct muscular belly and a single tendon. In the first-mentioned animal a cursory examination leads to the supposition that the extensor ossis metacarpi pollicis alone is present; but dissection proves the contrary. The muscles in question are best traced from the tendons upwards. The three together are inserted in an aponeurotic sheath at the root or proximal end of the pollicial metacarpal. One slightly overlaps the other, the extensor ossis metacarpi pollicis being superficial and outermost. The middle tendon, or that of the extensor primi internodii pollicis, is the smallest; whilst the deepest and innermost tendon is that equivalent to the extensor secundi internodii pollicis. (See woodcut, fig. 3, *E.p.i.p. &c.*)

Over the dorsal surface of the lower portion of the radial shaft their muscular bellies commence, and with considerable union may be traced upwards, becoming broader and, indeed, as a whole, triangular.

The extensor ossis metacarpi pollicis is attached chiefly to the back of the radius and interosseal membrane, though it is also fixed to the outer condyle; its innermost portion is the longest.

The small tendon of the extensor primi internodii pollicis, on altering upwards to a

[1] *Loc. cit.* 1867, vol. xv. p. 533.

muscular belly, runs into that of the extensor ossis metacarpi pollicis, and cannot well be divided from it. The extensor secundi internodii pollicis goes chiefly to the entire shaft of the radius and interrosseous membrane and olecranon process.

Having in *Otaria* fully described the broad and multiple long superficial palmar muscles, and the unusual strong sheet of tendon forming the palmar fascia and oblique ligamentous band acting upon the pollex, I need here only add that *Trichechus* has nearly a similar distribution of muscular and tendinous structures. In our young specimen of the latter the following differences were noted:—The tendon inserted on the deep surface of the palmar fascia of the palmaris longus primus was not so distinct. The special broad aponeurotic slip (palmaris longus secundus) to the distal end of the fifth metacarpal was not nearly so strong and ligamentous. Lastly, the fleshy belly of the palmaris longus tertius was relatively much weaker, but also fused with the flexor carpi ulnaris; and the oblique palmar tendon and aponeurosis was decidedly thinner than in the Eared Seal.

Another very characteristic differentiating feature in the manus of the Morse from that of the Sea-lion is the development of a flexor brevis manus (woodcut 4, *F.b.m*). This muscle is composed, at its origin on the deep surface of the palmar fascia, of a single narrow fleshy band, which at the proximal ends of the middle metacarpals divides into three small fusiform bellies, which end in delicate tendons. Each of these tendons, at the distal ends of the second, third, and fourth metacarpals, joins the perforated tendon and is lost therein. It was noticed particularly of that to the second that it split and allowed the perforans to pass through. Such may have been the case with the other two; but this was not observed.

Neither the fleshy origin nor insertion of the flexor carpi ulnaris (woodcut 4, *F.c.u*) is with certainty divisible from the so-called third or ulnar palmaris longus, the only distinguishable portion being the broad tendon fixed to the pisiform bone; but even this has aponeurotic connexion with the oblique palmar fascia.

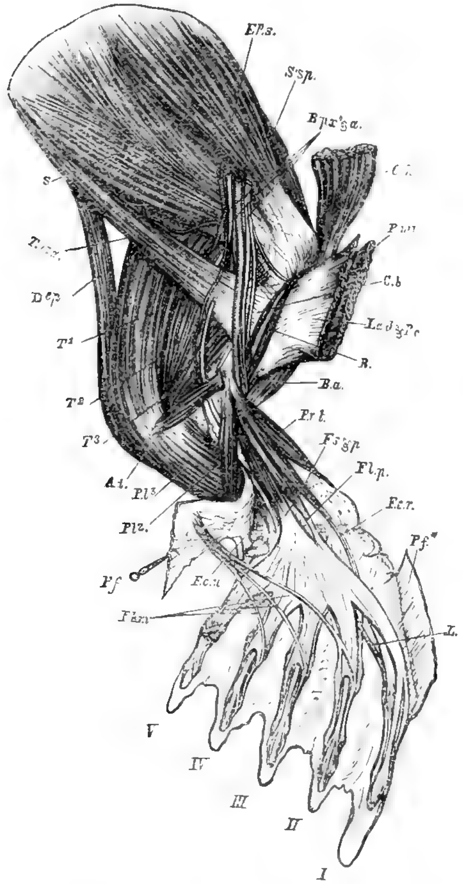
In *O. jubata* there is no pronator quadratus; but in the Walrus it is undoubtedly met with and fairly developed (woodcut 5, *P.q*). It exists as a thin fan-shaped sheet of muscular substance with a superficial intermixture of tendon. The ulnar attachment, nearly $1\frac{1}{2}$ inch broad, is quite at the distal end of that bone, and partly on the interosseous ligament. Set obliquely upwards and outwards, it is inserted into the shaft of the radius above its lower expansion, where it is less than an inch broad.

The muscles representing the sublimis, profundus, and flexor longus pollicis in the Morse have a partially different tendinous distribution from those of the Sea-lion.

What may either represent the flexor sublimis digitorum, or, conjoined with it, the flexor profundus digitorum, is a double-bellied muscle. One head, as in *Otaria*, arises from the internal condyle and capsular ligament, the other from the inner surface of the ulna below the olecranon; and these two elongated flattish bellies run separate to the wrist-joint, each being tendinous, however, an inch above that.

Where the two tendons join (woodcut 4, *F.s&p*) they spread out and, closely intermingled with each other, form a wide triangular aponeurotic tegumentous expanse, which receives in addition, on its radial side, the tendon of the flexor longus pollicis. This last muscle has an elongated moderate-sized belly, and arises from the shaft of the radius immediately below its bicipital tubercle.

Fig. 4.



Inner aspect of the left fore limb, the superficial palmar fascia being raised and thrown outwards.

S. Subscapularis. *Ep.s.* Epi-subscapularis. *S.sp.* Portion of supraspinatus. *T.ma.* Teres major. *C.h.* Cephalo-humeral, cut through near insertion. *La.d&P.c.* Combined insertion of latissimus dorsi and panniculus carnosus. *P.mi.* A similar segment of pectoralis minor, like last, dragged out. *B.* Biceps. *C.b.* Coraco-brachialis. *B.a.* Brachialis anticus. *D.ep.* Dorso-epitrochlear. T^1, T^2, T^3. Triceps, three bellies. *A.i.* Anconeus internus. $P.l^2$ & $P.l^3$. Palmaris longus secundus and tertius; the palmar fascia (*Pf,Pf**) is retroverted on both sides of manus. *P.r.t.* Pronator radii teres. *F.c.r.* Flexor carpi radialis. *F.c.u.* Flexor carpi ulnaris. *F.s&p.* Flexor sublimis digitorum and Flexor profundus digitorum. *F.l.p.* Flexor longus pollicis. *F.b.m.* Flexor brevis manus. *L.* Lumbricalis.

I.–V. Digits. *B.px & a.* Brachial plexus and arteries.

From the palmar fascia above spoken of, five large tendons are given off, one to each digit. At the distal ends of the metacarpals the tendons alter in character, splitting into two layers, the lowermost of which forms a kind of sheath for the uppermost, or, in other words, represents a perforatus and perforans.

The perforated tendons go to the proximal ends of the second phalanges; the perforating, on the other hand, proceed further, and are inserted quite into the digital cartilages. But, besides their mesial tendon, each perforating tendon of the second, third, fourth, and fifth digits has, about the middle of the second phalanx, three other short tendons divaricating from it, one to either side and one immediately beneath the said mesial tendon; two of these proceed obliquely outwards and are inserted into the proximal end of the last phalanx, where they are continuous with the lateral binding fascia of the digit; the third terminates about the middle of the bone of the last phalanx.

The tendon derived from the palmar expanse of fascia which goes to the pollex slightly differs from the preceding in terminally not splitting into four, but continues singly to the root of the digital cartilage.

There is no trace whatsoever of the flexor brevis minimi digiti so well developed in the *Otaria jubata*, *Phoca fœtida*, and *P. vitulina*.

On the contrary the Walrus has a pollicial muscle, wanting in the Sea-lion. This appears to be the homologue of the opponens pollicis (woodcut 5, *op.p*). It has origin at the proximal end of the first metacarpal, and lies along the whole radial side of this bone. The fleshy portion, very moderate in quantity, stops short about the middle of the bone; but tendon is carried on and is lost in the binding fascia.

It may be remarked, as probably more influencing the flat plantigrade character and stiff unyielding nature of the manus of the *Otaria*, in contradistinction to the more flexible paw of the *Trichechus*, that in the latter the deep palmar fascia is by no means so large and strong as in the former animal.

The portion superficial to the interossei, and extending lengthwise to the distal ends of the first and second metacarpals, which I have designated in the Sea-lion as the first part, and which gives rigidity to the great pollex, is wanting in the Walrus, or at least only represented by thin membrane, and thus permits much more grasping-power in the latter animal. The second portion is equally thin and non-ligamentous.

Sir Everard Home[1] says there are no lumbrical muscles in the Walrus, though the interossei are, as he acknowledges, well developed; but my dissection revealed a single and very delicate lumbricalis in the fore paw (woodcut 4, *L.*). On cursory inspection this was taken for a division of the flexor brevis manus; but it was found not at all to come from the upper surface of the palmar flexor fascia, but from its lower surface, quite apart from the other. This representative of the lumbricales had origin on the pollicial side of the common fascia, and beneath the tendinous part going to the index; from this by a very small fleshy belly it passed obliquely outwards, and with a long and very fine tendon was inserted into the binding fascia of the pollex at the inner distal end of the metacarpal, and partially in conjunction with the interosseous tendon.

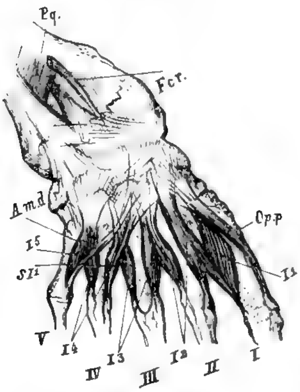
Another curious feature was the possession of a small palmaris brevis muscle. This was only of moderate thickness; and its flesh had a breadth of half an inch, and a length more than double that. From its attachment, on the outside of the bone of the fifth digit, it as usual stretched palmar-wise on the surface of the superficial fascia.

Interossei (woodcut 5).—It may be better to describe these separately, as they

[1] Phil. Trans. 1824, p. 239.

disagree with the condition extant in the Sea-lion. A superficial and a deep layer are not so well defined in the Walrus. There is a single interosseous belly to the fifth digit on its radial side, and also a single larger muscle to the first digit on its ulnar side; the second, third, and fourth digits have each moderately developed double interossei.

Fig. 5.



Interossei of manus, with portion of antibrachial bones, to display the pronator quadratus muscle.

P.q. Pronator quadratus. *F.c.r.* Tendon of the flexor carpi radialis. *A.m.d.* Abductor minimi digiti. *Op.p.* Opponens pollicis. I^1, I^2, I^3, I^4, I^5. The double or deep interossei. Si^1. Superior interosseous muscle. *I, II, III, IV, V.* Applicable to the respective shortened digits.

The representatives of a superficial layer are two in number, one of which, however, may, indeed, be the representative of the abductor minimi digiti. This latter, long and thin, arises on the surface of the deep palmar fascia and ligamentous interosseous union at the base of the third phalanx. Crossing obliquely outwards, its insertion, chiefly fleshy, is into the binding fascia on the radial side of the distal end of the fifth metacarpal in common with the single interosseous muscle. The second of the superficial layers has a position identical with the last, but slightly to its radial side, and it is inserted into the fourth digit.

Muscles of the Abdomen, Loins, and Tail.

In the Walrus the digitations of the external oblique are carried forward to the fourth rib, and four slips of the serratus magnus interdigitate with it, besides six or seven of the latissimus dorsi behind that.

The diaphragm is very strong and almost entirely muscular. The central tendon differs somewhat in shape from that in *Otaria*, inasmuch as the median portion is broader and rounder. The diaphragm has an attachment to the ensiform or xipho-cartilage, and laterally extends to the tenth and ninth sternal ribs or rib-cartilages; thence it passes backwards to the remainder of the ribs, inclining inwards to the tip of the transverse process of the first lumbar vertebra (where it is fleshy), and with fibrous tissue fixes itself to the bodies of the second and third lumbar vertebræ. It likewise sends a small tendon which is inserted into the body of the fourth lumbar vertebra.

Psoas muscles.—There appears to be a partial division between the psoas parvus and psoas magnus, although upon the whole these two muscles are closely united; at their insertion there can only be said to be a single tendon. The portion corresponding to the psoas parvus is decidedly weaker relatively than in the Eared Seal. The other part, or psoas magnus, is thin, and has origin by two narrow tendons,—the first of these from the last rib, just outside the quadratus lumborum; the second from the body of the second lumbar vertebra, close to where the tendon of the psoas parvus arises: there is also a muscular origin from the bodies of the fourth and fifth lumbar vertebræ. The united psoas magnus and psoas parvus is rather longer in *Otaria*, and is attached to the ilio-pectineal eminence.

A slightly different arrangement of the muscular bundles of the quadratus lumborum prevails. The most anterior slips have origin from the last dorsal vertebra. The double slip in question comes partly from the ventral and partly from the lateral superficies, the outer portion covering the head of the rib; the inner portion passes down to the tip of the transverse process of the second lumbar vertebra. Behind this there come, in a V-shaped manner, three muscular slips which unite and send on a tendon which is inserted into the tip of the transverse process of the third lumbar vertebra. The outermost of these three slips, fleshy, comes from the last rib and outside muscle already described. The second and third slips come close together from the body and side of the second lumbar vertebra. In a similar manner there is an outer slip from the transverse process of the second lumbar, and an inner fleshy head from the body of the third lumbar vertebra, uniting into a single tendon which is inserted into the transverse process of the fourth lumbar vertebra.

According to Duvernoy's[1] interpretation of the functions performed by the inferior loin-muscles in *Phoca vitulina*, it is to the psoas chiefly that the peculiar belly-progression on land is due. There can be no doubt that the pelvic insertion of the combined psoas must have considerable influence; but while inclined to agree with him, I even lay more stress on the power exercised by the panniculus (his sacro-humérien) and belly-muscles generally on the movements in question. He states that the iliacus is absent[2]; but the result of my examinations of species of *Phoca* coincides with Meckel's[3] and Humphry's[4]—namely, the presence of a diminutive representative of the muscle, such, indeed, as has been figured by Cuvier and Laurillard ('Myologie,' pls. 169, 170. fig. 3, *i*). A semidivided fair-sized iliacus is decidedly met with in the Morse and Otary.

So far as my dissection of the parts enabled me to judge, the caudal muscles differed little from the condition existent in the Otary. The levator caudæ externus and internus had each a long narrow fusiform belly and a short strongish flattened tendon. The pubo- and ilio-coccygeus were but moderately fleshy, as likewise was the ischio-coccygeus, the tendons of the latter being much interwoven and strongly bound down by aponeurotic fascia.

[1] "Sur les Organes du Mouvement," *l. c.* p. 185.
[2] *L. c.* p. 170.
[3] Anat. Comp. vol. vi. p. 371.
[4] Paper quoted, p. 309.

Although the caudo-tibial expansion is very considerable and powerful in *Trichechus*, the muscular fibres of the levator ani are notwithstanding less developed than in *O. jubata*. In the place of muscle there is substituted a larger quantity of ligamentous-like substance or fascia, with, comparatively speaking, few fleshy fibres sparsely intermixed. Moreover the increased development of the aponeurosis continuous with the panniculus carnosus gives the caudo-tibial or astragaloid extension great elasticity and strength, whilst its breadth leaves less of the tail free than is the case in *Phoca* and *Otaria*.

Superficial veins homologous with the saphenous of other mammals lie upon and pierce the membrane above spoken of.

Muscles of the Pelvic Limb.

The gluteal muscles, as in *Otaria*, are relatively small. The gluteus maximus does not show any distinct line of separation into two parts in the Walrus, as to some extent it does in the other genus. It is comparatively larger than in the latter, and, though thinner than the gluteus medius, is the broader of the two and partially overlaps it. Thus its spinal origin by fascia extends for the whole length of the sacrum.

The gluteus medius does not overlap the gluteus maximus at any part, nor does it form to the same extent that encircling sheath to the gluteus minimus which obtains in the Sea-lion; in other respects it agrees with that of the latter animal, excepting no fixed attachment to the inferior border of the ilium. As may be inferred, the gluteus minimus occupies the whole of the outer surface of the ilium.

In the Walrus the biceps femoris presents the same broad, coarse, muscular sacro-tibial sheet met with in the Sea-lion. Its anterior border, however, does not overlap the gluteus maximus; and its first portion or half has origin by fascia, interspersed with muscular fibre, from the fifth or last sacral and the three next caudal spinous processes. The posterior half does not, as in *Otaria*, have origin above the supracaudal muscles, but instead arises from the tips of the transverse processes of the six anterior caudal vertebræ; and a considerable portion of it is overlapped by the first half of the muscle. The femoral and tibial insertion and the relations to other muscles are identical.

The following muscles of the leg offer no differences worthy of mention from those of *Otaria jubata*:—Pectineus, rectus femoris, the vasti and crureus, soleus, tibialis anticus, extensor proprius hallucis, extensor communis digitorum, peronæus longus, peronæus quinti, flexor longus digitorum, and the flexor longus hallucis.

Others show little variation. For example, the gracilis (Pl. LV. fig. 25, *Gr*) has no corner covering the insertion of the external oblique at the symphysis; and its tibial attachment is greater; namely, it extends almost the entire length of the tibia. The double adductors, longus and magnus, as described in *Otaria*, present no clear line of demarcation in the Walrus, but in the latter the femoral vessels and nerves pierce the adductor longus as well as adductor magnus.

The gastrocnemius is relatively narrower in the latter form. The plantaris does not cover so much of the belly of the gastrocnemius, and the two muscles are more nearly equal in volume, in *Trichechus*. The popliteus, with nearly the same attachments in both animals, lies quite at the back of the leg in the Walrus (woodcut 8, *Po*); neither does it touch the head of the tibia or internal lateral ligament, but glides obliquely across the head of the fibula.

The remarkable semimembranosus and semitendinosus (Pl. LV. fig. 25, *S.t*) are each rather relatively broader, and the latter is inserted higher on the tibia.

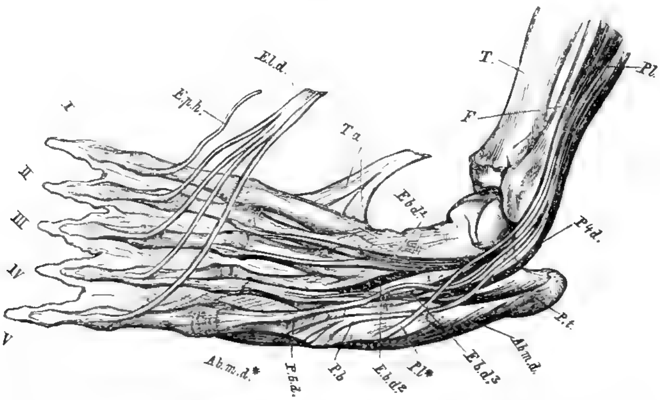
It may be noted of the sartorius (Pl. LV. fig. 25, *Sa*) that in the Walrus it is much broader than in the Eared Seal. With a fleshy origin from the anterior superior spine of the ilium, its fleshy mass expands inwards and covers the entire groin and front of thigh. Muscularly it is inserted into the patella; and fascia, derived outside that, is continued over the inside of the knee-joint. Thus the main difference from what obtains in *Otaria* relates to width, and its covering or overlapping the insertions of the rectus femoris, vasti, pectineus, and adductor muscles. Its inner moiety is much thinner than the outer one.

The extensor brevis digitorum in the Trichechidæ is composed of three flat muscular slips, not, as in the Otariidæ and Phocidæ, of two bellies. (*a*) The first or innermost fleshy portion in the former animals lies about the middle of the dorsum (woodcut 6, *E.b.d*^{1}), and arises in front and to the fibular side of the astragalus. Almost at the head of the third metatarsal it becomes broadly tendinous, and spreads out on both sides of that bone, and is also fixed to the fibular side of the second metatarsal. (*b*) The second or middle portion (woodcut 6, *E.b.d*^{2}) is similarly a flat muscular slip which has origin from the fibrous tissues and interarticular fascia in front of the astragalus, and partly from underneath the belly of the first portion. It joins the muscle next to be described at the head of the fourth metatarsal. (*c*) The third or outer portion (woodcut 6, *E.b.d*^{3}) arises as a fleshy strip from the fibular and astragaloid lateral ligament. Its belly passes straight forwards to the proximal end of the fifth metatarsal, where a few of its fibres are inserted; but its strong flat tendon, joined by that of the second muscle above described, goes along the outer side of the fourth metatarsal, and is finally inserted by a broad tendinous expansion of the head of the proximal phalanx of that digit. This tendon is moreover strengthened by that of the peronæus quartus and peronæus tertius.

The distinction between the peronæus brevis in the Sea-horse and Sea-lion is its manner of insertion. In the former the tendon spreads out and has somewhat double points of fixture into the root and outer side of the fifth metatarsal bone (woodcut 6, *P.b*); in the latter there is less expansion.

In the Walrus we meet with a deviation from the type of Eared and Earless Seals in the decided development of a peronæus quartus muscle; and, moreover, it is probable that the homologue of a peronæus tertius is also present. Both of these muscles, it is true, are small, and the latter abnormal in origin; they nevertheless possess some interest myologically.

Fig. 6.



Left hind foot, with portion of the fibula and tibia, seen dorsally in a three-quarter view from the outside, and dissected to expose the short, and insertion of the long, extensor muscles.

Digits, respectively numbered *I* to *V*. *T.* Tibia. *F.* Fibula. *T.a.* Double insertion of the tibialis anticus. *E.l.d.* Extensor longus digitorum. *E.p.h.* Extensor proprius hallucis. *E.b.d*[1], *E.b.d*[2], *E.b.d*[3]. The three bellies of the extensor brevis digitorum. *P.l,P.l.** Peronæus longus, belly and tendon. *P.b.* Peronæus brevis. *P.t.* Peronæus tertius? *P.4.d.* Peronæus quarti digiti. *P.5.d.* Peronæus quinti digiti. *Ab.m.d*, *Ab.m.d**. Abductor minimi digiti.

Peronæus quarti digiti (woodcut 6, *P.4d*).—Compared with the peronæus longus, peronæus brevis, and peronæus quintus, this has a very diminutive muscular belly. It arises deeper than, and in close conjunction with, the combined belly of the two latter peronæi, at the lower fourth and on the outside of the fibula, and it passes behind the malleolus in company with them. In front of the os calcis it becomes tendinous; and the fine tendon runs inwards and forwards, piercing the fleshy portion of the third belly of the extensor brevis digitorum; mingling with its tendon, both proceed to the outer side of the fourth digit.

Peronæus tertius?—This (woodcut, fig. 6, *P.t*) appears almost as an extra reinforcement or slip, and, indeed, may be part of the compound extensor brevis digitorum; but, notwithstanding its junction thereto, it is in the main quite free; and from its manner of insertion I am inclined to regard it as a displaced peronæus. It is a long fusiform slip, which arises muscularly from the upper and outer posterior end of the os calcis, where it is covered by fascia. It runs beneath, or rather crosses under the peronæi-tendons at the distal end of the calcaneum; and its tendon joins that of the above-described peronæus quartus; finally they both lose themselves in the expanded tendon or fascia at the root of the fourth metatarsal, common to them and the outer portion of the extensor brevis digitorum.

Fig. 7.

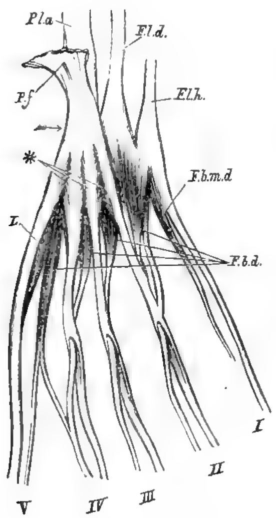


Diagram of the flexor-tendons of the left hind foot.

P.f. A small portion of the superficial plantar fascia left attached to the plantaris (*Pla*), which is carried into the sole of the foot. *F.l.d.* Flexor longus digitorum, tendon near the heel. *F.l.h.* Flexor longus hallucis, as it joins the previous tendinous expansion. *F.b.d.* Flexor brevis digitorum. *L.* Lumbricales to the great and little toe. ⟶. Indicating the position of the uniting tendon, equivalent to an accessorius.

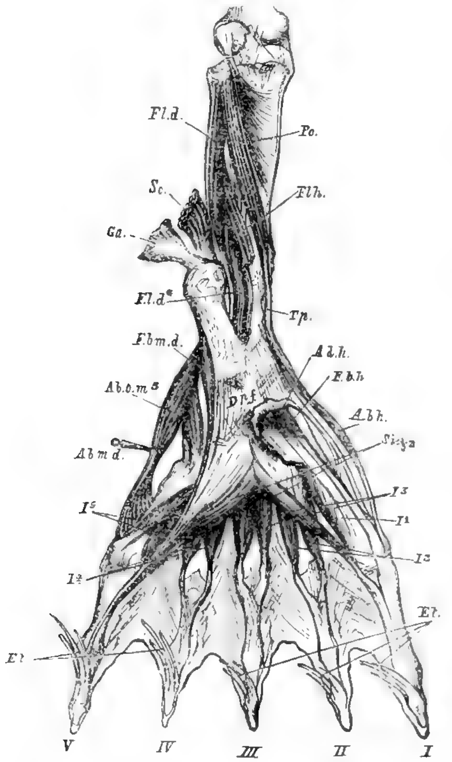
The plantaris on reaching the sole of the foot (woodcut, fig. 7, *Pla*) presents a structural difference from the condition found in *Otaria*. The change consists chiefly in a greater expansion of its plantar fascia and in a less development of fleshy fibres. From the fascia in question four broad and strong tendons are derived, as is the case in the forms compared; but in the Walrus these are inserted into the *distal* ends of the proximal phalanges. Three or four weak muscular slips (*, woodcut, fig. 7) are mingled and considerably interwoven with the ligamentous structure; and as they are attached to its deep surface they consequently are almost entirely hidden, whereas in *Otaria* they show as long and moderately strong fusiform bellies.

There is no accessorius muscle; but a distinct short tendinous slip passes between the outer border and deeper surface of the plantaris and the superficial surface of the flexor longus digitorum. The arrow (⟶) in woodcut, fig. 7, points to its position, otherwise hidden by the plantar fascia.

The flexor brevis digitorum (woodcut, fig. 7, *F.b.d*) agrees with those of the Eared Seal, excepting that the fifth belly sends off a fascia of insertion both to the fourth and fifth digits on their adjoining sides.

Abductor hallucis (woodcut, fig. 8, *Ab.h*).—The presence of a muscle answering to one of these in the foot of the Walrus, manifests a commencing change in the adaptation of the pes as an instrument of clutch as well as of support. The muscle in question has a long narrow belly arising by a tendon from the extra bone outside the cuneiform, and is fleshy three-fourths the length of the hallucial metacarpal, being inserted by tendon and fascia into and over the metacarpo-phalangeal joint. Both in the Sea-lion and Seal, tendinous fascia takes the place of this muscle; but it is noteworthy that in *Ursus americanus* its representative is found.

Fig. 8.



Dissection exhibiting the deep layer of the muscles of the sole of the left hind foot, and partially those of the lower leg.

Po. Popliteus. *F.l.d, F.l.d**. Flexorl ongus digitorum. *F.l.h.* Flexor longus hallucis. *T.p.* Tibialis posticus. *A* and *N.* Arteries and nerves. *So.* Soleus, and *Ga.* Gastrocnemius, cut short. *F.b.m.d.* Flexor brevis minimi digiti. *Ab.m.d.* Abductor minimi digiti. *Ab.o.m*^{5}. Abductor ossis metacarpi quinti. *S.i.*$^{1\,\&\,2}$. Superficial layer of interosseous muscle. 1, 2, 3, 4, 5. Numerically apply to the double (or deep) interossei. *F.b.h* and *Ad.h.* Deep, short metatarsal bellies equivalent to a flexor brevis hallucis and adductor hallucis. *D.p.f.* Deep palmar fascia partially removed to show the short metatarsal slips.

The two short extra and deeply situated muscles met with in the sole of *Otaria jubata* are exactly similar in appearance and situation in *Trichechus rosmarus.* From position and attachments, though covered (and, indeed, entirely hidden) by the deep plantar fascia, they nevertheless may be the homologues of a double adductor hallucis, though it is still more likely that the tibial division is a flexor brevis hallucis, and the fibular one above an adductor (see woodcut, fig. 8, *F.b.h* and *Ad.h*).

The abductor minimi digiti is not unlike that of the Sea-lion; however, in the Walrus (woodcut, fig. 8, *Ab.m.d*) it comes from the outside of the os calcis, and not from the plantar fascia. Its tendon is also longer in the latter, and its muscular belly not so strong.

Flexor brevis minimi digiti.—This exhibits a degree of variation from what obtains in the Eared Seal. In the Morse (woodcut, fig. 8, *F.b.m.d*) it commences by a broad strip of muscular fibre from the outside of the middle of the os calcis, just in front of the abductor minimi digiti. Thence it advances to the root of the fifth metatarsal, where it is tendinous and partially fixed thereon; but the muscle assumes a digastric type, inasmuch as from the above tendon, in reality a median one, a broad portion of flesh goes forwards and outwards, and at last is inserted into the outside of the fifth metacarpal along with the interosseus muscle of the same digit.

There is a short, broad, and fleshy abductor ossis metacarpi quinti present (woodcut, fig. 8, *Ab.o.m*^{5}). It has origin from the plantar surface of the calcaneum immediately beneath the flexor brevis minimi digiti. Its insertion by tendon is into the base of the fifth metacarpal bone. A representative of this muscle is met with in the Otary, though absent in the Seal.

VII. Final Remarks.

In the subdivision of the Pinnipedia the majority of naturalists of recent times are inclined to look upon the Walrus as the sole representative of a family or subfamily of that group, the Trichecina of Turner (P. Z. S. 1848), Trichechidæ of Huxley and others. Previously, in 1821, Dr. Gray used Trichechidæ as a family designation for this aberrant form; but in his late 'Catalogue of Seals and Whales,' 1866, he includes the Grey Seal (*Halichœrus grypus*) and the Morse under the subfamily Trichechina. For the present I shall only say I incline to those who place the Walrus, *per se*, as the type of a family. Howsoever, as this isolation is based chiefly on the characters of the skeleton, which I have not treated of in this communication, I prefer to confine my résumé to such portions of the animal's organization as the foregoing dissection warrants.

I may however, *en passant*, quote Prof. Huxley's[1] lucid definition of the group and genus *Trichechus*:—1, skull narrowing more gradually forwards than in the other groups (Phocidæ and Otariidæ); 2, muzzle truncated; 3, minute supraorbital processes; 4, palate extending back to the pterygoid processes; 5, tympanic even more ragged than in Otaries; 6, toes subequal in length; 7, astragalus normal; 8, two immense canine tusks in the upper jaw; 9, the fifth metacarpal does not articulate with the cuneiform; 10, an alisphenoid; 11, angle of mandible almost obsolete (as in Otariidæ); 12, fifth digit of the foot the largest; 13, scapular spine further from posterior border than in Otariidæ.

Whilst the above, without doubt, represent the most rigid taxonomic characters, yet there are others which may not be without value individually, or in the aggregate when a full review and comparison with other forms is instituted. Dr. Gray wisely uses a few of such external points in his synopsis of the tribes and genera. As an appendix to the preceding, they are:—1, hind limbs more loosely attached than in other Pinnigrades; 2, tail externally deficient from the greater development of the caudo-tibial membrane; 3, a broad supraanal fold; 4, skin deeply and much wrinkled; 5, external

[1] Hunterian Lecture, reported in 'Lancet,' 28th April, 1866, p. 466.

auditory aperture unusually wide and without pinna; 6, eyes small and blood-shot; 7, mystacal bristles large, very numerous (and used as a sieve in feeding); 8, nails of both pes and manus rudimentary and subequal in size; 9, terminal spatulate cartilage of pollex and hallux only moderately developed; 10, proximal ends of soles very rough and warty; 11, tip of tongue not bifid; 12, epiglottis exceedingly small; 13, upper cleft of thyroid cartilage only slightly cleft, pomum Adami salient and high; 14, cricoid cartilage relatively deep; 15, the right common carotid artery springs from the aortic arch; 16, lobes of liver moderately rounded and superficially sculptured; 17, venous capsular sinuses of kidney of medium calibre; 18, meatus urinarius pendulous; 19, presence of muscles in fore and hind limbs wanting in other Pinnipedia hitherto examined; 20, variation in form and development of the brain (not fully worked out).

I am aware such diagnostic items can only be of rough application; but they nevertheless direct attention to the shades of change observable in a group notorious for their similitude in visceral and outward organization.

The characters distinguishing the marine orders Sirenia and Cetacea from the Pinnipedia are numerous and trenchant; and, as several zoologists have shown, these groups bear relations to true terrestrial Mammifers, the Ungulata and Carnivora. With, therefore, it may be granted, a typical stock or basis which they gradate to or from, much interest is attached to the organic modifications whereby the altered conditions of life are sustained. The first mentioned three orders, divergent though they may be in various ways, similarly exhibit physiological changes coordinate with functional activity adapted to a watery element.

Each and all possess equivalent, though diversified, relations towards their terrestrial allies as regards:—1, tegumentary structure; 2, manner of locomotion; 3, circulation; 4, vocal and respiratory apparatus; 5, vision; 6, hearing; 7, smell; 8, taste; 9, alimentary organs; and, lastly, 10, procreation and parts connected therewith.

The palmar and plantar pads and cushions conspicuously developed and defined in digitigrade Carnivores, become less prominent and circumscribed in the plantigrade manus and pes, where, though modified, they nevertheless are distinctly present. The Walrus's feet gradate from the Bear's by the less specialization or line of demarcation of the parts in question; and through the former the passage is easy to the smoother-surfaced and planer soles of the Earless and Eared Seals.

The elongate digital nails of the Phocidæ, with some few exceptions, resemble most those of the Ursidæ. The Otaries and Morse agree with, and in the ungual diminution and bluntness diverge from the Land-Carnivore type.

As respects tegument and hair the Walrus stands midway. Unlike the Eared Seals, there is no thick underwool or fur; and neither as in them nor as in the Earless Seals is the hair itself so short, stiff, straight, and adpressed. The latter group are maneless; the males, at least, of the former maned; whilst Walrus has throughout shaggier hair, and may be said to be bull-necked.

Skin-folds, such as have been described in the *Trichechus*, are, comparatively speaking, absent in *Otaria* and *Phoca*.

The Pinnipedian act of locomotion, both on land and in the water[1], is a study of the highest interest, and, from an almost fish-like movement in some, transitionally glides in others to the motions pertaining to ordinary terrestrial Mammifers. In the water the Seal progresses alone by its hind feet, used almost like a piscine tail; the Sea-lions (and Sea-bears?) progress with extraordinary speed by dint of alternate sweeps with their enormous pectoral limbs, the pelvic limbs being kept in abeyance or simply employed as steering-apparatus. The Walrus in the same element simultaneously lashes its posterior extremities curvilinearly or Seal-fashion; but, besides, it reciprocally moves its anterior extremities, somewhat after the manner of *Otaria*.

On land, the total suspension of the limbs as motor agents, and instead a saltatory wriggling abdominal movement, pertains to the Seal, though I have observed in the *Phoca grœnlandica* an intermediate stage in an occasional use of the fore feet; the Otary manifests increased power of limb in its hobbling plantigrade walk; and as the Morse is reached a still further deviation from the Seal towards the Bear tribe is shown in the greater freedom of use of the pelvic limbs.

Modifications trending in a similar direction are witnessed in the less or greater freedom of limb-attachment, in the development of axillary and caudo-tibial tegument, lowering of muscular insertions, in ligamentous union, and, lastly, osseous apposition.

We have only attentively to watch the Ursine walk to become convinced that the way in which the fore limbs are thrust forwards and the hind legs bowled along, is but a remove from the constrained and more fixed heel-action of the Walrus. Indeed, in examining a Polar Bear some few years old, I could not but acknowledge that the pelvic extremities, seen from below, only required a slight extension of the ischio-tibial parts, and corresponding reduction of the already short tail, to transform them into the condition which obtains in the Morse.

Considering the very different attitudes assumed by the Trichechidæ and Otariidæ as compared with the Phocidæ, it is remarkable how very little deviation follows in the muscular development. The two former, as might be anticipated, present a general agreement, especially in the mode of implantation of the muscles of the hind leg, and in this respect recede from the Seal, yet but slightly. The first-mentioned possess several muscles not found in the second. The variations of minor importance have sufficiently been dwelt on; it is only necessary therefore to advert to the more striking points. Amongst such are the presence of a coraco-brachialis, a flexor brevis manus, a pronator quadratus, an opponens pollicis, and a palmaris brevis. The large size of the auriculares is remarkable when deficiency of a concha is taken into account. There is a distinct fleshy external anconeus, as in *Otaria*, and a double set of extensors of the

[1] Consult the researches and masterly analysis of these movements, as bearing on the mechanism of flight, by Dr. J. B. Pettigrew, Trans. Linn. Soc. 1867, vol. xxvi. p. 207.

manus, which, however, is met with in *Phoca*. The splitting or subdivision of the extensor ossis metacarpi pollicis marks variation from the Eared and Earless Seals.

In the superficial and deep long palmar muscles and tendons some differentiation is witnessed, whilst the palmar fascia is not nearly so dense as in the great flipper-like manus of *O. jubata*. The latter possesses a flexor brevis minimi digiti, which the Morse has not. A single lumbricalis has been found equally in the Seal and in the Walrus.

The extensor brevis digitorum has an increased number of bellies; and instead of an accessorius, a short bridging tendon between exists.

The veins in the Walrus, as in the Seals and Otaries, evince adaptation to frequent aquatic submergence—this by their great capacity towards the root of the heart, and by the enormous cava or hepatic reservoir. The widened aortic arch and diminution of the abdominal aorta modify the current, the vast muscular apparatus of the fore quarters and large brain receiving the major share of supply; and the tendency to rete mirabile observed in the extremities spreads out the blood's force so that a slow but steady current is ensured. The glands, thoracic, axillary, inguinal, and ischiatic, are numerous, large, and surrounded with vascularity; and here I am inclined to think, under certain conditions, stasis of the circulation temporarily takes places. After repeated conversations with men who have often watched young Seals in a state of nature, and my own anatomical observations upon animals of various ages, I am satisfied that what Dr. Wallace[1] and Mr. Brown state bears the stamp of truth, viz. that expertness in swimming and power of remaining long under water is an acquired habit. There is this, however, to be said, that the vascular distribution and reservoirs inherently allow of further development[2] through use accruing; the Walrus forms no exception. It is useful to reflect on the manner in which long submergence is provided for in the air-breathing Sirenians and Cetaceans, *i. e.* by intercostal plexuses and manifold retia mirabilia.

Voice in a great measure is suppressed in Cetacea; and as the enlarged arytenoids are thrust upwards towards the spiracle or nares, breathing ensues. In Sirenia the nostrils are situate nearer the muzzle; the larynx in diminution and form resembles more terrestrial mammals; but the lungs, unlike those Whales, are extraordinarily lengthened. The Walrus and Seals revert more to land breathers. Still the lungs have great magnitude; but the laryngeal apparatus is modified by the increment of the arytenoids, atrophy of the epiglottis, and full development of the pharyngeal constrictors and uvular curtain, so that powerful inspiration and expiration are effected as the surface of the water is reached.

As to the visual organs in the Walrus, they pertain to the Carnivorous type, adapted, however, to media of different refraction.

[1] P. Z. S. 1868, p. 408.

[2] If an example were needed, the mode in which varicose veins are produced in the human subject might be cited.

Looking at the teeth as instruments of mastication, the greater triturating surface of the molars, as compared with the fish-eating Seal's, is in concord with the molluscivorous habits of the Walrus.

Little appreciable difference is exhibited throughout the Pinnigrades in the construction of the alimentary canal. It is simply that of a Carnivore, with, however, a moderate-sized cæcum. The great glandular superficies and correlated large lymphatics point to means of speedy and frequent digestion; and in the Walrus these apparatus are extraordinarily developed.

DESCRIPTION OF THE PLATES.

PLATE LI.

Fig. 1. Profile of the head and neck of the Society's specimen of young male Walrus (1867), from a photograph taken immediately after death. Reduced to about two-thirds natural size. *a.c.* Placed in front of the external auditory canal; a projecting pinna is wanting.

PLATE LII.

Fig. 2. Foreshortened view of the muzzle and partially opened mouth, the upper lip being dragged upwards and outwards by hooks. When in this position, the labial bristles radiate, or are bent somewhat backwards. $\underline{C}$. Upper canine of right side; the pointer rests on the distal boundary line of the thick layer of cement. *l.l.* Lower lip. Photographed natural size, and diminished to two-thirds in the present lithograph.

Fig. 3. Under aspect of the chin, muzzle, and part of throat. *th.* Parallel skin-folds of throat. *ch.* Rough hairy chin. $\underline{C}$. Left upper canine protruding at angle of mouth.

Fig. 4. About two-thirds natural size, foreshortened view of muzzle, nares, and chin, the mouth and nostrils being closed. *a.n.* Anterior nares. *l.l.* Lower lip. The shadow of the beard beneath simulating an oral cavity. The bristles are seen to converge and overlap each other. From a photograph.

Fig. 5. Sketch of the semidilated anterior nares, about natural dimensions. *a.n* points to the right orifice.

Fig. 6. Reduced semidiagrammatic view of the palate and dentition of the upper jaw.

Fig. 7. A similar sketch of the anterior segment of the mandible and teeth.

PLATE LIII.

Fig. 8. Dorsal surface of left pectoral limb and parts adjoining. *sh.* Shoulder-folds. *Ax.* Axillary margin. *I, II, III, IV, V,* Digits, numerically lettered.

Fig. 9. Under surface of the same limb. *W.p.* Warty pad. A line cutting the arrows *a, b,* defines posteriorly the area of sole which touches the ground in walking. Other lettering as in fig. 8.

Fig. 10. Upper surface, right hind limb, the digits approximated and partially overlapping. The numbers refer to the digits respectively.

Fig. 11. The same limb, seen with the sole twisted backwards as in the act of swimming. The foot from the heel thus appears alone free. *t.* Tail enveloped in the skin, which stretches outwards towards the heel. *W.p.* Calcaneal rugose pad. *I, II, III, IV, V,* Digits.

The above four figures are accurate copies from photographs, and $\frac{3}{10}$ nat. size.

PLATE LIV.

Fig. 12. View of the buttocks and pelvic limbs, from behind, to show the lozenge-shaped skin-markings over the sacro-caudal region. This reduced representation is from a photograph taken of the dead body; the feet having been propped into a walking position, are therefore not quite natural in their posture. *I* to *V.* The digits of the right foot. *t.* Tail. *a.f.* Anal fold of skin, &c.

Fig. 13. Sketch of the anal region, from below, the legs being thrust at right angles outwards, and here indicated merely by a faint line as far as heel on right side. About three-fifths natural size. *a.f.* Anal fold, which overlaps and hides the anal aperture. *t.* Tail. *g.* Points to the cutaneous glandular patch of the right side situated near the groin.

Fig. 14. A reduced representation of a middle of the abdomen, giving the relative situation and appearance of the skin-folds around and between the umbilicus and genital orifices. *um.* Umbilicus. *a.p.* aperture of penis.

Fig. 15. Longitudinal mesial section of the lobulated kidney. *a.* Renal artery. *v.* Vein. *u.* Ureter.

Fig. 16. Foreshortened view of the truncated tip of the penis, of natural size. *Os**. Termination of the os penis, overlaid with mucous membrane. *g.* The roughened folds of the glans. *s.* Sulcus partly encircling the bone. *m.u.* Meatus urinarius.

Fig. 17. Urino-generative organs as dissected, and considerably reduced from nature. U.B. Urinary bladder, in part. *u.* Ureter. *l.* Lateral ligament. *v.d.* Vas deferens. *I.c.* Ischio-cavernosus, and *B.c.* Bulbo-cavernosus muscles. *c.c.* Corpus cavernosum. *c.s.* Corpus spongiosum. *os.* Os penis, and *os** its

terminal extremity. *l.* Ligament covering the bone=suspensory aponeurosis. *p.* Preputium. *g.* Glans. *m.u.* Orifice and subpendulous meatus urinarius.

Fig. 18. Portions of urethra and bladder cut open, from above. *u.* Vesicle openings of ureters. *Pr.* Prostate gland, thin and partially enclosed within the urethral wall. *e.d.* ejaculatory ducts. *c.c.* Corpus cavernosum at bulb.

PLATE LV.

Fig. 19. Dissected view of the thoracic and renal organs *in situ.* The sternal wall with cartilages, the diaphragm, liver, stomach, and intestines have been removed. *L.* Lungs. *H.* Heart. *ao.* Abdominal aorta. *K.* Kidney. *Spg.* Right suprarenal gland. *vc.* Vena cava cut short above the emulgent veins.

Fig. 20. Semidiagrammatic view of the undisturbed abdominal viscera. *L.* Liver. *St.* Stomach. *um.* umbilicus. *ap.* penal aperture. *mg.* a nodule of the mesenteric glands, and beside it portion of right kidney. *B.* Bladder.

Fig. 21. A reduced sketch of the cæcum, with portion of the small and great intestine. *cæ.* Cæcum. *i.* Ilium. *c.* Colon.

Fig. 22. Under or abdominal surface of the liver and its great venous reservoir, with segments of the stomach and duodenum attached. *St.* Cut end of stomach. *Py.* Pyloric orifice, opened. *Pa.* Portion of pancreas. *Gb.* Gall-bladder. *dch.* Ductus communis choledochus. *r.* Reservoir of the bile-duct within the intestine. *o.* Its intestinal orifice. *rl.* Round ligament. *ha.* Hepatic artery. *n.* Nerves. *v.c.* Vena cava. vs^1, vs^2. Hepatic venous sinus, partially opened on the left side. *D.* Small part of the diaphragm with the caval aperture piercing it, through which the arrow issues. Nos. 1 to 7. The several lobes of the liver: dotted lines connect together portions representative of a right and a left lobe.

Fig. 23. Outline diagram of the dilated hepatic vena cava, showing by arrows the convergent blood-streams towards the diaphragmatic orifice. The cross arrow indicates the communication betwixt the right and left moieties, otherwise partially divided by a membranous wall.

Fig. 24. Dissection to display the vessels &c. at the root of the heart and the brachial plexus. *a.* Tip of right, and *a** of left auricle. *l.* Upper lobe of left lung. *Pa.* Pulmonary artery at root. *ao.* Aorta. *c* and *ca**. Right and left carotids. *i.* Innominate trunk. *rs* and *ls.* Right and left subclavian. *im*, *im**. Internal mammary. *Va*, *Va**. Vertebrals. *ss*, *ss**. Suprascapular arteries. *Bpx.* Brachial plexus of nerves. *pn.* Pneumogastric nerve. *Sy.* sympathetic ganglia. *Vc.* Vena cava ascendens and descendens. *Pma.* Portion of pectoralis muscle &c. of left side. *tr.* Trachea.

Fig. 25. Sketch of the left groin and tibio-caudal region partially dissected, to show the situation of the testis. *T.* Testicle. *t.v.* Tunica vaginalis, ripped open; the

sac is attached by a fibrous band to the caudal membrane below. *Spc.* Spermatic cord. *ep.* Epididymis. *Eo.* External oblique muscle of abdomen, cut across. *Sa.* Sartorius. *Pe.* Pectineus. *Al.* Adductor longus. *Amg.* Adductor magnus. *Gr.* Gracilis. *St.* Semitendinosus. *La.* Levator ani, lying across tail. *oc.* Position of the os calcis.

Fig. 26. The external auditory canal and auricular muscles, reduced to about half natural size. *ac.* Auditory canal, or cartilaginous tube. *ma.* Meatus auditorius. *atl.* Attollens, *atr.* Attrahens, and *ret.* retrahens aurem muscles.

Fig. 27. Section of the tissues of the muzzle cut tangentially through the roots of some of the larger bristles. Designed to show their structure and the muscular fibrillæ interwoven between them. *h.* Horny layer of bristle; and *p*, pulp. *m.* Muscle.

Fig. 28. Front view of the larynx and hyoidean apparatus; the lingual muscles cut short are merely indicated by (*Gh*) remnants of the genio-hyo-glossi &c. *S.h.* Insertions of sterno-hyoidei. *Th.* Thyro-hyoid. *Sth.* Cut portion of left sterno-thyroid. *Cth.* Crico-thyroid. *T.* Thyroid ala. *C.* Cricoid. *tr.* Trachea.

Fig. 29. View of the tongue and pharyngeal cavity displayed as an anatomical preparation. *fl.* Filiform, *fg.* Fungiform, and *cv.* Circumvallate papillæ. *œ.* Œsophagus, the rings of the trachea seen at its sides and above the pharynx, which has been opened; at the hook the strong constrictor muscles are dragged to either side. *ep.* Epiglottis. *a.* Fleshy prominence above the arytenoid cartilage; the small chink of the glottis immediately in front.

Fig. 30. Reduced semidiagrammatic side view of the larynx. *T.* Thyroid, and *C.* Cricoid cartilage. *ic.* Inferior cornu.

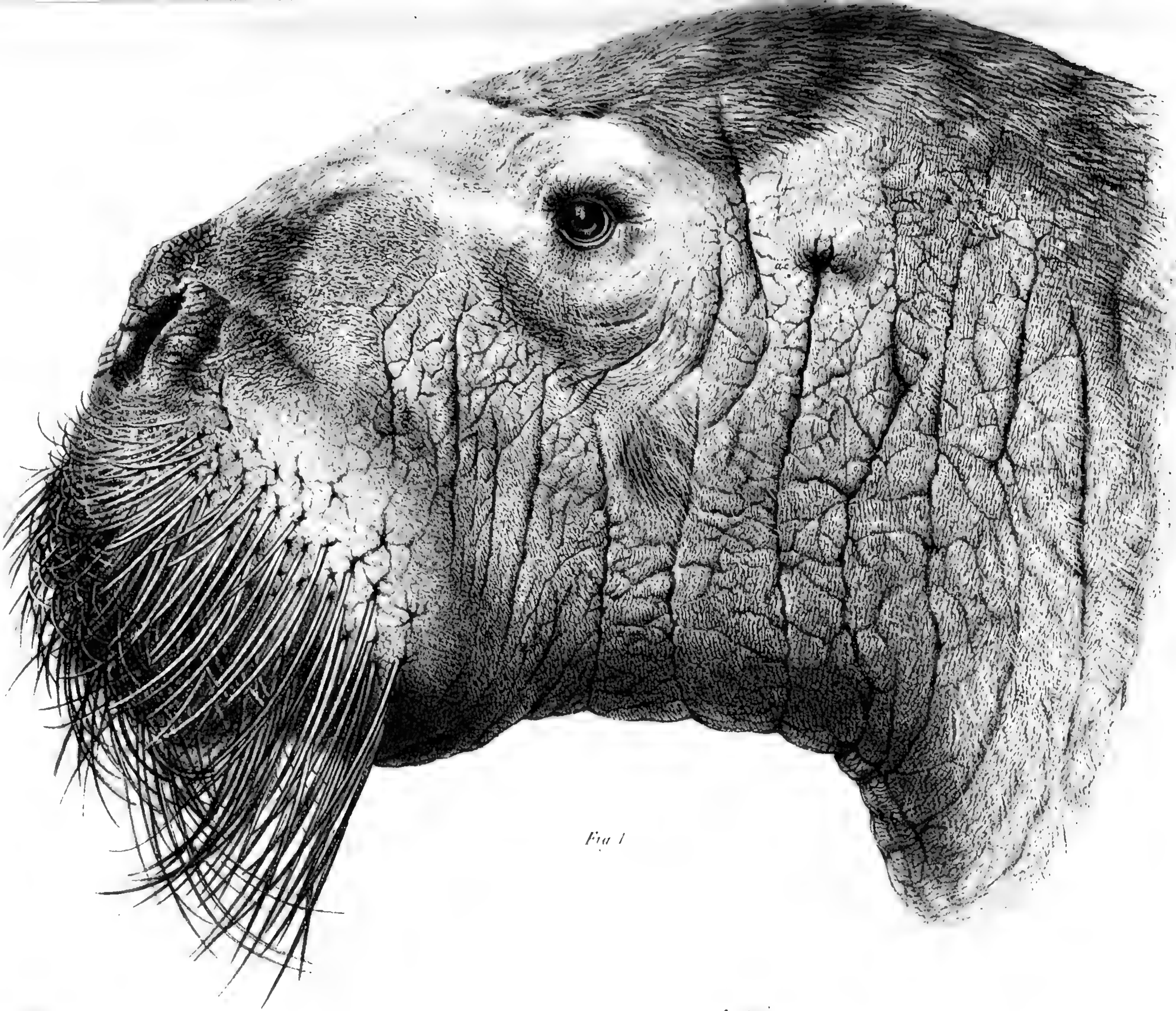
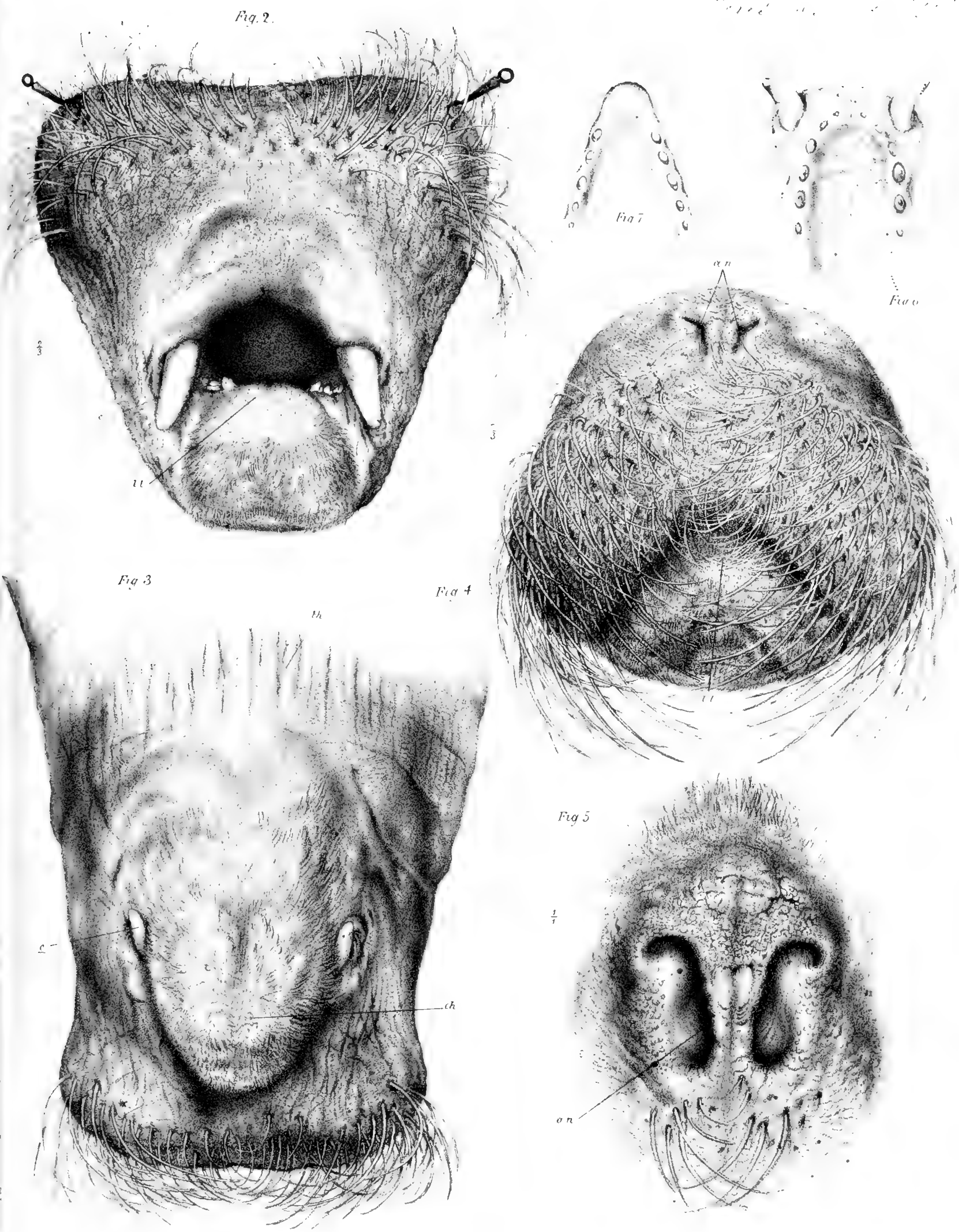


Fig. 1



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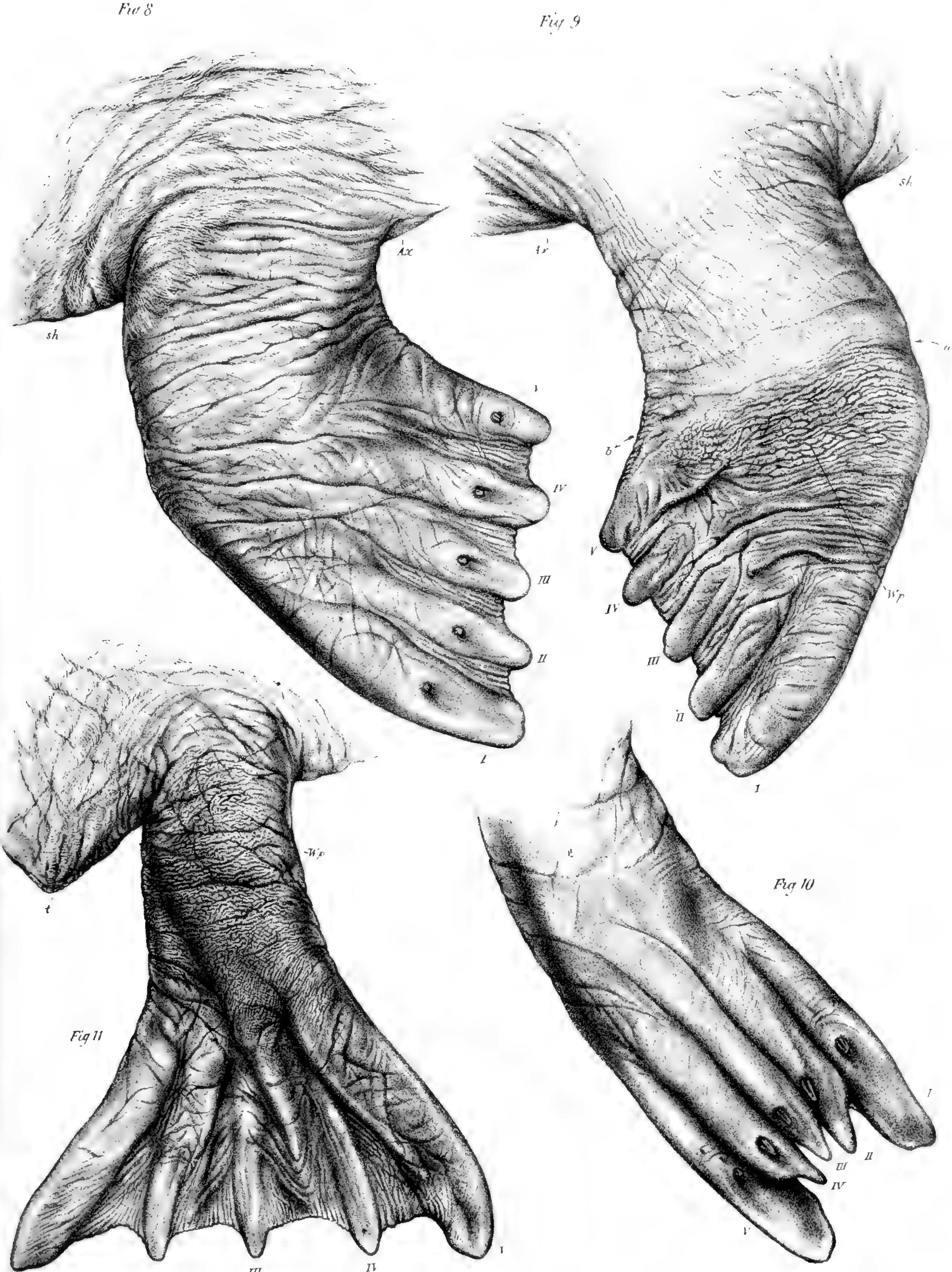
Berjeau lith

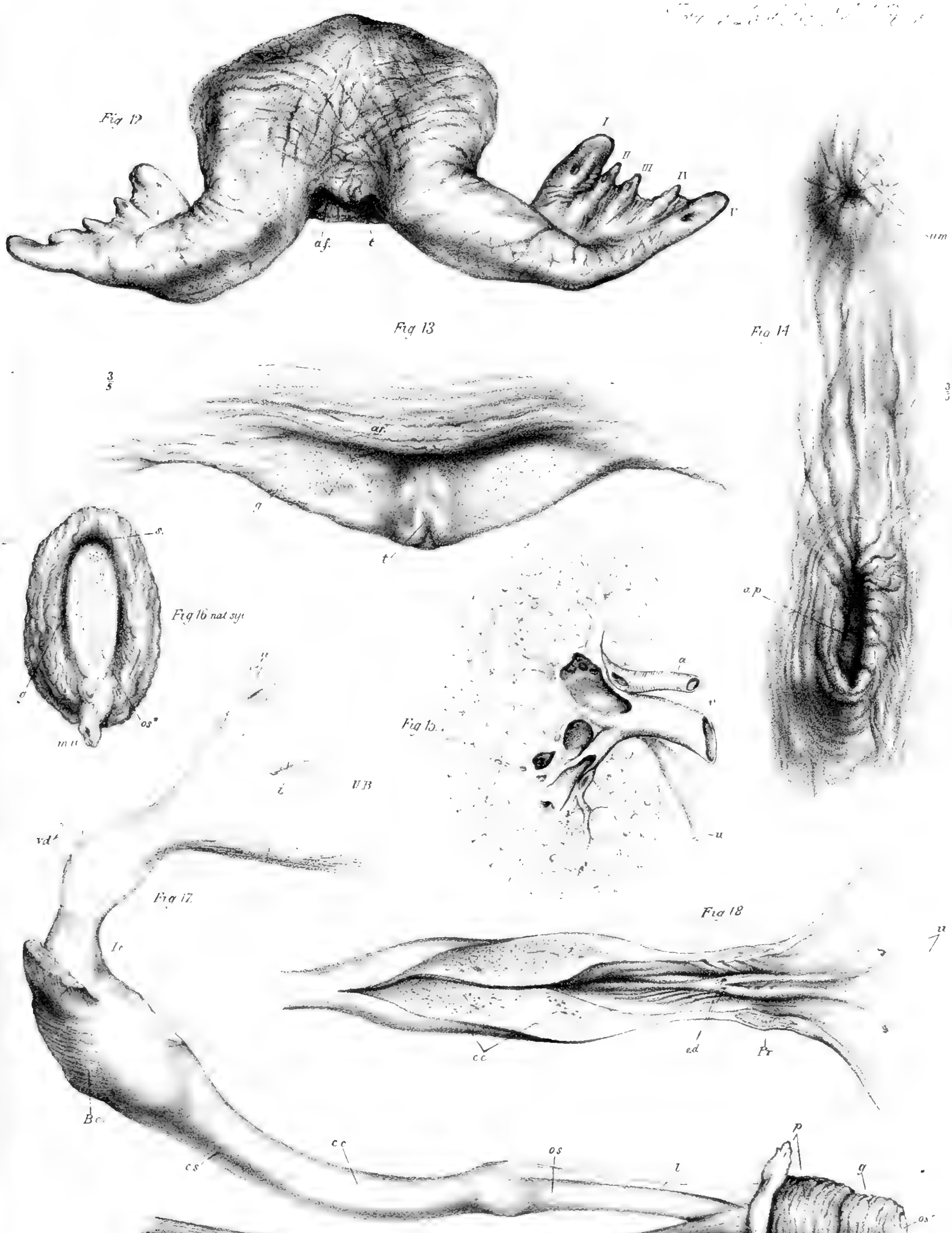
M & N Hanhart imp

VIEWS OF MUZZLE, PALATE & DENTITION



J. Murie photo. J. Bergeau, lith. M & N Hanhart

DORSUM & SOLES FORE & HIND FEET 2/3 N.S

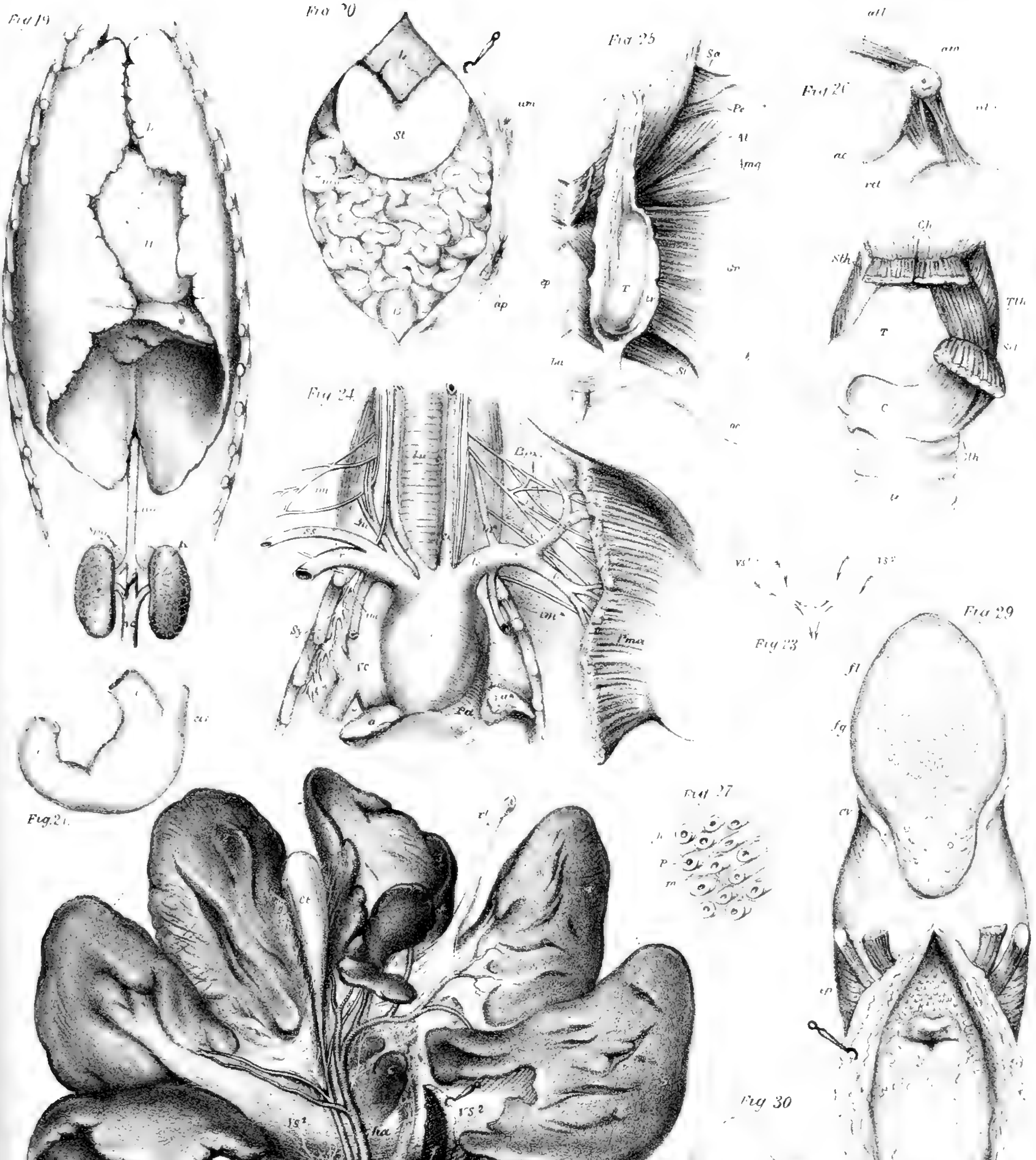


C. Berjeau del et lith.

J. Murie dir.

M & N Hanhart imp

URINO GENERATIVE ORGANS &c



J Murie dir

C.Berjeau del et lith

M&N Hanhart imp

VASCULAR DIGESTIVE & VOCAL ORGANS &c

XII. *On the Dermal and Visceral Structures of the Kagu, Sun-bittern, and Boatbill.*

By JAMES MURIE, *M.D.*, *F.L.S.*, *F.G.S.*, *&c.*, *Prosector to the Zoological Society.*

Read May 9th, 1867.

[PLATES LVI. and LVII.]

Prefatory Observations.

THE order Grallæ, as at present[1] defined, contains several forms which it has puzzled the ornithologist and the comparative anatomist to assign clearly to any one of its families. The three species which I shall more particularly refer to, the Kagu (*Rhinochetus jubatus*), the Sun-bittern[2] (*Eurypyga helias*), and the Boatbill (*Cancroma cochlearia*), are among those somewhat indefinite types. They may, indeed, have some predominant points assimilating them to one more than another group; but these are curiously masked and considerably interwoven with features leaning differently.

My colleague, Mr. A. D. Bartlett, shrewdly studying the resemblances offered by external characters and habits, arrived at the conclusion (P. Z. S. 1862, p. 218) that *Rhinochetus* is more closely allied to *Eurypyga* than to any other bird, while he admitted the singular combination of other general and family characters in the general appearance of the former.

Since then my friend Mr. W. K. Parker, in an interesting little article "On the Osteology of the Kagu (*Rhinochetus jubatus*)" in our Proceedings for 1864, p. 70[3], exemplifies its multiple type and relationships in a tabular view. Therein he places *Rhinochetus*, *Eurypyga*, and *Psophia* on the same level; whilst each, as it were, is

[1] I allude of course to the date when this communication was read. About the same period Professor Huxley's now almost classic paper "On the Classification of Birds" was brought before the notice of our Society, and not long afterwards published. His new terms and divisions I have not adopted, simply because it would have involved my here and there altering the text without obvious advantage to the general tenor of my conclusions.

[2] The name of Sun-bird, and not Sun-bittern, has been given to *Eurypyga helias* (Pall.) in the "List of Vertebrated Animals living in the Society's Gardens" for 1866. As signifying that it is not a true Bittern, this name is admissible and possibly may have advantages. I prefer, however, to retain the older and better-known name.

[3] A more extended memoir, based on the above partial abstract, and bearing the same title, has since appeared in our Transactions, 1868, vol. vi. p. 501, illustrated by two plates of the skeleton. Whilst Mr. Parker in it has extensively compared the bones with those of other "Geranomorphs" of Huxley, and also very extensively homologized certain bones of the face with those of Reptiles, Mammals, and ornithic forms generally, he has departed little, if at all, from the taxonomic conclusions arrived at in his earlier shorter paper.

derivative from a different stock, respectively—the Rails, the Herons, and the Cranes. Looked at inversely, including the Plovers as a stem, the three above-mentioned genera, according to him, form the summit of a truncated pyramid; while they are interwoven in characters with the genera of the four families supporting the basal structure.

The Boatbill Mr. Parker regards as a true Heron. Such are the affinities drawn from the skeleton!

For my own part, in the present communication, I shall chiefly invite attention to the dermal and visceral structures of the Kagu, Sun-bittern, and Boatbill, comparing those together, and with such other forms as have come within my reach.

In this way I hope to throw a side light on the subject. If unable to supply sufficient data for a just disposition of these aberrant forms, I may thus at all events furnish desirable information respecting some parts of their anatomy at present but imperfectly known and understood.

The Kagu[1] which I have had the opportunity of dissecting was a healthy male purchased by our Society on the 5th February last (1867). But on the 18th March following it accidentally choked itself while attempting to swallow a piece of flesh.

The body weighed 2 lbs.[2], and was loaded with a thick layer of light-coloured fat, which, however, did not extend to the wings or legs. I shall speak of the structure of the feathers further on, but here mention that the plumage was rather imperfect, the tail- and wing-feathers having their plumes chafed and broken.

Throughout the body tracts of young feathers, here and there, sprouted forth. In such of the tail-feathers as were tolerably complete, traces of imperfect development, technically called "hunger-marks"[3], prevailed on the vanes; but the barrels bore evidence of a recent and vigorous accession of growth. Taking these appearances into consideration, it seemed as if the bird had previously been in poor condition, and had afterwards become invigorated and plump when placed in more favourable circumstances.

The Sun-bittern used for comparison was a male specimen received in presentation from our Corresponding Member, Dr. Huggins, on the 16th September 1861. Upon the right foot of the bird there grew a fibroid tumor, which ultimately attained the size of a walnut; and through irritation from it, or otherwise, death ensued. The plumage was intact, and the body in moderate condition.

Only recently (6th March, 1867), and for the first time, has the very rare Boatbill been added to the Collection. This male bird unfortunately lived only three weeks after its receipt. It suffered from dry gangrene of the feet. The viscera were healthy,

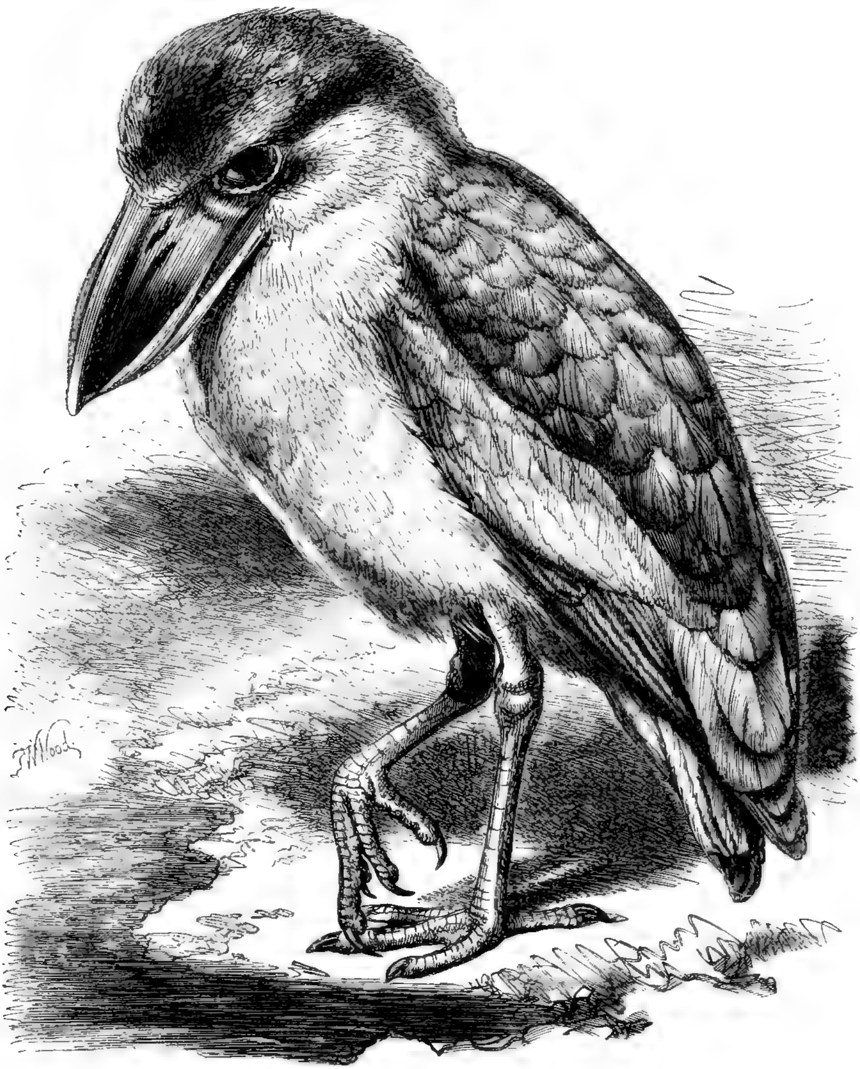
[1] For an excellent delineation of this bird from life see Wolf's 'Zoological Sketches,' 2nd ser. pl. 45.

[2] This, I believe, to be under the average of a plump full-grown bird; for, although fat, the specimen bore poor comparison with some of the Society's old prime-conditioned Kagus.

[3] These (in bird-fanciers' parlance also denominated "hunger-lines") are the cracks or wavy bars across which the feather easily breaks, and are supposed to indicate imperfect growth through disease, starvation, and such like.

but the body was uncommonly lean; the entire carcass weighed only $1\frac{1}{4}$ lb. The feathers were in a remarkably bad condition.

Fig. 1.



The Boatbill[1], *Cancroma cochlearia*, Linn., ♂.

[1] The above specimen, sketched from life, is that described anatomically in the present paper; the diseased condition of the feet, however, has not been rigidly adhered to. The woodblock has been kindly placed at my disposal by the Proprietor of the 'Illustrated London News,' in which journal it appeared, 6th April, 1867.

I. Dermal Structures.

1. *The Plumage.*

(*a*) *Feathering in general.*—The very original and valuable treatise on "Pterylographie," by Christian Ludwig Nitzsch, an English edition of which has lately been issued by the Ray Society[1], ought to have made it incumbent on me to supply desired information regarding the entire pterylosis of the interesting and almost unknown form *Rhinochetus*.

The partially imperfect condition of the specimen, however, and still more my ignorance at the moment of the taxonomic value of the disposition of the complete feathering, debarred me from paying the subject such full attention as it wanted. A comparison of all its feather tracts and spaces with those of the two other birds here in question is still a desideratum. I did, though, note some points, which shall be mentioned below.

For a description of the pterylosis of *Cancroma* and *Eurypyga* and comparison of its general arrangement with that of the wading birds, and more especially with the genus *Ardea*, I cannot do better than refer to Nitzsch's statements[2] concerning them. What little differences I have observed in the number of wing- and tail-feathers I announce in the subjoined paragraph, along with some remarks on *Rhinochetus*.

In the Kagu the approximate stretch of the wings from tip to tip is about 26 inches. There are ten primaries, and thirteen secondaries. The tail contains ten rectrices. An oil-gland of fair size is present, which is naked. The Boatbill agrees with the Kagu in the number of the primary and secondary wing-feathers, and in having a naked oil-gland, which, however, is small; but the tail-feathers are twelve in number.

In the Sun-bittern I find there are eleven primaries, the first of which is shorter than the succeeding ones. Eleven secondaries follow. The wings have a spread of about 2 feet. In the tail there are twelve rectrices. The oil-gland is small, and with a few short feathers at its base.

According to Nitzsch there are in *Cancroma* twenty-two remiges, and ten on the pinion. The first are somewhat falciform, and attenuated at the inner vane; the third, fourth, and fifth are the longest. The tail has only ten feathers. The specimen of *Eurypyga* which the same writer had the opportunity of examining through Cuvier's kindness in Paris, does not seem to have been in a favourable condition for correct observation. The number of remiges he did not ascertain with exactness; but on the pinion he considers "there are certainly ten, of which the third is the longest." In the tail he counted nine feathers, but, from the gaps, he supposed there "would probably be twelve."

Relative to the structure of the feathers I noted what follows:—

The Kagu (as well as the Boatbill) possesses an erectile crest (woodcut, fig. 2), some

[1] Folio, vol. for 1867, edited by Dr. Sclater, from Burmeister's edition of Nitzsch's MS.

[2] *Op. cit.*, German edition (Halle, 1840), pp. 184–187, tab. viii. figs. 13, 14, & 15; and English translation, pp. 127–130.

of the feathers of which, chiefly the posterior, are as much as 7 or 8 inches in length, the front ones, however, being much shorter. These have each an accessory plume (*hyporhachis*), which is downy in character. The vane of the main feather, for its

Fig. 2.

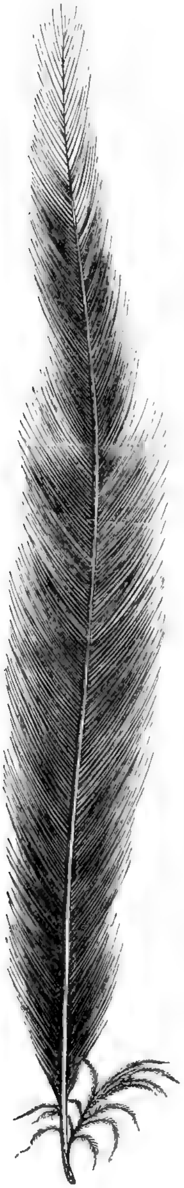
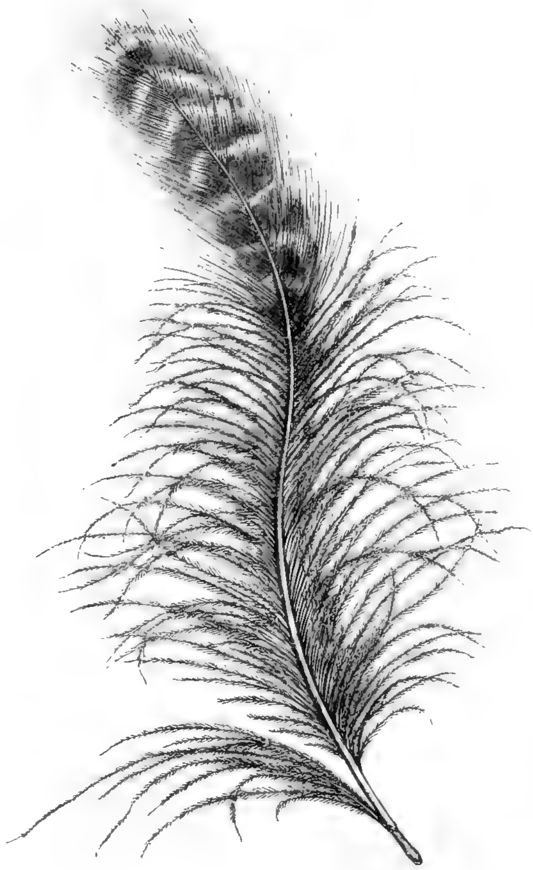


Fig. 3.



2. Back crest-feather; and 3. Inside view of an upper wing-covert, of the Kagu. Both of natural dimensions.

lower two-thirds or more, according to the length of the feather, is composed of delicate barbs, which have an abundance of soft downy barbules, excepting at the tip, where the barbs become filiform. The upper third of each feather has fewer barbules, the barbs appearing mainly hair-like (see fig. 2, p. 469). The tail- and wing-feathers have strong shafts, and the vane is more or less equally disposed on either side of the shaft. Further satisfactory examination was prevented in consequence of their imperfect condition.

The contour-feathers, for example the upper wing-coverts (see fig. 3, p. 469), retain, to a certain extent, the peculiarities mentioned in the crest-feathers. They have also accessory plumes, but of increased size. The proximal two-thirds of the vane has remarkably long and beautiful plumose barbs downy to its very extremity. The distal third of the feather has stronger barbs, more closely set together, and interwoven by the overlapping barbules. Only at the tips is the capillary nature of the barbs witnessed.

The down-feathers are very profuse; they likewise have elongated, very velvety accessory plumes. Their barbs are almost of equal length from base to tip of the vane; and the barbules, very great in number, are extraordinarily light and delicate (see fig. 4, p. 472). Between these down-feathers of the Kagu and those of *Psophia* there is a strong resemblance.

The feathers of the Sun-bittern come wonderfully close to those of the Kagu, without, however, assuming identity. Whilst fashioned in general as above described and figured, the following differentiation is noticeable:—The accessory plume is not so strongly developed, the barbules and barbs are less downy, and, of those that possess them, the filiform terminal points are harsher. The elegant, soft, fluffy barbs and barbules, so characteristic of the down-feathers in the Kagu, are much reduced in the Sun-bittern.

With regard to colouring, although the outward hue of *Rhinochetus* is slaty, yet, as Mr. Bartlett has stated, the markings upon the wing- and tail-feathers, viz. the bars of brown, black, and grey, bear much resemblance to those of *Eurypyga*. The same cannot be said of *Cancroma*, where a generally diffused brown tint is prevalent.

In the Boatbill the feathers are of a stiffer nature than in the two species already compared. This is in the main caused by the strength of the shaft and the barbs. The component parts of the feathers otherwise are like those of the Kagu, but, from the peculiarity mentioned, appear far less plumose and downy. They possess the accessory plume.

So far as structure is concerned, the feathers of the Boatbill approach much nearer to those of the Night-Heron (*Nycticorax*) than to those of the Kagu or Sun-bittern. In the Night-Heron the feathering of the upper wing-coverts, if compared with those of the Kagu, shows far greater interlocking of the barbules. So much is this the case that only in the lower third of the feather, and that in the outer half of the vane, is plumose character as freely developed as obtains in the Kagu. This remark is more or less applicable to the thigh- and other feathers generally.

So amply has the pterylosis generally of groups and many genera of the Wading Birds been worked out by Nitzsch that it would be superfluous in me to enlarge in comparisons.

(*b*) *Powder-downs, their Structure, Situation, and mode of Examination.*—Perhaps the most interesting point concerning the structural formation of the feathery covering of the birds under consideration, is that of the powder-down feathers (*Puder- oder Staub-Dunen* of Nitzsch, evidently the *flake*-feathers of McGillivray[1]). Not only is their microscopic structure curious, but their physiological adaptation and use is as strange.

Nitzsch arrived at the conclusion they are secretory organs; and, taken in a certain sense, this view appears to me quite justifiable.

In their minute constituents I find Nitzsch's observations to be very accurate, as far as they go; and I can further bear evidence to his asseveration that birds of widely different families possess them. The forms which I have more particulary studied have been those forming the basis of the present paper, several species of Bittern, Heron, Night-Heron, and Parrots, though I have not confined myself to these groups.

The powder-patches in the different birds vary in their outward appearance and aggregate quantities, and moreover exist in several situations in the same bird.

The best-known and most notable sort is that wherein they form the so-called "patches," or are aggregated closely and terminate in a long free plume. Such, for instance, is the predominant character in the Herons generally, in *Balæniceps*, *Leptosoma*, and, more excellently figured by Dr. Sclater[2] than in any case I know, in *Podargus cuvieri*, Vig. et Horsf., the woodcut of which I have been enabled to incorporate in the text (*vid. infra*, p. 483).

But the powder-down feathers, according to my researches, are far more freely distributed than has hitherto been suspected, not so much in bunches as in the form of short roots or feather-sprouts, in great part wanting the free terminal plume so obvious where collected in masses. Indeed there would seem grounds for believing that the comparatively solitary short kind of powder-down feathers might represent a first stage of arrested down-feathers, whilst the plumose variety would be a second, erupted stage, the down-feathers themselves completing the gradation of growth. Of the so-called *filo-plumæ* of Nitzsch, distinguished by their extraordinary slenderness, he himself incidentally notes, "To the latter I formerly gave the name of *arrested feathers* (Kümmerfeder)," thus intimating, as it were, his idea of serial developmental grades existing between the different kinds of feathers.

Regarding the distribution of the powder-downs, I shall treat of this at length as I proceed, but propose first to inquire in what respects they are distinguishable from other portions of the plumage, and what constitutes these differences, textually.

[1] 'A History of English Birds,' vol. i.

[2] "Additional Notes on the Caprimulgidæ," P. Z. S. 1866, p. 581, fig. 1.

Colour is not restricted to one shade; for, from the pure snowy whiteness of the clumps in *Egretta alba*, through the grey tints of *Ardea cinerea*, brownish tinge of *Cancroma*, up to the almost black stripes of *Rhinochetus*, there is an infinity of gradations. The most I can affirm, after examination of many species and specimens, is that the colours of powder-bearing plumes and brushy stumps bear a relation to, and, indeed, are harmonious in tint with, the rest of the true down-feathers.

Fig. 4.

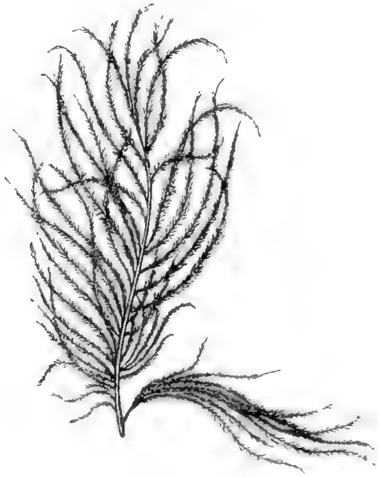


Fig. 5.

Fig. 4. A down-feather from outside the thigh; and fig. 5. Powder-down plume from the shoulder, of *Rhinochetus jubatus*, compared. Nat. size.

Length, proximity, and volume of the tuftlets present extremes. They obtain often only as little, short, downy (camel-hair-pencil-like) brushes, isolated, singly, or sprinkled here and there in lines and limited territories, well exemplified in the Parrots and Cockatoos (*vide* fig. 11, Pl. LVI.). At other times, and markedly in confined spots on the rump and belly, they are met with as closely aggregated filiform plumes, one, two, or more inches in length, and with an areal base as varied in extent, admirably shown in *Podargus* heretofore mentioned (woodcut, fig. 6, p. 483), and in the better-known breast- and rump-patches of the Egrets and Herons. Thus their combined roots may be roundish, angular, or in linear strips, broad or narrow, short or long, separate from or intermingled with the contour- and true down-feathers, as the case may be.

But from these somewhat negative characters I return to others of a more positive kind. In all, with a slight differentiation, the powder-downs are to all intents and purposes essentially down-feathers, differing materially from the strong-quilled wing- and tail-plumage, from the other stiffish contour-feathers, from the semiplumes and filo-plumes of Nitzsch's terminology. In all, growth from the root or within the basal sheath is continuous, and minute powdery substance is constantly emitted. Lastly, as

I shall attempt to show, there appears in all a certain forecast and inclination towards defined lines of tract as in the contour-feathers.

The powder-down patches, which Mr. Bartlett, in his paper already referred to, mentions as being very profuse in the Kagu, I made a point of examining with diligence. Their presence I found even more numerous than he has recorded. In fact, except the distal ends of the wings and legs, it might be said, broadly speaking, that the entire cutaneous surface has received a sprinkling.

In *Eurypyga* they appear on the whole to follow the distribution which obtains in *Rhinochetus.* In this respect my observations differ from those both of Nitzsch and Bartlett.

In *Cancroma* there are four pairs of patches, as stated by Bartlett; whereas Nitzsch describes and figures only three pairs.

The manner of research which I have adopted in examining these powder-down patches has been much after the fashion which Nitzsch recommends as applicable to the investigation of the "feather-tracts" and "featherless interspaces."

First. The bird was minutely examined with its plumage entire. In this way the large patches were readily apparent, while the scattered shorter plumes were more or less detected in place among the "contour-" and "down-feathers."

Second. The skin was carefully plucked on the one side, the large contour-feathers previously being removed, excepting the remiges and rectrices, which were cut short by a pair of scissors. Then, after noting the appearance in this condition, the down-feathers, or "*semi- and filo-plumes*," were regularly pulled out one by one with a pair of forceps. The number, form, and direction of the powder-down patches were then sufficiently clearly displayed for drawings to be made.

Lastly. The plucked half skin was removed; and upon its inside the roots of the powder-down patches could be followed throughout their areas with ease.

Thus a single bird suffices for a fair examination. The one half of the body remains intact, and permits of any doubtful point being reascertained and corrected as comparison of the opposite half goes on.

The author of the very valuable monograph on "Pterylographie" devotes an entire chapter in discussing the nature, position, &c. of the powder-down feathers and their tracts. His observations go to prove their presence in *limited patches* in the orders Accipitres, Passerinæ, Gallinæ, and Grallæ. Dr. P. L. Sclater has since shown that in the order Picariæ two genera, *Leptosoma* and *Podargus*, have each powder-down feathers in a patch.

Nitzsch, moreover, had already mentioned of some of the family Psittacidæ that they possess powder-downs; but, as he expresses himself, these are "scattered all over the body, and not collected into tracts," as likewise occurs in *Gypaëtus barbatus* among the Rapacious birds.

Thus it would seem that the distinguished German ornithologist appreciated these peculiar feathers as being distributed in given tracts or patches. To quote his own words, he mentions, "I have found these definitely limited *powder-down tracts* of very different forms, numbers, and positions in certain Hawks of the subgenera *Elanus* and *Circus*, and also in *Ocypterus*, *Crypturus*, *Eurypyga*, all the *Ardeæ* and *Cancroma*." But evidently he has failed to recognize in their distribution a certain relation and interdependence between them and the contour-feather tracts and featherless interspaces, both of which he has so critically minutely worked out and graphically described. At all events, it appears as if he had only entered on the threshold of their arrangement; for he does not adopt any definite nomenclature as applied to them in contradistinction to the feather-tracts and spaces. Indeed his brief remarks are confined particularly to the clumps situated on the back and rump of certain genera among *Accipitres*, *Passerinæ*, and *Gallinæ*, and to the additional ventral patches among the *Grallæ*.

The preceding general considerations are meant to introduce the subject of the propriety of adopting a separate nomenclature to be applied to the powder-downs in contradistinction to the true feather-tracts and spaces.

If, as I shall attempt to demonstrate, the powder-down feathers have a less or more regular distribution within certain limits, other than those pointed out by Nitzsch and succeeding observers, it appears to me advisable they should receive individual designation in the manner which has been so efficiently employed in the other portions of the pterylosis by the aforesaid author.

Such a matter it is more fitting for skilful ornithologists to decide: but I here make the suggestion, leaving it to their judgment to reject or adopt the proposal, which I work out, so to say, in a provisional form.

For convenience' sake, in comparing the relation of other parts of the pterylosis with the powder-downs, and to give uniformity as respects one form with the other, I coin a set of terms kindred to and in part derived from those used by Nitzsch in defining the feather-tracts and interspaces.

My plan is simply to apply the term *patch*, instead of and equivalent to Nitzsch's "tract" and "space," to those powder-down plumes, whether few, scattered, or aggregate in number. In this manner the regions, as denominated by Nitzsch, may hold good in general, excepting where the name used by him is not strictly applicable to the "patch" under consideration.

It must be remembered, and not lost sight of, however, that the powder-down feathers occasionally are ill-defined in their limits. Indeed, oftentimes they are so few, scattered, and intermingled with the feather-tracts and spaces, that this doubtless has inclined such an accurate observer as Nitzsch to conclude that they possess no regular arrangement, excepting the lumbar and ventral patches. I trust, though, to show, from their disposition and abundance in the Kagu &c., that a probability exists of their not being diffused at random, but subject to a plan, or found within guiding lines, as are the other feathers.

(*c*) *Distribution and Nomenclature of the Powder-downs in* Rhinochetus.—I may premise that the above-termed feathering, as far as is known to me, is more fully and generally developed in the Kagu than in any other bird. In this respect it may be considered typical, not alone from the great masses or areas that are present, but from the very regular way in which they are distributed. I shall proceed, therefore, to describe at length their distribution in *Rhinochetus*, afterwards comparing with it those of the Sun-bittern, Boatbill, and forms allied and otherwise.

(1) In the Kagu (Pl. LVI. fig. 1), then, this remarkable dermal structure commences on the top of the head, above the eyes, and running backwards and downwards, on both sides of the crest, forms a broad but rather scanty collar round the neck. This latter, however, is thickest where it covers the angle of the mandible.

The whole of the powder-down feathers composing the above-mentioned patch are short, in some spots sparse, and throughout intermingled with the contour and true down-feathers of the spinal and ventral tracts.

Agreeably to, or in accordance with, Nitzsch's names of the feather-tracts and spaces, the position of the powder-down patch above described in the Kagu might either be the head-patch, the anterior portion of the spinal patch, or the gular portion of the ventral patch.

For the sake of precision, and withal not to confound it with the conjoined feather-tracts, it may, as a whole, be termed the cranio-nuchal patch. Its several subdivisions then, though not rigidly defined, nevertheless would bear respectively the additional affix of *head*, *nape*, and *throat* portions, according to their regional area. In Pl. LVI. figs. 1, 2, & 3, therefore, the patches mentioned are lettered in sequence Cn^h, Cn^n, and Cn^t.

The cranial portion of this upper neck-patch, as it divaricates, would lie on the outer margin, or enclose the head-space of Cockatoos &c.

If, however, it can afterwards be shown in other birds that this upper neck-patch is but an interrupted continuation of the dorsal or spinal patches yet to be spoken of, the above term, cranio-nuchal patch, might be so altered as to correspond with the divisions (*pteryla spinalis* of contour-feathers) anterior and posterior of the dorsal or spinal tract.

These are so separated from the head and upper patches in *Rhinochetus*, however, that I prefer to designate them as above.

(2) Two elongate, but diamond-shaped, thick-set patches lie below the middle of each side of the neck; and their inferior extremities reach to about an inch above the shoulder-joint. These powder-down patches are situate in the hollows between the trachea and the cervical vertebræ. Each is an inch in long diameter and a quarter of an inch across at the centre or point of greatest breadth.

They are completely isolated, and remarkably well defined from the other nuchal powder-down feathering and strips. They occupy what Nitzsch has denominated the lateral neck-space and tract.

Thus each may appropriately be termed the *lateral neck-patch* (*Ln*).

(3) Upon the dorsal aspect of the body are two remarkably extensive parallel and externally placed patches, which arise in a pointed manner at the lower end and on the back of the neck. Widening in front of the shoulder-joint, they pass over each scapula, and run along the back as far as the loins; whence becoming narrower, by their inner borders being lessened, they diverge and leave a wide, median, bare interspace; but the narrowed powder patches continue behind the space, and ultimately join *en masse* at the rump. The said interspace (* fig. 2, Pl. LVI.) is heart-shaped, an inch and three quarters long by half an inch broad; and the apex, situated anteriorly, is continued in a narrow line along the spine, forming the median separation of the dorsal patches.

The back patches of powder-downs just described, without doubt represent the dorsal and lumbar portions of the spinal tract (*pteryla spinalis*, Nitzsch). Viewed in this light, each lateral half accordingly ought to receive the name of spinal or dorsal *patch* throughout; but the *scapular*, *lumbar*, *iliac*, and *caudal* regional sections of the elongate strip might be denoted by the addition of these anatomical divisions to the above term. In the illustrations I have lettered them D^s, D^l, D^i, D^c, without specifying the imaginary rather than real boundary-lines.

The powder-down feathers composing the lumbar, iliac, and sacral portions of this dorsal patch have long plumose or brush-like extremities. These, during life, continuously throw off immense quantities of whitish powder. Mr. Bartlett (*l. c.* p. 219) mentions—"I have seen the bird enter the small pond and attempt to wash; and upon dipping partly under water the whole surface of the water was covered with a white film, like French chalk." This observation I myself have repeatedly witnessed, and can not only vouch for its truth, but may express my own astonishment at the marvellous quantity of powdery material given off by the bird.

It is a curious yet significant fact, that the double almond- or heart-shaped bare interspace met with in the sacral region of the Kagu, is precisely the spot and equivalent circumscribed area which in the *Balæniceps rex*[1] is occupied by two dense and plumose powder-patches. Of the bearings of this more hereafter.

(4) Near the rump of the Kagu, where the dorsal and abdominal strips of powder-patches join (that is, at the union of the iliac portion of the former and gastric portion of the latter, lateral sterno-ventral strip), the roots of the plumes are tolerably thick. Thence they reach forwards to the outside of the leg, where, however, they assume a sparse scattered disposition.

The place and general limits of this isthmus of powder-patch are identical with Nitzsch's "Femoral or Lumbar tract" (*pteryla femoralis seu lumbalis*), and fittingly may receive the name of *femoral* patch (F).

(5) A somewhat triangular and dense powder-patch is situated on each side of the

[1] P. Z. S. 1861, p. 132, fig. 1.

root of the neck, in the hollow just in advance of the shoulder. Its greatest diameter is about an inch. Superiorly and posteriorly it merges in the anterior portion of the scapular division of the dorsal patch already described. Externally, and also above, it is continuous with the brachial or shoulder portion of the humeral patch to be alluded to hereafter. Inferiorly, where in junction with the latter, it unites or even forms the origin of a long sterno-ventral strip, subsequently to be referred to.

The central powder-down in question, from which radiate the three divergent lines above mentioned, I name *Coracoid* patch (*Co*), its place being close to the upper end of that bone. Besides its trifid connexions spoken of, the coracoid patch has a fourth spur, more properly belonging to itself. This is no more than three quarters of an inch long, descends in front and to the inside of the others—in fact occupies linearly the furcular ridge; hence I distinguish it as the *furcular* portion of the coracoid patch (Co^f in figs. 1 and 3).

(6) On the mesio-ventral aspect of the neck, commencing rather above but between the posterior or lower end of the diamond-shaped lateral neck-patches, is a single, long, narrow patch. This strip, running in the median line, continues backwards upon the chest and abdomen, narrows linearly at the latter region, and then near the vent spreads out and joins the patches, heretofore mentioned, on the gluteal regions.

I have called it the *Carino-ventral* patch—*sternal*, *abdominal*, and *cloacal* segments (Cv^s, Cv^a, Cv^c) limiting as many portions of its course. It might as lief be denominated the inferior patch; for the inferior space (*apteria mesogastræi*) of Nitzsch is where this powder-down patch is found. The term inferior, to me, however, does not seem a good designation in the case of the powder-downs; hence I prefer adopting carino-ventral.

(7) Separated by a wide interspace from the carino-ventral strip, and occupying each outer moiety of the inferior aspect of the body for its whole length, are a pair of well-developed powder-down patches. Individually they interlace and arise from the coracoid and brachio-humeral patches, as before hinted. Descending upon the side of the breast, each patch runs backwards over the outer sternal region to the abdomen—thence being continued right on to the side of the rump, amalgamate with the caudal portion of the dorsal patch and partly with the cloacal segment of the carino-ventral patch. Named according to their situation, *Lateral sterno-ventral* patches express this; and specifying the anterior from their portions, *pectoral* and *gastric* are applicable, as lettered in Plates $L.s.v.^p$ and $L.s.v.^g$ respectively.

The pectoral part of each lateral sterno-ventral patch is comparatively narrow, but thickly set with short plumose feathers. At the commencement of the gastric part it widens, the powder-downs being in separate clumps towards the middle line of the abdomen, but more closely set outside, where a fork from the side of the chest joins it. Behind that it again narrows, and quite posteriorly spreads out as it turns round the rump.

(8) Upon the side of the body, close behind the root of the wing, there exists a

narrow, somewhat vertical powder-strip of feathering. Directed both downwards and backwards from the axilla to as far as opposite the knee-joint, it is there lost in junction with the right and left bands of the lateral sterno-ventral patches of the present nomenclature.

The powder-patch in question I shall call *Costo-thoracic* (*Ct*), corresponding as it does to the lateral tract (*pteryla lateralis*), which, according to Nitzsch, is nothing more than a branch of the ventral tract.

I shall consider the distribution of powder-downs upon each fore extremity of *Rhinochetus* as together constituting but a single area, to which collectively the term *humeral* patch (*H*) is applicable. This, however, is further divisible into four or five well-defined segments, viz. *brachial*, *axillary*, *cubital*, and *anterior* and *posterior alar* subpatches.

The first of these is that which I have spoken of as springing in part from the coracoid patch, of which in a sense it might be reckoned a spur or branch. Whether or not, this *brachial* portion of the humeral patch (H^b) proceeds from over the shoulder and clothes the interior proximal end of the humerus like an epaulette. It is narrowed at its lower extremity, is fully one inch long by three eighths of an inch at widest, and is moderately compact in feathering.

Besides the powder-downs which I have described as occupying the shoulder anterior humeral region, there is another less-defined area upon the wing, intermediate between the arm and forearm.

It appears, indeed, as a kind of continuation of the above, but is represented only by a series of sparsely scattered short feathers or plumes inserted on both sides of the alar membrane.

These, according to position, if considered distinctly separate, may be regarded as *alar* patches, upper and lower respectively, on each surface of the wing (H^{al^1} and H^{al^2} in illustrations, figs. 2 and 3, Pl. LVI.).

In virtue of their situation, alar patch is a significant term. The wing-tract (*pteryla alaris*) of Nitzsch in some measure includes this patch, while it comprises all the feathers inserted upon the wing, with the exception of those which form the humeral tract. The upper and lower wing-spaces (*apterium alæ superius et inferius*) also intrude upon the sparsely distributed alar powder-patches.

Another powder-down area, five eighths of an inch long and a quarter of an inch broad, is placed on the outer posterior and lower part of each humeral region. This I name, for distinction's sake, the *cubital* portion of the humeral patch (H^c in the left pectoral limb of sketch, fig. 2).

Lastly, near this there is a separate patch an inch and a half by a quarter of an inch in its different diameters, situated in the deep posterior aspect of the arm, and stretching between the axilla and the elbow in partially divided plumes.

If these otherwise defined humeral patches be considered but offshoots or isolated portions of a general clothing or upper-arm powder-down, then this last-mentioned portion would be the *axillary* division of the said humeral patch (fig. 3, H^{ax}).

The humeral feather-tract of Nitzsch, however, is entirely differently placed from these so-called humeral powder-down patches. The brachial subsidiary powder-downs previously adverted to, though not precisely agreeing, most nearly correspond with Nitzsch's *pteryla humeralis*, the others partially with the wing-tract plumage.

(*d*) *Comparison of the Powder-patches in other Genera of Birds.*—Herr Nitzsch and Mr. Bartlett have both said that the powder-down patches in the Sun-bittern (*Eurypyga*) are but two in number. I find, nevertheless, a much closer resemblance to that extraordinary distribution in the Kagu than I had supposed from the accounts of the above equally careful observers.

Taking those of *Rhinochetus* as representing the maximum of number or quantitative space, *Eurypyga* may be said to possess several of the heretofore described patches. Their development, however, is not by any means so profuse, neither are they so well defined. Indeed the most that can be affirmed is that the powder-plumes are there, remarkably short or stunted certainly, and very thinly scattered in some parts, so that it is their microscope structure that certifies as to their nature more than decided obvious presence. Withal their existence is appreciable to the naked eye on careful examination.

The following patches in the Sun-bittern, as compared with the Kagu, with the above proviso, were distinctly traced by me:—

1. The lateral neck-patches.

2. The dorsal patches. These, as in the Kagu, broaden out, and assume the plumose character in the lumbo-sacral region. The almond-shaped interspaces, however, are not left free or bare in *Eurypyga* as in *Rhinochetus*. On the contrary, in the former the spinal patches approach the mesial dorsal line. It is these ilio-caudal patches which Nitzsch and Bartlett believe only exist in the Sun-bittern.

3. The lateral sterno-ventral patches or stripes. They mingle with the caudal portion of the dorsal patch at the rump, as in the Kagu.

4. The costo-thoracic patches. Well marked, but not particularly plumose.

The subjoined were very indistinct:—

5. A coracoid patch barely indicated, evidence of its existence being surmised rather than substantiated by a few dark-coloured roots.

6. The brachio-humeral patch likewise sparsely represented by a few roots.

7. The same may be said of the axillary, humeral, and alar divisions.

8. There is an entire absence of a cranio-nuchal distribution, and barely, if at all, a vestige of cubital patches.

As regards the Boatbill, Mr. Bartlett has pointed out that in this bird four pairs of powder-down patches are present, whereas Nitzsch limited the number to three pairs. My examination enables me to coincide with the former author's observations, and to remark that his figures (2 and 3, p. 133, P. Z. S. 1861), though somewhat diagrammatic, are quite characteristic of the shape and position of the patches on the body of the bird.

I shall give my own notes on the subject, specially to show what the powder-downs in *Cancroma* are equivalent to compared with those of *Rhinochetus.*

There are two clavicular or sternally placed, elongated, oblique, thick patches; each is 1·4 inch long diameter and half an inch broad. The base of these is light-coloured.

They appear to be representative of the furcular portions of the coracoid patches of the Kagu, or more possibly the segregated segments of the pectoral portion of the lateral sterno-ventral patches in that bird.

Another pair of patches, 1·7 inch long and but a quarter of an inch in breadth, lie parallel to each other, but apart, on the hinder surface of the abdomen. These unquestionably are the gastric parts of the lateral sterno-ventral patches. It would seem, therefore, that in *Cancroma*, with a wide middle interruption, the last-mentioned remarkable belly-strips of *Rhinochetus* are demonstrable.

The third pair are very small indeed, being composed of not many more than a dozen plumes each; and they are placed on the back, towards the posterior extremity of the scapula. I homologize these with the scapular portion of the Kagu's dorsal powder-down patches.

The fourth and last pair, as Bartlett has truly rendered, but not so Nitzsch, are V-shaped, the apex hindermost.

The upper limb is widest, and lies upon the ilium; the lower outer narrower limb runs forwards along the posterior border of the gluteal region or towards the femoral region. Now of this pair of powder-downs I am inclined to regard the diverging forks as identical with the femoral patches, and the inner broad bands as the combined ilio-lumbar portions of the dorsal patches of the Kagu and Sun-bittern. Thus, like the belly, the back of the Boatbill has a broad interrupted space completely dividing what is one long dorsal strip of powder-patch in the two other avine forms.

The head and neck in *Cancroma* are void of any thing that I could recognize as powder-downs. Scattered on the wings and body there are traces of under down, but no powder-bearing plumes; even the down does not obtain in such quantity as in the common Heron. Those solitary hair-like feathers (filo-plumes, Nitzsch) seen abundantly in the Heron, are very few in number in the Boatbill, and what there are chiefly occupy the head.

Furthermore, it is worth mentioning that the roots of the powder-down patches, as in the Heron, are straw-coloured, and the plumes themselves pure white.

The Trumpeter (*Psophia*), placed on a level with *Rhinochetus* and *Eurypyga* by Parker, as "intimately related, *inter se*, and very closely also to the Cranes and Herons," offers a trenchant difference from the said genera in being devoid of powder-patches. The down-feathers, which, in the Kagu and Sun-bittern seem partially trans-formed or supplanted by the dust-bearing kind, have not been so arrested in *Psophia*, but are long, powderless, and with remarkably downy barbs and barbules on the contour-feathers.

In the *Ardeidæ* the powder-downs are not diffused, but restricted to patches, which Nitzsch shows number three or two pairs. I have myself, however, detected a very few solitary rootlets, here and there, in the body of the Great White Egret.

It seems, according to the above authority, that pectoral and rump-patches obtain in all the group, and, with the exception of the Common and Little Bittern, also inguinal patches. Those on the hip doubtless constitute my so-called caudal clump of the dorsal patch; while the inferior segregate areas may be either homologous with separated extremities of a long *lateral ventral* strip, or simply *furcular* and *crural* patches.

In the Common Heron, several of which came under my inspection, I have been impressed with the resemblance between its powder-down patches and those of the Boatbill. They are of a darker straw-colour, however, at the roots, and each feather-thread stronger. The rump-patches I have noticed incline towards the femoral region, therefore carried but a stage further in *Cancroma*, and the abdominal patches similarly bridge outwards to the groins.

Whatever may be the affinity of the three Gralline forms (the gist of this Memoir) to the Cranes, *Grus* and its generic modifications resemble neither in their absence of powder-down plumage. The Storks and Ibises are equally unprovided.

Among the family Psittacidæ some of the Cockatoos are notorious for free sprinkling of chalky dust, as those who may have handled a *Cacatua cristata* can well substantiate. Others are destitute of apparent pulverulent secretion. These facts had long been known; but the nature of the powder-bearing feathers was not collated and associated with those plumose powder-clumps in the Wading Birds until the issue of Nitzsch's thesis 'Pterylographie.'

Species of the following genera of Parrots are said to have scattered powder-downs[1]:—*Cacatua*, *Chrysotis*, *Psittacus*, and *Calyptorhynchus*. I think *Licmetis* possibly might be added. The genera individually examined by Nitzsch and found to be perfectly deficient in the modification of plumage in question are:—*Ara*, *Conurus*, *Pionus*, *Psittacula*, *Palæornis*, *Platycercus*, and *Trichoglossus*. To my own knowledge, besides the foregoing, species of the genera *Brotogerys*, *Electus*, *Loriculus*, *Lathamus*, *Geopsittacus*, *Melopsittacus*, *Calopsitta*, *Euphema*, and others show no sign, even in rootlets, of the development of powder-down.

I have less desire in this place to lay special stress on the Psittacine subfamilies, or otherwise, which have powder-downs, than to establish the *primâ facie* inference that their supposed irregular disposition of the latter harmonizes with the leading lines or patches demonstrated in the Kagu and other Grallæ. Two species of different groups

[1] See Ray Society's translation of Nitzsch's Pterylography, p. 98 *et seq.*

are sufficient for my purpose; and by describing one I include the other, so nearly identical are they.

Ducorps's Cockatoo[1], *Cacatua ducorpsii*, Hombr. et Jacq., is that which I have illustrated (Pl. LVI. fig. 11); the other, the Grey Parrot, *Psittacus erithacus*, I intercalate in the text. In the first cited every short, dumpy, powder-down feather is unequivocally distinct and full of dust, the larger rump-plumes being *en masse*; all are white. The second species has smaller and darker-coloured feathering, so that the rough definition is less salient and striking when the contour-feathering is removed.

Upon the back of the head and neck small, delicate, single-rooted, and promiscuously scattered powder-down feathers obtain (see fig. 11, *C.N*) equivalent to a *cranio-nuchal patch*.

Lateral neck-patches are absent in *C. ducorpsii*, but foreshadowed in *P. erithacus* by only a few strong featherlets.

Clavicular and breast-puffs (*i. e. furcular coracoid*) and pectoral portion of *lateral sterno-ventral* patches are met with in the latter bird, but not in the former. They are small, short, and rather separately dispersed.

In the Cockatoo two or three featherlets may be recognized on the alar membrane, *humeral alar* (H^{al1}, fig. 11); none are distinguishable in the Parrot.

The *dorsal* patches in both species are in greater profusion (D^s, D^l, and D^c in fig. 11); and the caudal bunch of long plumes cannot be mistaken.

No manifest *costo-thoracic* or *femoral* patch is discernible in *P. erithacus*; but both are sparsely represented in *C. ducorpsii* (*C.T* and *F*).

In the Grey Parrot's groins and front of tibia, as far as its middle, scattered pens obtain; I did not specially note them in Ducorps's Cockatoo, although they may be present. Such last powder-feathers indicate tendency to *crural* and gastric portions of *lateral ventral* patches.

Of whatever importance as an item of affinity may be the development and distributive amount of powder-down patches among families of birds, it certainly has less weight as evincing relationship betwixt the higher orders. For example, we should hardly be prepared to admit it as a strong bond uniting such genera of the Grallæ and Psittaci as possess it with the widely different Accipitres, several of which Nitzsch has shown have more than a fair sprinkling. Moreover its isolated presence in single species and genera of Passerinæ (*Ocypterus*), Gallinæ (*Tinamus*), Picariæ (*Podargus* and *Leptosoma*[2]) forbids the idea.

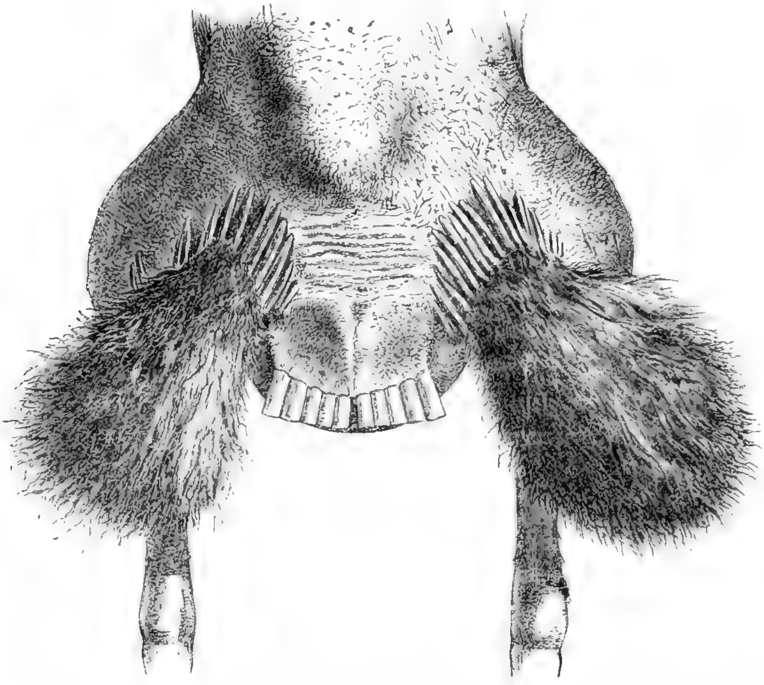
Let us for a moment glance pterylographically at the powder-downs in these diverse groups. Those beautiful plumose clumps on the rump of the *Podargus* and Green *Leptosoma* evidently consist of a posterior remnant of the lengthened dorsal patch in

[1] A specimen of this rare form is delineated in our 'Proceedings,' 1864, pl. xvii.

[2] Dr. Sclater is inclined to regard the *Leptosoma discolor* as structurally approximating to the Coraciidæ more than to the Cuculidæ. This bird has prominently a pair of ilio-dorsal powder-patches.—P. Z. S. 1865, p. 686, fig. 5.

the Kagu and Cockatoo; and in their insulation closely resemble the ardeine patches. Although Nitzsch[1] affirms of the Variegated Tinamou (*Crypturus variegatus*) that its powder-down feathers of themselves form no true tract, but are inserted into the gaps of the contour-feathers of the dorsal tract, in fact enclose as a fringe the hinder dilatation of the latter; yet a comparison of his description and figure with what obtains in *Eurypyga* and *Rhinochetus* persuades me that these powder-downs are a stage or relic of their mid-elongate *dorsal patch*—in short, are developed consistently with the nature and disposition of the dorsal contour-feather tract in the Tinamou. Again, we

Fig. 6.



Hinder segment of the body of *Podargus cuvierii*, nat. size, stripped of feathers, excepting the pair of lateral sacral powder-down plumose patches.—From P. Z. S. 1866, p. 582.

find, in the same author's description[2] of the peculiar powder-down strips in *Ocypterus leucorhynchus*, that these, three or four on each side, are fringes to the rhombic saddle of the spinal, femoral, and lateral branches of his inferior contour-tracts—as I would interpret, costo-thoracic, femoral, and dorsal powder-patches, the latter only developed as an ilio-lumbar segment compared with the Kagu. Of the Rapacious birds *Gypaëtus barbatus*, at least in my reading of Nitzsch's observations, possesses, as do the Cockatoos, a sparse distribution, on the head and neck, of what I term cranio-nuchal

[1] Ray Society's ed. pp. 38, 117, tab. viii. fig. 12.

[2] *Op. cit.* pp. 38, 80, tab. iii. fig. 4.

powder-down patch. Others (the noble Falcons and the Kites, to wit) have short, or more elongate, dorsal powder-down patches.

The above distinguished ornithologist, while in general disallowing or, more strictly speaking, not accepting the dust-bearing feathers as being distributed in special tracts, subsidiary or equivalent to his contour-feather lines and featherless interspaces, nevertheless was shrewd enough partially to employ them for characterizing a few of the species of Falconidæ. He shows that in *Elanus furcatus* there is a large powder-down strip on the hinder surface of the back, but that in *E. melanopterus* and *Cymindis uncinata* they form two symmetrical tracts on the sides of the pelvis.

Furthermore, even laying more weight on the shortening and lengthening of this obvious dorsal powder-patch, he says[1], "but the Harriers may be with more certainty distinguished as a form differing at least from all other European Falcons by the powder-down tracts which ascend on each side of the dorsal portion of the spinal tract as far as the shoulders."

It follows, from what precedes, that mere possession of powder-down feathers does not prove alliance of ornithic orders—but species, genera, and subfamilies in some instances indicate their connexion or distinctness by the restricted or profuse character of their powder-down patches,—also that this continuously growing plumage casting off dust-particles is not indiscriminately strewn among the feathering, but occupies in all birds, where present, different areas referable to a type whereof the Kagu affords a well-developed example. The powder-downs, besides, may be closely aggregated in a brush, set in serried ranks, or even only discernible as short sproutlets intermingled with the ordinary down-, contour-, and other feathers.

2. *Tegument of the Lower Limb.*

The superficial dermal vestment of the lower extremities of the Kagu presents the subjoined characteristics, which are more or less displayed, on a reduced scale, in the accompanying figs. 4 & 5, Pl. LVI. The legs and feet are clothed with bright orange-coloured cutaneous scales, having the following shapes and dispositions:—At the tibio-tarsal joint in front are numerous (17 or 18) rows of very small roundish or polygonal scales, which diminish in numbers (12) laterally. Behind the same joint, and slightly on a lower level, are a score or more somewhat larger transverse scale-plates, some of which at the sides have tiny marginal attached scales, these inter-digitating with the common intervening lateral ones. In front of the tarso-metatarsal bone are some twenty large scutes or scales stretching from side to side of this part of the leg, but leaving clear longitudinal side interspaces between them and the posterior scutes. The middle dozen or thereabouts of these anterior scales assume very convex upper and concave lower margins; but those placed at the proximal and distal extremities of the long bone become less arched in form, while decreasing likewise in

[1] Pterylography, p. 66, Engl. ed.

depth. Their general direction is not quite horizontal, but obliquely inwards and downwards. The tarso-metatarsal bone behind is clad somewhat similarly with as many transverse scales; but these differ from the preceding in a considerable diminution of size both towards the upper and lower extremes of the rod-figured tarsus. The middle toe on its dorsal aspect has a serried row of narrow cross scales from its root to the nail; they are subequal in dimensions, excepting at the first and second joints, where they are narrower.

At the proximal ends of the three toes, or over the tarso-phalangeal joints, is a patch of minute ovoid scales. These occupy the entire breadth of this part of the foot, and alter, as they approach the dorsal tarsal scutes, into broader single scales, which, however, are separated by an interspace of smooth yellow tegument. The hind toe is shortest, and has fewest scales. The entire sole is besprinkled with minute, punctate, roundish scalelets. All the claws are tolerably solid, the hind one most curved; edges smooth.

Taken in the aggregate, and bearing in mind that the legs of the Sun-bittern are short and slender, contrasted with the Kagu, they are not unlike each other so far as figure and disposition of the scales are concerned.

It is unnecessary to describe in detail the leg-coverings of the Boatbill, as the comparison I shall institute together with the figures given (Pl. LVI. figs. 7 & 8), will enable the salient distinctions between it and the two foregoing birds to be distinctly appreciated.

The scales behind and in front of the tibio-tarsal joint are very abundant, but the parallel cross linear arrangement is obscure. The long tarso-metatarsal bone, instead of bearing transverse scutes, is beset before and rearwards with great numbers of moderate-sized hexagonal scales. The upper surface of the toes has cross scaling as in the Kagu; but the skin at their sides and the angle of junction is studded with minute hexagons. The middle toe-nail is serrated on its inner concave margin.

3. *The Beak.*

Two out of the three forms which I have brought together approximate in the shape of the beak. Those agreeing are *Rhinochetus* and *Eurypyga*. *Cancroma*, on the contrary, is most remarkable on account of the anomalous breadth of this organ, which bears a great resemblance to that of the great-billed *Balæniceps*.

In the Ardeine birds generally, Herons, Bitterns, and Night-Herons, the beak is of an elongate pickaxe-shape, more or less straight, and somewhat laterally compressed. The colour is often yellow, leaden, or dark-tinted.

As respects shape the beak of the Kagu agrees with that organ in the above-mentioned group; but in colour and other particulars it has characters of its own. It is distinguished by being of a bright orange tint, as are the legs. There is a very slight longitudinal descending curve; the root is 0·3 inch deeper than broad. Length 2·4, and extreme depth 0·8 inch.

The upper mandible is quite flat above at its middle third; and the peculiar nostril-lids give prominence and breadth to the basal part.

The openings of the nostrils in most of the Ardeidæ are situated proximally to the length of the beak. Such is the case in the Kagu. In it each orifice is 0·7 inch long, and provided superiorly with an elliptically shaped fold of tough cutaneous membrane, coloured like the horny beak. The said overhanging membranes form two scroll-like lids, hinged or attached above. These protect the external nares without entirely closing them while the beak is not in use[1].

The legitimate use of these lids, however, appears to be prevention of foreign matter entering the nostrils when the bird, as is its habit, digs into the soft soil for its food[2].

The manner of closing the above nasal apparatus is as follows:—As the nostril approaches the ground and is touched, its anterior part, having a plough-share formation or scroll-like contour, sends the earth upwards or over it. The springy semi-elastic lid, from in front to behind, is pressed down and inwards, finally completely closing the aperture as the beak is thrust deep into the earth in search of its living prey.

Eurypyga, in the comparative length to breadth of the beak, approaches more to the true Herons than does the Kagu; the latter has semblance rather to the Night-Herons. Neither has the Sun-bittern the anterior depressed curve of beak of the two last-mentioned forms. In *Eurypyga* the beak at the sides is more compressed; the dorsal ridge is sharper, and it wants the upper flattening present in the Kagu. The nostrils are simple, narrow, longitudinal slits, each 0·25 inch long, and they are not protected by a lid, the upper margin being rigid as is common in the Ardeines.

The simplest statement of a comparison between the bills of *Cancroma* and the two preceding genera is to say that they are totally unlike each other. From the pickaxe-model of the Kagu's beak, so admirably adapted for thrusting and digging into soft soil, we find a reduction as to strength, form, and purpose in the more elegant-beaked Sun-bird. In the Boatbill, however, true to its name, an entire reversal in the figure of the premaxillary region gives to the beak that character whereby the bird is known, and, significantly unfitting the bill for instrumental use as a sharp earth-cleaver, transforms it into a grappler of fish.

Mr. Parker, in his valuable Osteology of the Shoebill (*Balæniceps rex*)[3], doubtless was in one of his playful moods when describing the præmaxilla of that extraordinary

[1] One of the American Rails is distinguished from its fellows by a nasal appurtenance somewhat similar in kind to that of the Kagu, this minor link establishing structural approximation. In their 'Synopsis of the American Rails' (*Rallidæ*), Messrs. Sclater and Salvin on this account exclude from *Porzana* the species *shomburgki*, ranking it as a separate genus, *Thyrorhina*.—P. Z. S. 1868, p. 458, fig. 1, upper and profile view of head.

[2] Mr. Bartlett succinctly, but graphically, describes the bird's manner of feeding, its grubbing up earth-worms with evident relish.—See P. Z. S. 1862, p. 219.

[3] Trans. Zool. Soc. vol. iv.

form; yet his odd expressions are woefully true, as I have seen the bird in its native haunts on the White Nile. That "solemn, wise, but somewhat sinister aspect" borne by *Balæniceps* is retained in a manifest degree in *Cancroma*, though the bird's diminished volume and stature take away from its becoming gravity, and give it a sad comical expression in its quiet moments. But its whole demeanour is changed and lighted up when the prospect of food arrests its attention.

With regard to salient resemblances and differences between the bones and beaks of the Boatbill, Shoebill, and various Gralline and other forms, Mr. Parker's remarks are all that could be desired. I shall add merely a few notes on my specimen as specifying size &c., directing the attention of the reader to the accompanying sketches figs. 9 & 10, Pl. LVI.

The beak of *Cancroma* is black, more particularly above, but with a yellowish horny rim at the lower edge of the premaxillary element and the anterior half of the lower mandible. Length from tip to nasal feathers 3 inches, breadth at the middle 1·6 inch, vertical depth at the same place 1·3 inch. The distance between the anterior rim of the eyelid, the angle of the gape, and the beak-tip, in each case is $3\frac{1}{2}$ inches, from the latter point to the posterior end of the nasal aperture 2·8 inches, the length of the aperture of the nasal scooping 0·4 inch, the separation between the nostrils 0·6 inch. Above there is an interval of 1·4 inch betwixt the eyes. The diameter of the positively great eyeball is 1 inch; its anterior surface is about half that behind the nasal orifice. There is a well-developed and broad sclerotic ring, which is large, as in the Kagu.

As Parker has observed, when seen in profile, the dorsal ridge of the beak of the *Cancroma* is convex in its whole extent. In this respect it differs from the central gently valleyed and boss-rooted mandible of *Balæniceps*; and, moreover, it is still further removed from the comparatively ridgeless beak of *Eurypyga* and *Rhinochetus*.

The very shortened Gallinaceous bill of *Psophia* is widely distinct from the preceding Gralline forms.

II. Visceral Structures.

1. *Mouth and Organs of Digestion.*

The tongue in the Kagu (Pl. LVII. fig. 12, *t*) is lanceolate, 2 inches long, with tip and under surface horny, grooved above and sharply convex beneath. At the root, where the cerato- and basi-hyals join, there is a transverse crenate fold or fringe, its concavity being directed backwards.

The Sun-bittern agrees, excepting that the organ is smaller. *Cancroma* differs from both in having a relatively broader, flat, arrow-shaped tongue (fig. 19, *t*), which, being only an inch long, stops far short of the symphysis. It is cartilaginous, excepting the outspread angular root-processes, which are soft, fleshy, and smooth-margined. As in the Pelican, there is a great, wide inframandibular membrane stretching between the rami, and upon which the tongue rests posteriorly; but in the Boatbill it does not form such a vast gular pouch as obtains in the Pelican. The short-tongued *Balæniceps*[1] shows its affinity to *Cancroma* also in this particular.

In *Rhinochetus* and *Eurypyga* the palate is awl-shaped, mesially cleft (1·4 inch in the former), and provided with two separate transverse serrate folds. Of these the anterior is concave, and the posterior convex, in their backward direction. In the Kagu the folds are 0·7 inch apart, and occupy fully the hinder third of the palate.

The roof of the mouth in the Boatbill, as in the great Shoebill, corresponds to the enormously distended præmaxillæ. The entire length to the fauces is some 4 inches, and the breadth $1\frac{1}{2}$ inch, in the adult bird. It is slightly arched in both diameters; so that outwardly and inwardly the beak is decidedly boat-shaped. The postnares open by a mesial elliptical slit, 0·7 inch long.

In Pl. LVII. fig. 13, I have given a reduced sketch of the viscera of the Kagu in place as seen when the abdomen was opened. The following notes were made at the time. A thick layer of fat, similar to that coating the ventral surface of the body, lay superficially, and covered the gizzard, intestines, and almost the entire rectum and neighbouring parts. On removing the fat, a portion of the bilobed liver was exposed posterior to the sternum. The left lobe (*L.l*) reached further back than the right (*L.r*); and from underneath the former the gizzard (*Gz*) jutted into the abdomen. The right anterior moiety of the abdomen is chiefly occupied by the intestines, pancreas, and portion of the cæcum. The rectal portion of the gut (*R*) is free for an inch befoıe it forms the cloaca (*Cl*), and, as mentioned, is covered and laterally padded by the peritoneal fat.

The œsophagus proper in the Sun-bittern and Kagu is thin-walled and of moderate, nearly uniform diameter throughout. There is no crop as in the Gallinaceæ. In the Boatbill the œsophageal tube (fig. 20, *Œ*) is distinguished from the preceding by great width in its upper half; thence it tapers downwards very considerably. Above the parietes are thinnish; but below, where narrower, they become more muscular.

Figures 14 & 15, Pl. LVII., are designed to show the digestive cavity of *Rhinochetus jubatus*—in its outward aspect, and opened to display internal structure. The proventriculus (*Pr*) exteriorly has but moderate enlargement, and there exists only a slightly sensible constriction between it and the gizzard (*Gz*). Both divisions of the partly compound stomach have soft muscular walls; and the rounded but purse-shaped gizzard has anteriorly a small "central" glistening tendon (*t*) to the left, posteriorly another more to the right or close to the pylorus. The proventricular glands are numerous, and appear as minute punctate elevations on its mucous coat, which is thrown into longitudinal folds. The interior of the gizzard is chiefly plicated lengthwise; but an intervening strip, dividing and defining it from the proventricular area, markedly distinguishes itself by numerous cross furrows, which give quite a chequered appearance to the part. These smaller transverse grooves extend round the narrow,

[1] Parker, *op. cit.* p. 317.

raised, ring-like pyloric orifice (*py*). They are entirely absent in the Sun-bittern, which otherwise resembles the above form. The epithelial lining or inner coat of the gizzard is pale-coloured, horny, but not by any means so hard and coriaceous as in some birds.

The proventriculus of *Cancroma* (*Pr*, Pl. LVII. fig. 20) differs from the Kagu's, and still more from that of *Eurypyga*, in possessing considerable enlargement, and in being both relatively and absolutely larger than the corresponding cavity of the gizzard (*Gz*) when in its contracted condition. Both digestive organs in all three birds agree in the fleshy nature of their walls and in the limited size of the central tendon of the gizzard.

The intestines of the Kagu, upon leaving the gizzard, form a loop of 2·3 inches, wherein lies a rather large, double pancreas (Pl. LVII. fig. 14, P^1, P^2); beyond are several intestinal coils, with an average diameter of 0·3 inch. Previously to the gut constituting the great intestine it narrows by half, then suddenly widens into the latter as a horseshoe-shaped dilatation (fig. 16), the backward prongs of which are cæcal appendages (*Cæ*). The expansion spoken of has a breadth of 0·9 inch, and is continuous with each wedge-like but blunt-pointed cæcum. The latter are unequal in size, the right one (*r*) being rather the larger. It is half an inch long from where it is in contact with the small intestine, but may be reckoned 1·2 inch in extreme length, or from tip to the curve of the horse-shoe-figured enlargement. The rectum is lopsided, inasmuch as it springs from the left moiety of the ileo-cæcal swelling; it is three inches long, and quite half an inch in diameter.

The most notable difference in the Sun-bittern's intestinal tract, besides shortness and relative smallness of calibre, is the diminutive size of the cæca (see fig. 18). These are free no more than 0·2 inch, correspondingly narrow, and without the basal enlargement or swelling at the ileo-cæcal junction which obtains in the Kagu.

In the Boatbill (Pl. LVII. fig. 20) the duodenal loop is 3 inches; the cæcum single, a mere nipple-like projection, 0·1‴; and the commencement of the great intestine somewhat cylindrically swollen.

I further observed in the specimen examined, and about the middle of the intestines, a small diverticulum equivalent to or slightly larger in size than the cæcal appendage. This sacculus (*v*, fig. 20) appeared to represent or be the remnant of the vitelline sac of ovo-fœtal life, although, as far as likeness was concerned, it might have been taken for a second cæcal appendage. A relic of developmental structure, this process has not the zoological importance of the cæca coli, having been found in several of the Grallæ (*Rallus*[1], *Psophia*, and others). Owen mentions[2] meeting with it in the Gallinule half an inch long, and in the Bay-Ibis (*Ibis falcinellus*) an inch in length. But the *Apteryx*[3] &c. also possess it.

As regards the thickish ovate and partly bilobed liver, it is nearly identical in

[1] Meckel, Anat. Comp. t. viii. p. 233, note by Dr. Schuster.

[2] Aves, Cyclop. of Anat. and Physiol. vol. i. p. 323.

[3] Trans. Zool. Soc. vol. ii. p. 268.

Eurypyga and *Rhinochetus*, excepting size, but presents a marked difference in *Cancroma*. In the two former the left lobe or moiety is smaller than the right, whereas in the latter the reverse obtains. The bifid character of the hepatic organ is manifest by a deep incision at the upper and lower borders; the surface otherwise is smooth. In the Kagu the gall-bladder is roundish; of more elongate figure and larger in the Boatbill. In the first mentioned it occupies a position in a line with the fissures, but is to the right of that in the last-mentioned bird.

The three avine forms compared have each a small, fusiform, less or more elongated spleen (*Sp*, figs. 14 & 20), and attached to the proventricular muscular wall.

2. *Respiratory, Circulatory, and Urinary Apparatus.*

The aperture of the rima glottidis in the Kagu is narrow and elliptical. The thyro-arytenoid muscles are tolerably well developed. From the rima back they are divided by a deep fissure; and this and their posterior superficial membranous covering are marginally fringed with spines.

The trachea, 5·6 inches in length, is widest above, and narrows very gradually to 0·2 inch diameter before reaching the usual bifurcate bronchial divisions. In the upper third of its course the trachea lies in front, inclines towards the right in the middle, and is decidedly to the right side of the fleshy part of the neck at its lowermost third.

Save less magnitude, the same parts in the Sun-bittern accord with the above.

The mesial and floor pharyngeal territory, or that intervening between the root of the tongue and the fissure of the glottis, is in *Cancroma* equal to the tongue in length; whereas it is no more than a third of the tongue's length in the two above-mentioned species, as in the Gruidæ and true Ardeines. In this relation of the parts the "Whale-headed" *Balæniceps* conforms to its broad-billed prototype; and they furthermore agree together and differ from the others in a remarkable shortening of the uro-, basi- and cerato-hyals.

The glottidean aperture in the Boatbill appears above as a narrower but somewhat longer chink than in the Sun-bittern and Kagu; and the upper larynx is more swollen than in them. As in them, however, the calibre of the trachea is greater superiorly than inferiorly. Length 7 inches; upper 0·3, and lower diameter 0·2 inch; the narrowing commences well up, reaches its minimum about the middle of the tube, continuing so towards the bronchi. Before divaricating, the trachea exhibits a peaked prominence.

The lungs in all three species present no remarkable features; the intercostal fossæ, wherein the pulmonary structure is lodged, are shallow.

The heart (Pl. LVII. fig. 17) apparently differs only in size in the three specimens. The aortic arch, as usual in birds, divides into three subequal branches, the innominata being very short.

The Kagu and Sun-bittern possess two glandular structures which are absent in the

Boatbill, or, if they exist in the latter, are so minute as to escape observation. The glands in question are representatives of thyroid bodies. Each in the Kagu (fig. 17, *T.Gl*) is about 0·4 inch diameter, soft, subspherical, and lies outside the bronchus and bronchio-tracheales muscles.

The arterial divisions of the aorta so pass upwards, alongside, and behind them as to simulate their entering the thyroid body, which in reality they do not.

Accommodating themselves to the shallower and shorter pelvo-sacral depressions, the kidneys in all three avine species are of moderate size. In the Kagu each renal organ (1·6 inch long and 0·6 inch in widest diameter) has a figure-of-eight shape, the anterior lobal extremities being connected by a glandular bridge 0·3 inch across. In *Eurypyga* they seem divided into three lobes, the anterior one largest and less sunk than the hinder ones. This disposition obtains in *Cancroma*, the front oval-shaped superficial lobe pointing outwards.

DESCRIPTION OF THE PLATES.

PLATE LVI.

Fig. 1. Distribution of the powder-down patches in the Kagu (*Rhinochetus jubatus*). Profile view of the body; the wing and leg severed, and the body disrobed of all feathering, excepting that yielding the powder-down. Reduced to $\frac{2}{3}$ nat. size. In this and two subsequent figures the powder-down patches are designated as follows:—

$C.N^h$. Cranio-nuchal *head* patch.
$C.N^n$. Cranio-nuchal *nape* patch.
$C.N^t$. Cranio-nuchal *throat* patch.
L.N. Lateral neck-patch.
D^s. Dorsal *scapular* patch.
D^l. Dorsal *lumbar* patch.
D^i. Dorsal *iliac* patch.
D^c. Dorsal *caudal* patch.
$C.V^s$. Carino-ventral *sternal* patch.
$C.V^a$. Carino-ventral *abdominal* patch.
$C.V^c$. Carino-ventral *cloacal* patch.
H^b. Humeral *brachial* patch.
H^{ax}. Humeral *axillary* patch.
H^c. Humeral *cubital* patch.
$H^{al\,1}$. and $H^{al\,2}$. Humeral (anterior and posterior) *alar* patch.
F. Femoral patch.
Co. Coracoid.
Co^f. Coracoid *furcular* patch.
C.T. Costo-thoracic patch.
$L.S.V^p$. Lateral sterno-ventral *pectoral* patch.
$L.S.V^g$. Lateral sterno-ventral *gastric* patch.

Fig. 2. Dorsal view of the powder-down patches of the same bird. Lettering as mentioned above. *Og*, oil-gland.

Fig. 3. Ventral aspect. The tongue removed, so as to exhibit roof of mouth, palatal cleft, and appendages. Lettering corresponding to that of figs. 1 and 2.

Fig. 4. Lower half, left leg of the Kagu, about $\frac{3}{4}$ natural dimensions.

Fig. 5. Lower half, left leg of the Kagu, seen from within.

Fig. 6. Left nostril of the Kagu, opened, about nat. size: *l*, movable lid dragged up.

Fig. 7. Tarsal segment, left leg of Boatbill (*Cancroma cochlearia*).

Fig. 8. Tarsal segment, inside view, $\frac{2}{3}$ nat. size.

Fig. 9. Upper view, skull and beak of Boatbill, with eyes and temporal muscles unremoved, $\frac{2}{3}$ nat. size: *n*, nostril; *c*, carina, *n*, nares; *te*, temporalis.

Fig. 10. The same in profile, with mandible attached.

Fig. 11. Reduced sketch of Ducorps's Cockatoo (*Cacatua ducorpsii*) with plucked feathering, exposing alone the distribution of the powder-down patches and roots of tail-feathers. What lettering there is present refers to powder-down patches homologous with those of Kagu, *vide suprà*, fig. 1.

PLATE LVII.

Fig. 12. Tongue, upper larynx, and hyoid of the Kagu, nat. size: *t*, tongue; *R.g*, rima glottidis muscle; *Th.h*, thyro-hyal, on lower right side.

Fig. 13. Reduced sketch of the abdominal viscera of the Kagu *in situ*: *St*, sternum; *L.r*, liver, its right, and *L.l*, its left lobe; *Gz*, gizzard; *I*, intestine; *r*, rectum; *Cl*, cloaca.

Fig. 14. Stomach &c. of Kagu, rather less than nat. size: *Œ*, lower portion of œsophagus; *Pr*, proventriculus; *Gz*, gizzard; *t*, tendon; *D*, duodenal loop; P^1 & P^2, pancreas, first and second portions; *Sp*, spleen.

Fig. 15. Stomach of *Rhinochetus* opened, about life-size. Letters as in preceding figure: *Py*, pyloric orifice.

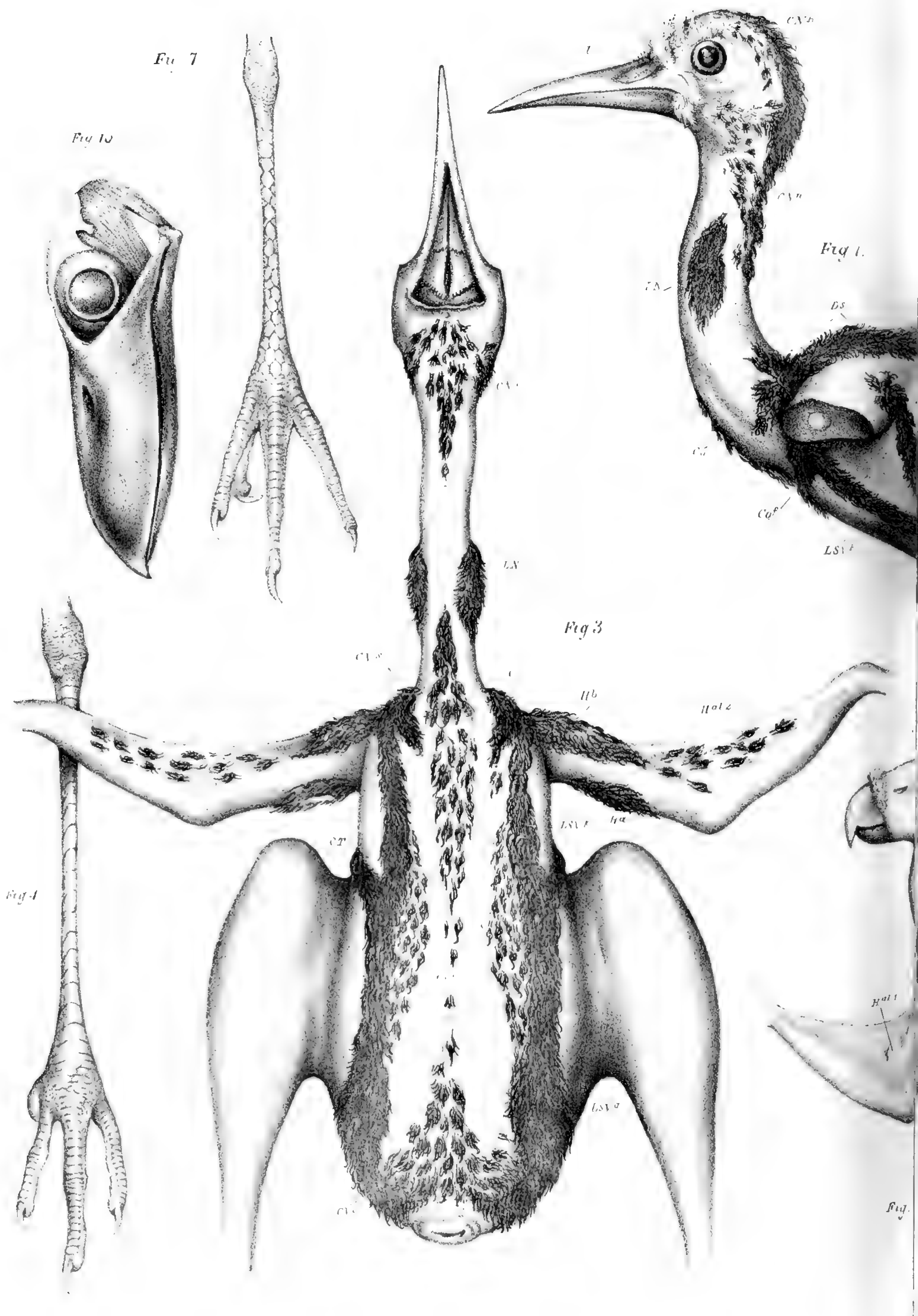
Fig. 16. Junction of ileum and colon, with distended cæcal appendages, in the Kagu, nat. size: *i*, ileum; *c*, colon; *cæ*, cæcal diverticula; *r*, that of the right side.

Fig. 17. Heart and great vessels, lower larynx and glands of the Kagu, nat. size: *Ao*, aorta trifurcating, the arteries passing between *T.Gl*, the thyroid glands, and *Bt*, broncho-tracheal muscles; *St*, sterno-trachealis of right side cut short.

Fig. 18. Portion of the intestine of the Sun-bittern (*Eurypyga helias*), with *Cæ*, cæcal appendages, to the scale of nature.

Fig. 19. A view, about nat. size, of the floor of the mouth, superior larynx, tongue, and hyoid of the Boatbill (*Cancroma*): *t*, tongue; *R.g*, rima glottidis; *m.e*, mandibular membranous expansion.

Fig. 20. Entire digestive canal of the same bird, also of natural dimensions: *Œ*, œsophagus: *Pr*, proventriculus; *Gz*, gizzard; *Sp*, spleen; *Pa*, pancreas. The vascular distribution is shown on the duodenal loop. *Cæ*, cæcal appendage; *v*, vitelline diverticulum; *Cl*, cloaca.



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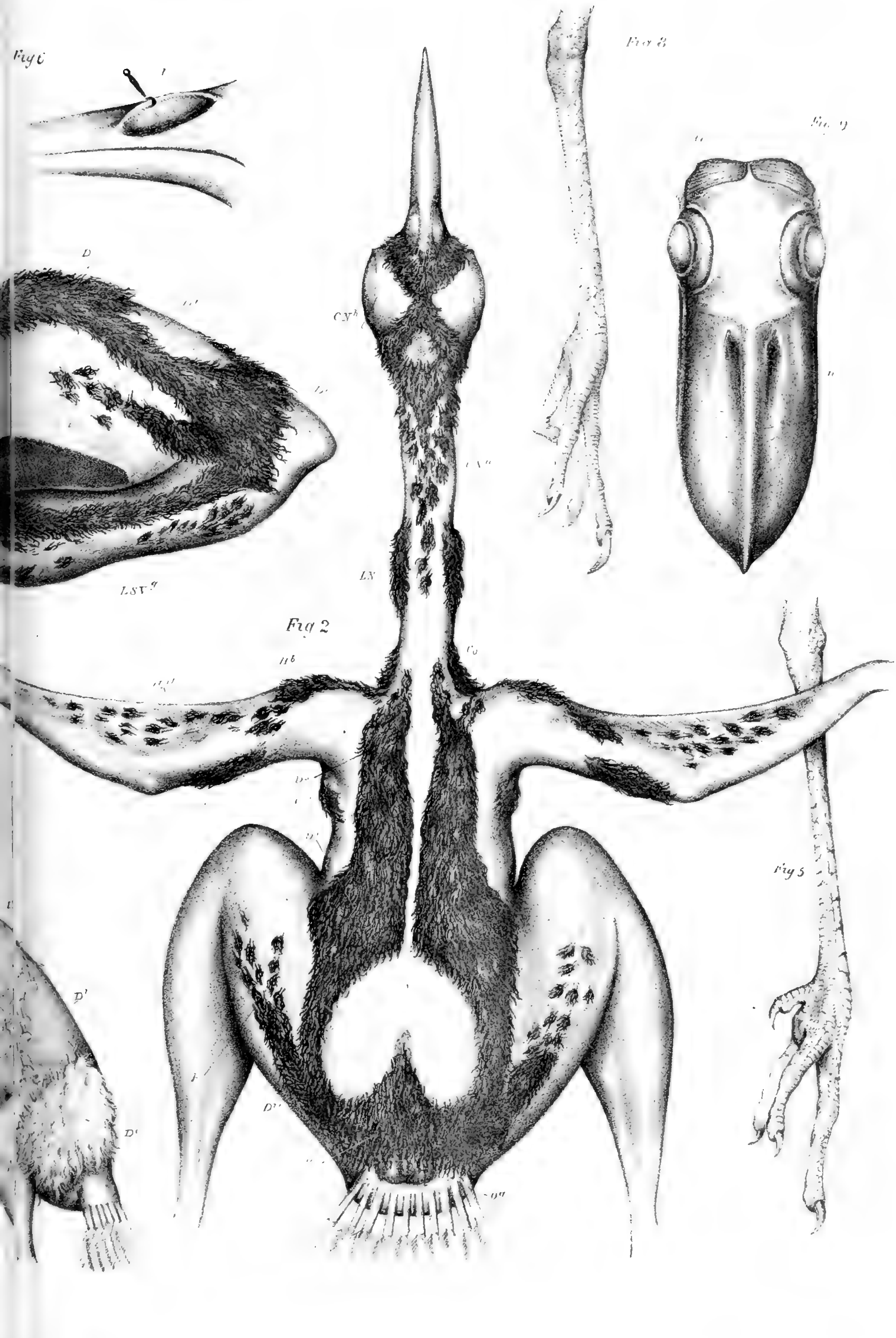

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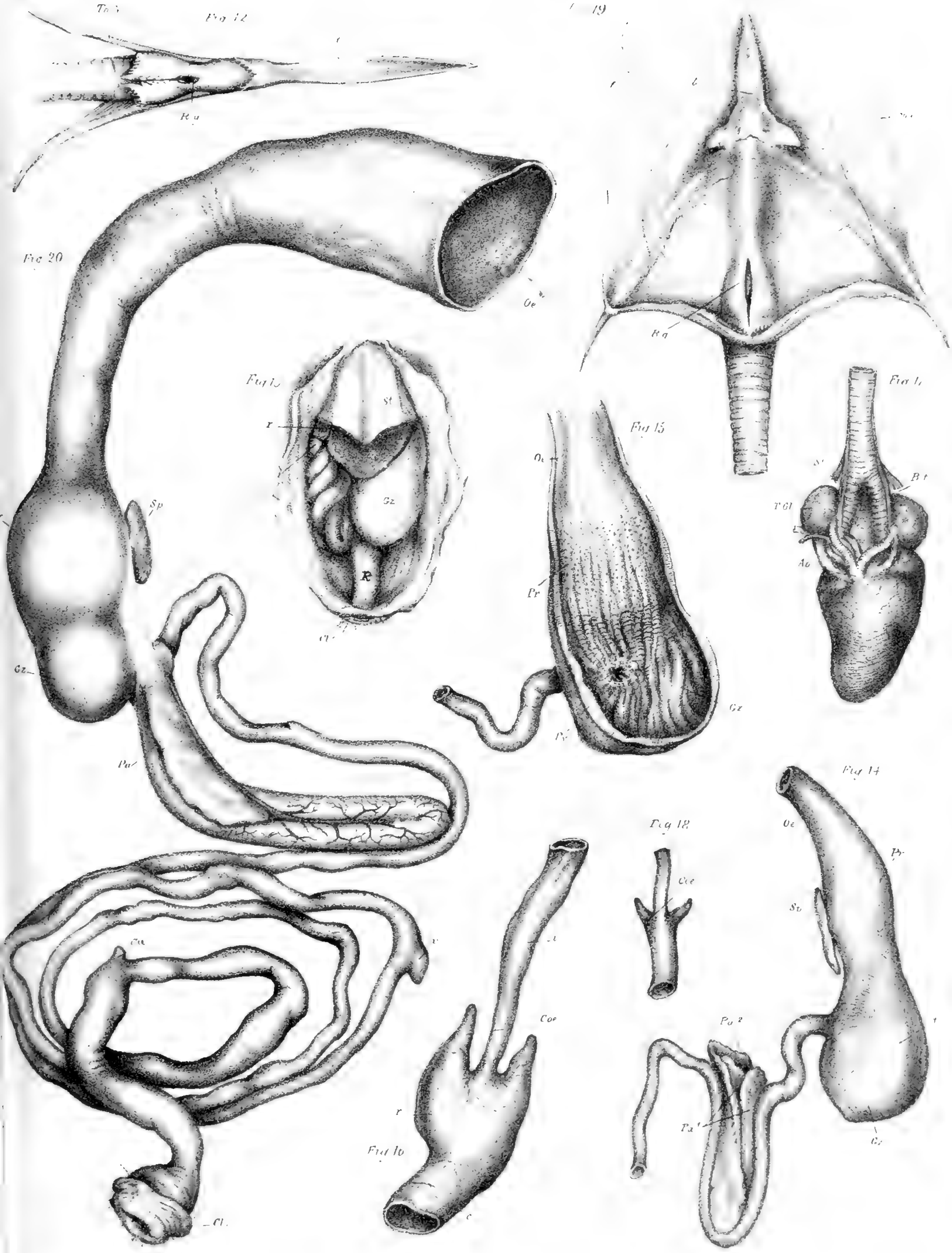

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RHINOCHETUS

XIII. *On some Points in the Anatomy of the Steamer Duck* (Micropterus cinereus).

By ROBERT O. CUNNINGHAM, *M.D., F.L.S., C.M.Z.S., Professor of Natural History, Queen's College, Belfast.*

Read March 21st, 1871.

[PLATES LVIII. to LXII.]

THE remarkable bird the structure of which forms the subject of the following few observations has been known for a long period to navigators in the stormy waters girdling the southern extremity of South America, the peculiar nature of certain of its habits readily arresting the attention of the most careless observer. As I have pointed out in my recently published volume on the Natural History of the Strait of Magellan, it was observed in that region in 1582 by the celebrated Pedro Sarmiento, who has given a short but unmistakable description of it in the narrative of his voyage. In the following century it appears to have been noticed by Wood; and about a hundred years later it is mentioned by Pernetty, Byron, Cook, and others, who bestowed on it the cognomen of the "Race-horse Duck." Between forty and fifty years ago Captain King, who met with it abundantly in the course of his survey in the Strait, suggested for it the greatly preferable title of Steamer Duck, on account of its movements when swimming presenting a strong resemblance to those of a paddle-wheel steamer.

Latham was, if I am not mistaken, the earliest naturalist to bestow on it a scientific appellation, denominating it *Anas brachyptera*, for which Quoy and Gaimard substituted the name by which it is now generally known, i. e. *Micropterus cinereus*. King having observed that certain Steamer Ducks were possessed of volant powers, while others appeared to be incapable of flight, believed that he had recognized two distinct species of the genus *Micropterus*, which were in addition distinguishable both in size and in plumage. The flying birds he designated by the specific name of *patachonicus*, while for the non-volant individuals he retained that of *brachypterus*[1]. In the summer of 1866, shortly before my departure for the Strait of Magallan, I was requested by Prof. Newton to endeavour to ascertain whether this view was correct, or the contrary; and as in the course of three seasons spent in the Strait and on the western coast of Patagonia I had many opportunities of observing the bird, I at length succeeded in satisfying myself pretty thoroughly on the point, the examination of numerous specimens having convinced me that there is but one species of Steamer Duck, and, further, that the flying birds are adolescent individuals of the non-volant form. My principal reasons for this conclusion are, that the flying and flightless birds associate together, that the former are smaller in size than the latter, and that I have invariably found the

[1] Proc. Zool. Soc. 1830–1, p. 15.

skeletons of the volant individuals to present unequivocal traces of immaturity, while, on the other hand, those of the non-volant were constantly found to be fully ossified. I believe, therefore, that as the bird increases in size and weight, owing to the deposition of an increased amount of mineral matter in the bones and various other causes, it gradually abandons the habit of flight, finding that the speed with which it can progress through the water by means of the rapid movements of its wings, together with its diving-powers, are sufficient to preserve it from threatened danger.

As I have very lately described the habits of the Steamer Duck, I shall not occupy the time of the Society by recounting them, but pass on to its anatomy. Owing to the difficulty of carrying on prolonged dissections on board ship, and the small amount of room at my disposal, which prevented me from preserving entire specimens of so large a bird in spirits, I much regret that I was unable to work out the anatomy of the soft parts; so that my observations upon them are very incomplete. So far as my cursory inspection of the *muscular* system extended, I did not observe any noteworthy peculiarities. The various muscles acting on the shoulder-joint and those of the leg were, as might be expected, very strongly developed. The length of the œsophagus was nineteen inches, and that of the entire intestinal canal fourteen feet two inches. The stomach, as may be seen from the figures, was extremely strong and muscular, so as to be admirably adapted for grinding down the shells of the mussels (*Mytilus chilensis* and *M. magellanicus*) and other lamellibranchiate mollusks which form the principal aliment. The cæca are six inches long, and their origin is at the distance of five inches from the anus. The *trachea* is very strongly formed, and only very slightly compressible, owing to the complete ossification of its rings. That of the male is provided with a strong, bony *lower larynx*, situated between the origin of the *bronchi* and the insertion of the sterno-tracheal muscles. The *bronchi* in the female, in which no bony enlargement exists, are wider than they are in the male. In length the trachea measures about eleven inches and a half.

Osteology.

Fully to describe all the specific peculiarities of the skeleton of the Steamer Duck would necessitate a much more minute acquaintance with the subject of bird-osteology than I can pretend to possess, as well as a much more extensive examination of the bones of allied species than it has been in my power to institute. I must accordingly content myself with the indication of those points which appear to me to be most worthy of note, and crave the indulgence of the Society for the meagreness of my descriptions, which I have endeavoured to illustrate and supplement by means of the accompanying sketches.

The materials at my disposal in drawing up the following notes have been as follows:—1st, two nearly entire skeletons of adult individuals from the Falkland Islands, in the Museum of the Royal College of Surgeons, for permission to examine which, in common with the other skeletons of Anatidæ in that collection, I am indebted to the kindness of Prof. Flower; 2nd, two crania of adult individuals procured by myself in the Strait of Magellan and on the west coast of Patagonia; 3rd, two skeletons of immature flying birds from the same regions; and 4th and lastly, two crania of young birds, still unfledged, which were shot while swimming in company with their parents in one of the harbours of the Messier Channel.

At the outset I may remark that, as might be expected from the habits of the bird, the bones, with the exception of the skull and vertebræ, appear to be entirely destitute of pneumatic apertures[1].

The *cranium* is of large size (upwards of five inches in extreme length, measured along the base in the largest adult specimens examined), and is very powerfully formed, with the various processes well developed, and the muscular impressions strongly marked. Its constituent bones appear to be unusually long in undergoing anchylosis, many of them readily separating in the process of maceration in fully fledged flying birds. The ridge circumscribing the occipital region is sharp and projecting in adult individuals, in which there is also a well-marked mesial vertical ridge above the foramen magnum. The foramen magnum is of large size; usually its upper border forms a deep angle; but in one specimen examined it is rounded in a manner similar to that which obtains in the Muscovy and some other species of Ducks. The lateral occipital vacuities vary much in respect of both size and shape in different individuals. That they are true "fontanelles," as termed by Meckel, and that they are not due, as has been asserted, to the influence of "the pressure of the brain within and the muscles from without," is rendered plain by the circumstance that in young crania, in which the bones have only undergone a very slight amount of anchylosis, they are proportionally larger than in those of adult birds. Usually the fontanelle of one side (right or left, as the case may be) considerably exceeds that of the other in size, being sometimes more than twice as large, the result of ossification proceeding at an unequal rate. Occasionally, however, they are as nearly as possible of equal dimensions. In adult individuals the surface of the occiput on either side of these fontanelles is rough, indicating the attachment of certain of the muscles which move the head upon the neck. The usual foramina for the transmission of various small blood-vessels and the eighth and ninth pairs of nerves are present on either side of the occipital foramen and condyle, varying slightly in position in different specimens. The condyle presents the customary reniform-shape, with a median vertical sulcus. The *fossa subcondyloidea* is deeply excavated, and of a rounded form. The paroccipital processes are well developed, and more divergent than in some other Anatidæ, such as the Muscovy Duck.

The elements of the occipital bone, *i. e.* supra-, basi-, and exoccipitals, remain distinct and readily separable for a considerable period. In a skull of one of the youngest specimens, which measures two inches and a half in length, this is very well seen. The

[1] These apertures are more conspicuous in the Muscovy Duck (*Cairina moschata*) than in the skeletons of most of the other Ducks examined by me.

supraoccipital consists of an upper, somewhat quadrangular plate, from which proceed downwards two processes which together circumscribe the upper (and larger) portion of the *foramen magnum*, and have their outer borders deeply excavated by the occipital fontanelles. The exoccipitals are rather irregularly shaped bones, which adhere closely to the periotics. The basioccipital presents a somewhat triangular figure. Its anterior third is covered by the posterior part of the combined basitemporals; and its apex bears the central portion of the occipital condyle. In the crania of flying birds the supraoccipital is anchylosed to the exoccipitals, but is still separated from the parietals.

I am not aware that the *basisphenoid* offers any special peculiarities, consisting, as is commonly the case, of a triangular body, formed of a superior and two inferior portions (which are anchylosed in the youngest specimens examined), and of a long rostrum, which forms the basis of the interorbital septum. The under surface of the triangular body is much flatter than in the Muscovy Duck. The *alisphenoids* are distinct bones in the two youngest specimens, but fully anchylosed to the basisphenoid in the adolescent flying birds, in which, however, they are only partially united to the frontals and squamosals. They constitute the major portion of the postorbital processes.

The *pre-* and *orbito-sphenoids* are not ossified in the youngest crania, while in the skulls of the adolescent and adult birds they unite with the ethmoid to form the interorbital septum.

The *ethmoid* in the youngest specimens presents much the same form which obtains in nestling individuals of many other birds, consisting of a (lozenge-shaped) horizontal and of a vertical plate. In the crania of adolescent birds the vertical plate has blended with the elements of the anterior sphenoid, as already stated; but the horizontal, which has now assumed an ellipsoidal form, is not anchylosed to the bones (frontals and nasals) which roof it in.

The *interorbital septum* in young birds, as may be gathered from what has been just stated, is almost entirely membranous. In adolescent individuals it is thin, and presents several large apertures, while in adult birds it is very fully ossified, in some instances only possessing a single vacuity of any considerable size, situated immediately in front of the foramen for the optic nerves[1].

The *vomer* is of the usual form, as may be seen by the figure, but is of larger size than that of the generality of Ducks.

The *parietals*, like the other bones, are distinct in the youngest specimens; and a small lozenge-shaped fontanelle occurs in the middle line of the upper surface of the cranium, between their upper extremities and the posterior internal angles of the frontals. They are irregularly triangular in form, their narrow curved base resting on the squamosal, and its anterior angle being intercalated between the frontal and that bone. In adolescent birds they are anchylosed to the squamosals, only a trace of the

[1] The interorbital septum in *Biziura lobata* is much more feebly ossified than in any of the other Anatidæ examined by me.

suture being visible anteriorly, as well as to the exoccipitals; but they are still ununited to the supraoccipital and frontals. In adolescent and adult specimens they present, in common with the squamosal, a well-marked fossa for the attachment of the temporal muscle.

The *squamosals* furnish a part of the postorbital process. They are readily separable from all the other bones in the young birds, and in adolescent individuals are still anchylosed to the frontals, and only partially so to the alisphenoids.

The *periotics* are readily separable from the surrounding bones in the young (unfledged) birds, but are fully anchylosed to them in the adolescent (flying) specimens. In general form, as may be seen from the figure (fig. 21), they do not differ materially from those of the young of the domestic Fowl, as figured by Professor Huxley in his Croonian Lecture "On the Theory of the Vertebrate Skull" and "Elementary Atlas of Comparative Osteology."

The *quadrate* bones are proportionally thinner and with deeper hollows than in some other species of Ducks, such as the Muscovy; and their orbital processes are much larger, more angular, and more sharply pointed than in that bird. The fossa for articulation with the posterior extremity of the quadrato-jugal is comparatively shallow.

The *pterygoids* possess the same general form as the corresponding bones in the Muscovy, but are longer, and have the various ridges and depressions more strongly indicated.

The *zygomatic* arch is feeble, if the size and strength of the other bones of the skull be taken into consideration. Its three elements, the *quadrato-jugal*, *jugal*, and *jugal process of maxillary*, appear to remain distinct throughout life.

The *frontals*, as usual, are very large. In the youngest specimens they are, like the other cranial bones, readily separable from those which surround them; and even in flying birds they are distinct from the parietals, squamosals, and ethmoid, and only slightly anchylosed to the alisphenoids and posterior portion of the interorbital septum. Even in the youngest specimens they present extensive, well-marked glandular impressions, which in adult individuals are separated by an elevated mesial ridge, so that the middle line of this region of the cranium is higher instead of lower than the lateral portions, as is the case in most Anatidæ, with the exception of the Swans.

The *nasals*, *lachrymals*, *intermaxillary*, *maxillaries*, and *palatines* are unanchylosed, both in the unfledged and flying birds; and even in the oldest specimens examined by me the lachrymals are only very partially anchylosed to the nasals, thus differing from those of the Mallard and most other Ducks, in which they are entirely, or almost entirely, anchylosed in adult birds. They send backwards from their upper margins, immediately behind the articulation with the nasals, a strong, rather rugged process, which is either absent or very feebly developed in the other species of Anatidæ examined by me. The space intervening between the postorbital process and the descending (or anteorbital) process of the lachrymal is much wider than in some other

Ducks, *e.g.* the Mallard. The nasal processes of the intermaxillary are only very slightly anchylosed to one another and to the nasal, even in the oldest specimens.

All the elements of the *lower jaw*, i. e. *articular*, *angular*, *coronoid*, *opercular*, *splenial*, and *dentary*, are readily separable in the unfledged birds. In the adolescent specimens the articular, opercular, angular, and coronoid have coalesced to form one piece, while the splenials and dentary are still distinct. In adult birds sutures still persist between the first three elements and the posterior portion of the splenial, and between them and the posterior portion of the dentary. The extreme length of the mandible in the largest adult specimen examined is five inches and a tenth.

The *hyoid* is of the usual form which obtains in the Anatidæ. The glosso-hyal bone in an adult specimen measures rather more than an inch and a tenth, in length. Its upper surface is concave antero-posteriorly, but convex from side to side. The cartilage borne at its tip is cylindrical, and nearly an inch in length when recently freed from the surrounding soft parts. The basihyal and cartilaginous uro-hyal measure respectively one inch, and half an inch, in length. The rami of the hyoid are three inches and a half in length, measured along the curve, the hypobranchial bones furnishing the greater part of the extent.

Vertebræ. There are twenty-one free vertebræ between the cranium and pelvis, and of these the last six are rib-bearing. The seventeenth, eighteenth, nineteenth, and twentieth have elongated hypapophyses. Owing to the anchylosis of the pelvic vertebræ it is not easy to form a perfectly accurate estimate of their number, which is probably seventeen. The combined mass is only united synchondrosially to the iliac bone of either side even in flying birds, and is consequently easily separated from them (see fig. 59). The first three vertebræ are rib-bearing. The caudal vertebræ are nine in number; but the eighth and ninth become anchylosed in adult birds.

Ribs. There are nine pairs of vertebral ribs, of which the last eight articulate with the corresponding sternal ribs.

Sternum and *shoulder-girdle.* The *sternum* is of large size, measuring fully five inches and a half in extreme length in adult specimens. It is thus nearly equal in length to that of the Muscovy; but it is much broader, the distance between the tips of the anterior costal processes being three inches and three-tenths, and a little over two inches and a half between the posterior costal processes. In general form and shallowness of keel it approximates more closely to the sterna of *Oidemia nigra* and *Biziura lobata* than to those of the other Anatidæ examined by me. In adult species the posterior border is more deeply excavated than in adolescent (flying) birds. On removing the pectoral muscles from the sterna of the flying birds I found on all occasions a layer of perichondrium of greater or less thickness covering the subjacent bone, which was much thinner, rougher, and more vascular than in adult birds. In one specimen of a full-grown bird in the Museum of the Royal College of Surgeons, there is present on either side of the keel, at a distance of about an inch and a third from the sternocoracoid articulation, and about eight lines from the costal region, a vacuity of considerable size, apparently the result of deficient ossification. The *furcula* is comparatively feeble, being thinner and less massive than in the Muscovy and many other Ducks. The process at the junction of the rami is either entirely absent or very slightly developed. The *scapula* and *coracoid* do not present any striking peculiarities.

Bones of the wing. The differences existing between the bones of the wing of the Steamer and Muscovy Duck, in respect of general form, are not of great importance. The shafts of the humerus and ulna are stouter in the latter bird. The depressions marking the origin and insertion of the *brachialis internus* are larger and deeper, however, in the former. The metacarpal differs very slightly, as regards form, from the corresponding bone in other Ducks. The second phalangeal joint of the first finger and the third of the second are well developed, though from their minute size they are very easily lost in the process of maceration. Indeed, although they are probably present in all the species of Anatidæ, they are almost invariably absent from their skeletons as exhibited in Museums.

Pelvic girdle. The two halves, *i.e.* the united ilium, ischium, and pubis, are only united synchondrosially to the sacrum in flying birds. The ischiadic foramen is of considerable size, being larger than in the Mallard and Muscovy, but smaller than in *Biziura lobata.* The posterior extremity of the pubis is dilated in male specimens.

Bones of the leg do not, so far as my examination goes, exhibit any very marked peculiarities. The ecto- and pro-cnemial processes of the tibia are well developed; and the metatarsus tapers in a greater degree from either extremity towards the middle than in the other Ducks examined by me.

DESCRIPTION OF THE PLATES.

PLATE LVIII.

Fig. 1. Tongue, natural size, upper surface: *a*, rima glottidis.

Fig. 2. Lower part of trachea, lower larynx, and bronchi of adult male *Micropterus*: *a*, trachea; *b*, sterno-tracheal muscles; *c*, lower larynx; *d*, bronchi.

Fig. 3. Ditto of male *Chloephaga magellanica*, for comparison. Lettering the same. The lower larynx, as will be observed, is much more capacious; but its walls are much thinner than in the *Micropterus*, readily yielding to pressure by the finger.

Fig. 4. Stomach of *Micropterus*, from the side, natural size: *a*, musculus intermedius; *b b*, musculi laterales or digastrici.

Fig. 5. Antero-posterior vertical section of ditto: *a*, musculus intermedius; *b*, musculi laterales; *c*, internal coat of gizzard.

PLATE LIX.

Figs. 6, 7, 8. Cranium of adult *Micropterus*, from above, from the side, from beneath. Lettering the same in all: *So*, supraoccipital; *Eo*, exoccipital; *Fm*, foramen magnum; *Of*, occipital fontanelle; *Qf*, fossa for articulation with quadrate; *Bs*, basisphenoid; *Bp*, facette for articulation with pterygoid; *pop*, post-orbital process; *aop*, anteorbital process; *gl*, glandular depression of frontal; *Pa*, parietal; *Pl*, palatine; *Vo*, vomer; *E*, ethmoid; *L*, lachrymal; *Mj*, jugal process of maxillary; *I*, groove for olfactory; *V*, foramen for trigeminal. (The quadrate, pterygoid, quadrato-jugal, and jugal bones are not figured in figs. 7 & 8.)

Fig. 9. Right jugal.

Fig. 10. Left quadrato-jugal.

Figs. 11 & 12. Cranium of adolescent flying bird, from above, and from the side: *Sq*, squamosal; *As*, alisphenoid. The remaining letters as in figs. 7 & 8.

Figs. 13 & 14. Cranium of unfledged birds, from above, and from the side: *Q*, quadrate; *Qj*, quadrato-jugal; *J*, jugal; *N*, nasal; *M*, maxillary; *Im*, intermaxillary; *Pt*, pterygoid. The remaining letters as in figs. 7 & 8.

Fig. 15. Left quadrate of adult Steamer Duck: *a*, outer; *b*, inner side; *o*, orbital process.

Fig. 16. Left pterygoid of adult bird: *a*, from beneath; *b*, from above.

Fig. 17. Vomer of adult, from left side: *a*, upper margin.

PLATE LX.

Fig. 18. Occiput of adult: *Oc*, occipital condyle; *Of*, occipital fontanelle; *Fm*, foramen magnum.

Fig. 19. Transverse vertical section of cranium of adult, to show the exit of the orbital nerves: *I*, olfactory foramen; *II*, optic; *V*, ophthalmic.

Fig. 20. Occiput of unfledged bird: *So*, Supraoccipital; *P*, parietal; *Sq*, squamosal; *Eo*, exoccipital; *Of*, occipital fontanelle; *Fm*, foramen magnum; *Oc*, occipital condyle; *Bo*, basioccipital.

Fig. 21. Left periotic of unfledged bird: *VII*, notch for seventh nerve.

Fig. 22. Left squamosal of unfledged bird.

Fig. 23. Ethmoid of unfledged bird: *a*, from the side; *b*, from above.

Figs. 24 & 25. Basisphenoid of ditto, from beneath and above: *Bt*, combined basi-temporals; *s*, sella turcica.

Fig. 26. Right parietal of ditto.

Fig. 27. Right frontal of ditto.

Fig. 28. Right nasal of ditto.

Fig. 29. Right maxillary of ditto.

Fig. 30. Intermaxillary of ditto, from above.

Fig. 31. Elements of right ramus of mandible of ditto: *a*, articular; *b*, opercular; *c*, coronoid; *d*, angular; *e*, splenial; *f*, dentary.

Fig. 32. Right lachrymal of ditto.

Fig. 33. Right quadrate of ditto.

Fig. 34. Right ramus of lower jaw of a larger individual: *a*, articular; *b*, coronoid; *c*, angular; *d*, dentary.

Fig. 35. Articulating surface of mandible of adult bird, from above.

Fig. 36. Condition of right ramus of mandible in an adolescent (flying) bird: *a*, combined articular, angular, coronoid, and opercular; *b*, splenial; *d*, dentary.

Fig. 37. Right ramus of mandible in adult bird.

Figs. 38, 39. Hyoid, from above and from the side: *a*, cartilage; *b*, entoglossal; *c*, basihyal; *d*, hypobranchial; *e*, uro-hyal; *f*, cerato-branchial; *g*, terminal cartilage.

Fig. 40. *a*, *b*, atlas of adolescent bird, from the side and from the front; *c*, facette articulating with occipital condyle.

Fig. 41. Axis of adolescent bird, from the side: *op*, odontoid process.

Figs. 42, 43. Seventeenth and eighteenth vertebræ of adolescent bird, from the side: *n*, neurapophysis; *d*, diapophysis; *hy*, hypapophysis.

Fig. 49. Humerus of adolescent bird: *b*, impression marking origin of brachialis internus.

Fig. 50. Ulna of adolescent bird: *b*, impression marking insertion of brachialis internus.

Fig. 51. Internal (ulnar) surface of radius of ditto.

Figs. 52, 53. Carpal bones of ditto: 52, from the side; 53, from beneath.

Fig. 54. Metacarpus of ditto.

Figs. 55, 56, 57. First, third, and second digits of ditto.

PLATE LXI.

Fig. 44. *a*, *b*, Furcula of adult, from beneath and from the side.

Figs. 45, 46. Scapula and coracoid of ditto.

Fig. 47. Sternum of adolescent bird.

Fig. 48. Sternum of adult bird. The vertebral extremity of the third sternal rib of the right side is malformed.

PLATE LXII.

Fig. 58. Pelvis of adolescent bird, from above.

Fig. 59. Left half of pelvic girdle of ditto.

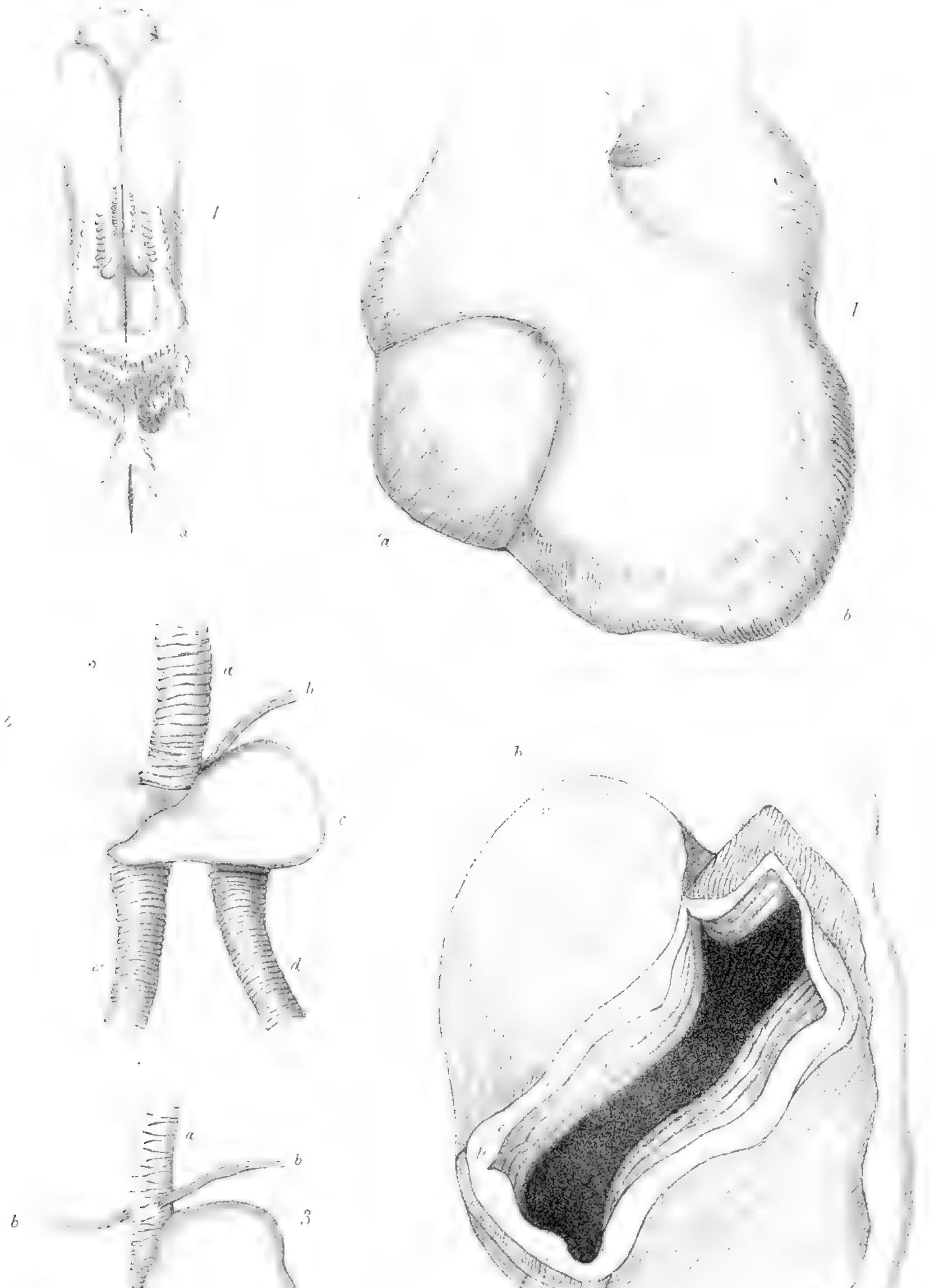
Fig. 60. Combined lumbo-sacral vertebræ of ditto, from beneath.

Fig. 61. Left femur of ditto, anterior surface.

Fig. 62. Left tibia and fibula, ditto.

Fig. 63. Left metacarpus.

Figs. 64, 65, 66, 67. Phalanges of the first, second, and third toes: *a*, metacarpal element of first toe.



J.Smit lith.

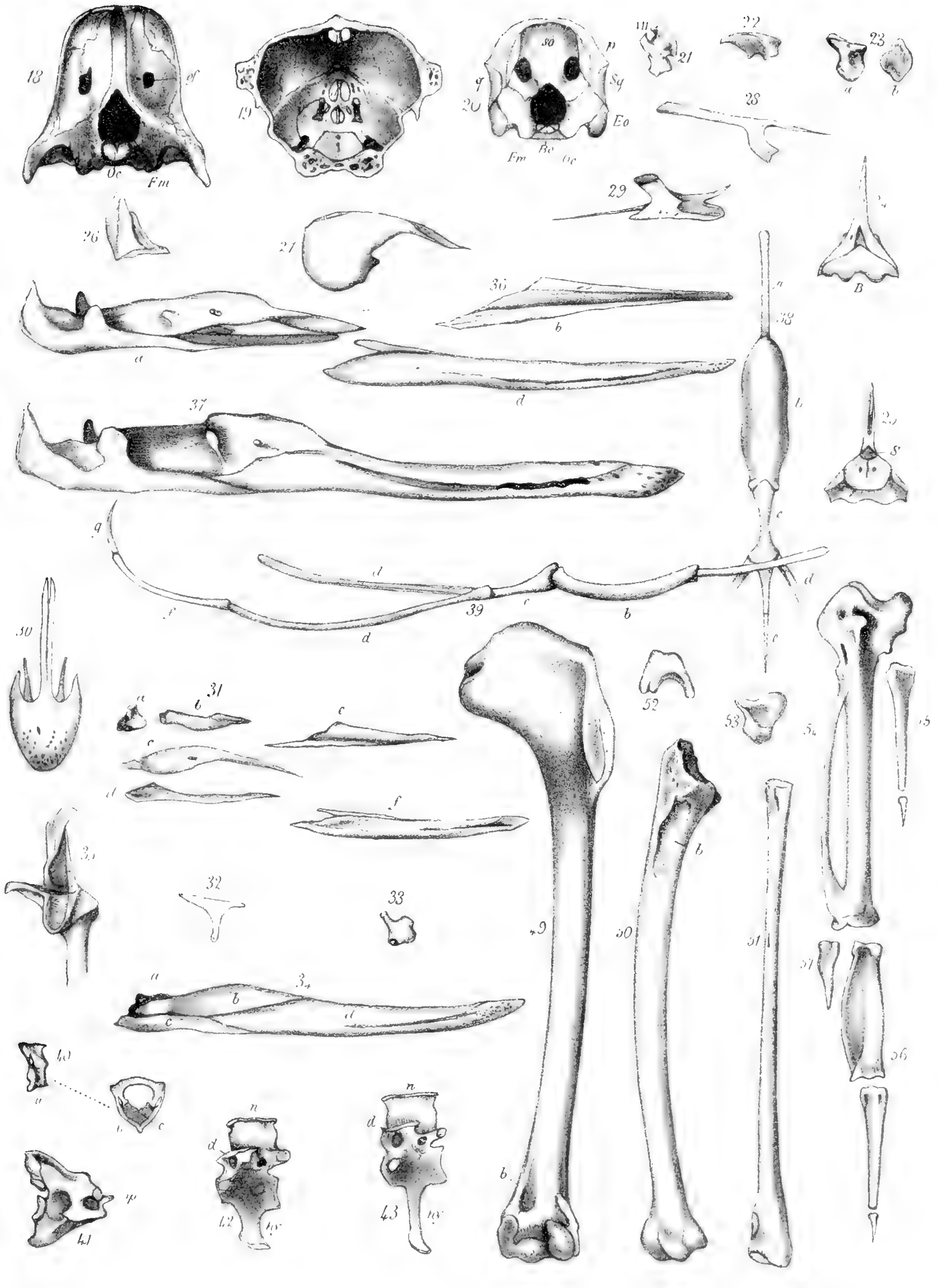
M&N Hanhart imp.

MICROPTERUS CINEREUS

J. Smit lith.

M&N Hanhart imp.

MICROPTERUS CINEREUS



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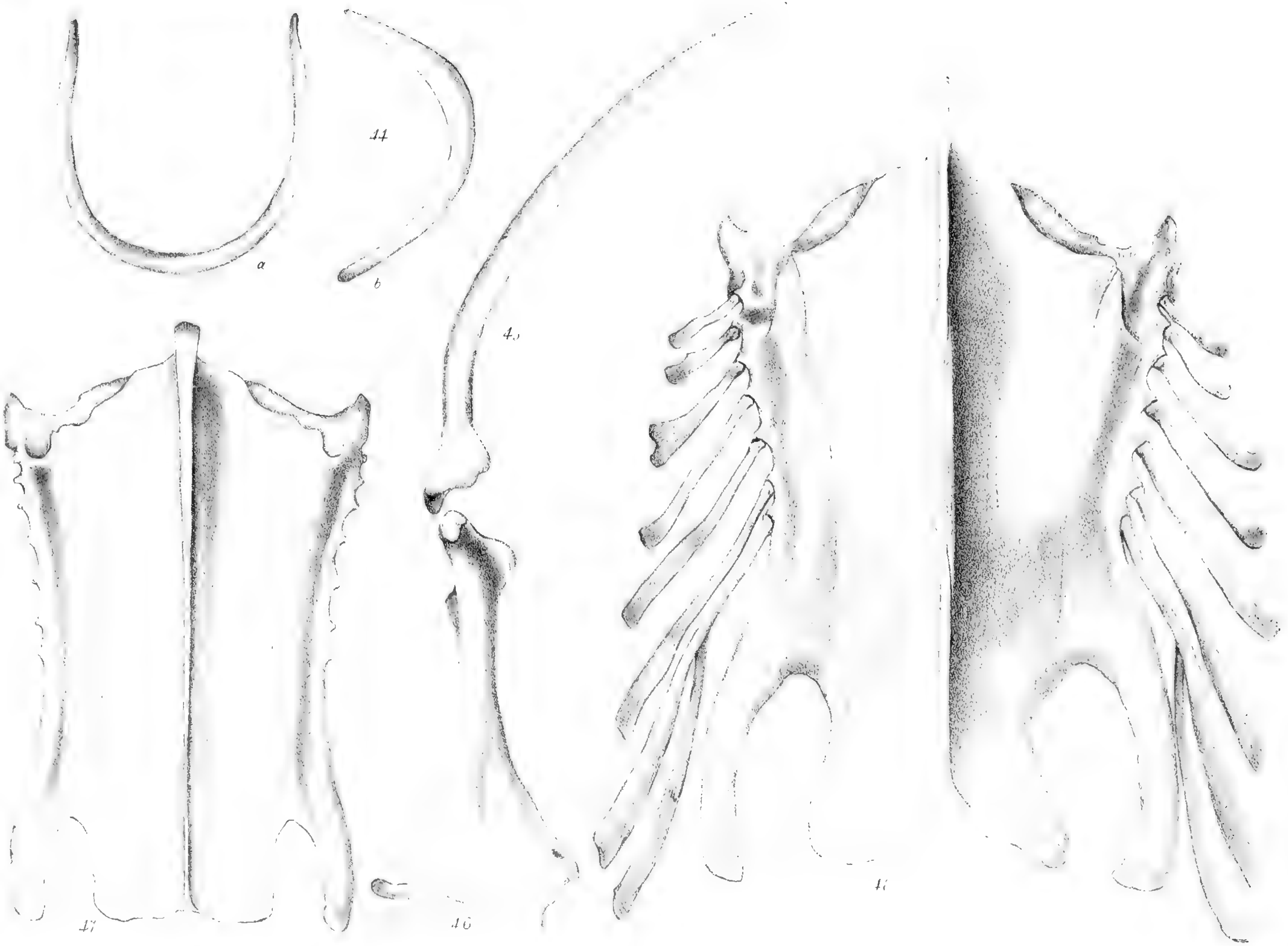

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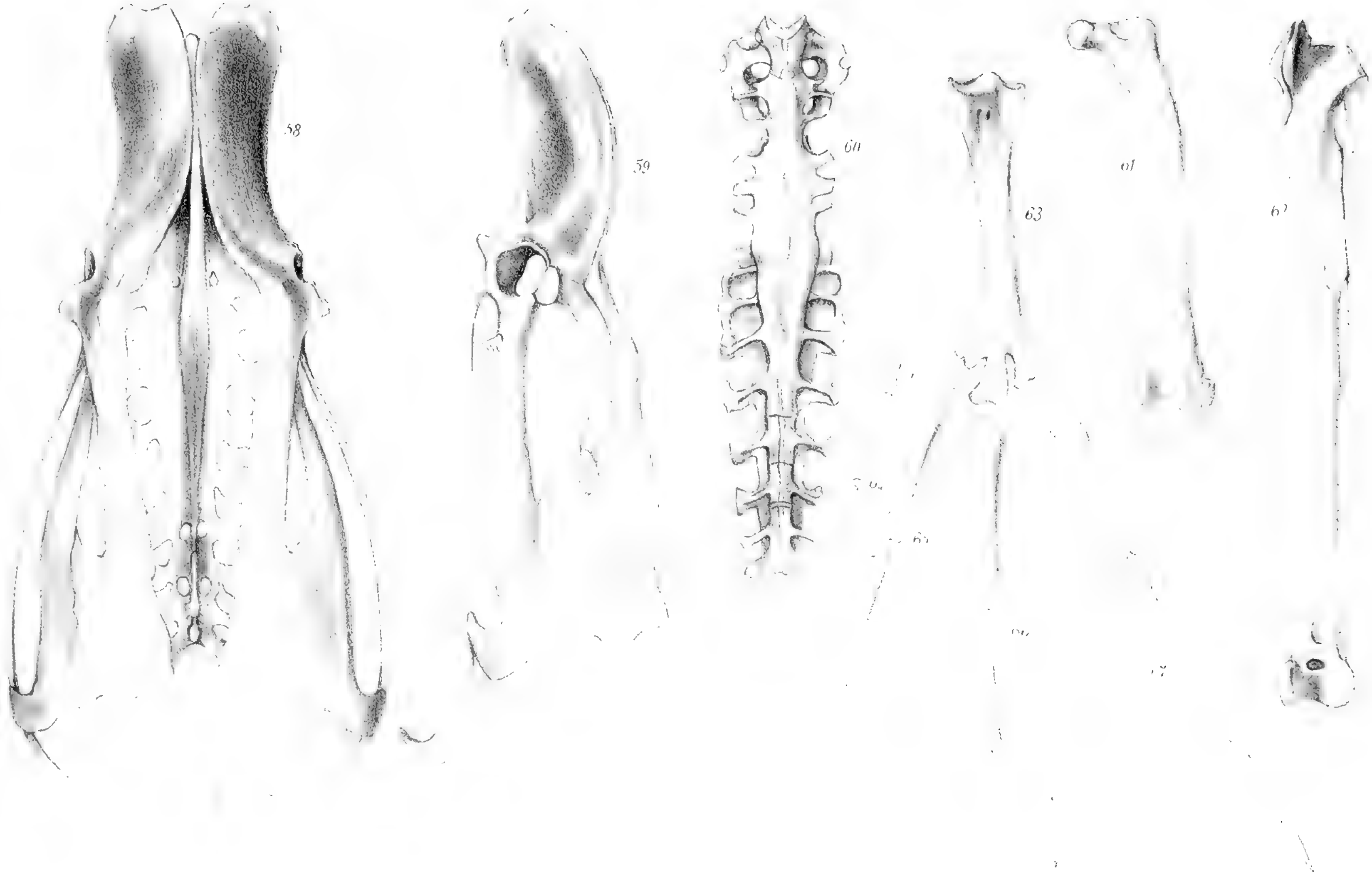
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XIV. *On the Female Generative Organs, Viscera, and Fleshy Parts of* Hyæna brunnea, *Thunberg. By* James Murie, *M.D., F.L.S., F.G.S., &c., Lecturer on Comparative Anatomy, Middlesex Hospital, late Prosector to the Zoological Society of London.*

Read February 14th, 1867.

[Plate LXIII.]

A CARNIVOROUS animal so well known to naturalists and anatomists as the Hyena is unlikely to be a form yielding much that is new to science in the structure of its organs as ordinarily dissected. But whilst nothing rare or striking in this sense is offered, there nevertheless are two points which may bear closer investigation and further illustration than they have already received. These, the postanal pouch and glands[1], it is more especially the object of the present paper to describe and figure in the Brown Hyena (*Hyæna brunnea*, Thunb.[2]), the so-called "Strand-Wolf" of the Cape. In addition to the record of my dissection of those parts, I have appended notes on the soft tissues generally.

Of the specimen I need only say that it was a perfect example of the species, both as regards development, colouring, and coat. The skull, seen both by Mr. Busk and Professor Flower, authenticated the external characters. The animal, which had lived in the Society's Gardens about thirteen years, died on the 13th of August, 1866.

The following were its dimensions:—

	inches.
From tip of nose to that of tail (in a straight line)	53
The hair, however, extended beyond the tail 8 inches, which gives	61
Head in length from tip of nose to occiput	12½
Tail from its root to tip	8
Height from of sole fore foot to shoulder	28
Height from sole of hind foot to behind loins	24½
Girth of body behind the fore limbs	36½
Girth of middle of body	40
Girth in front of the hind legs	31
Girth of head before the ears	25
Girth of head round the muzzle	13½
Girth of neck just behind the ears	24

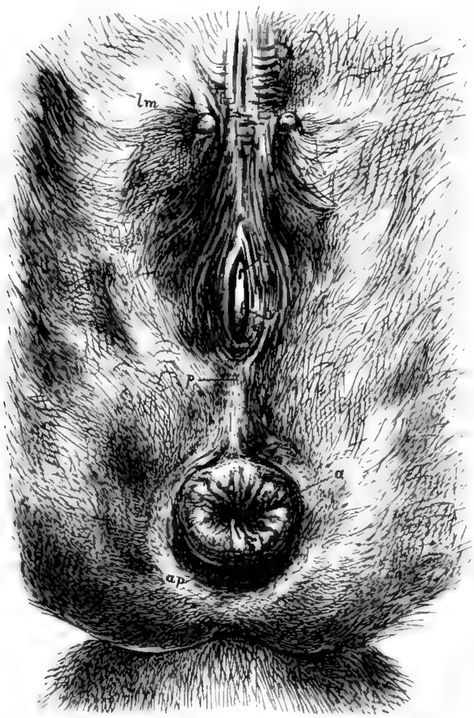
[1] Daubenton, in Buffon's Hist. Nat. tom. ix. p. 287, pls. 28, 29, describes and figures the said parts of *H. striata*. In John Hunter's dissection of the Striped Hyæna (*vid.* 'Essays and Observations,' edit. by Professor Owen, Lond. 1861, vol. ii. p. 58) these parts and the male and female generative organs are noted. The original preparations exist in Coll. of Surgs. Mus. Preps. nos. 2148 to 2151.

[2] "Beskrifning och Teckning på ett nytt species *Hyæna brunnea*, Tab. 1," in K. Vetensk. Handl. Stockholm, 1820, p. 59.

1. *Mammæ, Anal Pouch, and Glands.*

The mammary development consists, at least in the adult female specimen under consideration, of six pairs of fairly developed teats, which are rather irregularly distributed. The anterior one of the right side is placed in advance of the shoulder; and the corresponding one on the left side, which is of smaller size, occupies a position relatively posterior to its fellow of the opposite side. The remaining teats are slightly irregular in their disposition and size. The most posterior inguinal one on the left side is distant about one and a half inch from what I take to be the labia majora; it is very diminutive as compared with the hinder one on the right side, which is also not so backwardly situated. Besides the above six pairs of teats there are two small papillary or nipple-like elevations of the skin, which lie in each axillary hollow, about its centre or rather behind this, and outside the antero-posterior line of the other teats.

Fig. 1.



Reduced sketch of the perineal region of the adult female *H. brunnea*: *l m*, labia majora: *u*, urethra; *v*, vagina; *p*, perinæum; *a*, anus; *a p*, anal pouch.

What appear to be the labia majora are two large nipple-like projections of the skin and subcutaneous fatty tissues, which are situated at a point which would represent the angle of junction of the two groins, and distant about ten inches from the umbilicus. Their tips and superficial portions of the inner sides are bare, the remaining outer three-quarters of their circumference being set with light-coloured longish hairs.

Each of these labial prominences has a diameter of about three-quarters of an inch and a height equal to half an inch. When the hind limbs are brought together, the labial elevations approximate, and almost touch one another on their inner bare edges; but when the limbs are thrown apart, there is an interval of as much as an inch between them. In the median interspace there is a slight sulcus; and from their anterior margins backwards to, and for half an inch around the vulva, the skin is nearly devoid of hairs, and assumes a dark, blackish-brown colour. It is also considerably puckered into minute folds, or ridges, which possess a slight punctate glandular surface.

The slit-shaped opening of the vulva, which itself is seven-eighths of an inch in length, and with the urethral outlet placed in its anterior angle, lies an inch behind the above-mentioned elevated labia majora.

The shortened and but faintly marked perinæum is scarcely more than an inch long, and, except a narrow central band or indistinct raphe, is covered with somewhat long lightish brown or yellowish hairs.

The anus is situated immediately behind this; and in the examination of our animal shortly after death, the terminal portion of the anal mucous membrane appeared to bulge rather prominently, so as to present three or four carunculated and extruded folds, altogether an inch in diameter. These might be justly compared to the abnormal condition of this part in man when suffering from external hæmorrhoids. On inquiring of the keeper regarding this appearance of detrusion of the anus, he replied that it seldom if ever had been visible to him while the animal was alive.

The anal pouch appears superficially as a large and deep semilunar fossa, having its concavity forwards and the lateral horns embracing the anus itself, which lies before it. The pouch and anus together form what at first sight might be considered the anal opening alone. This somewhat circular-shaped and common superficial depression ranges from 1·7 to 1·5 inch in diameter, the greater measurement being antero-posteriorly. The cross distance between the horns of the postanal fossa is 1·2 inch; and in an opposite diameter (namely, towards the tail) the fossa is 0·3 inch wide. The elevated bridge of hairy skin between the posterior edge of the anal pouch and the root of the tail is scarcely so much as an inch.

The anal excavation has an average depth of a couple of inches, though one portion is sunk or burrows deeper beneath the protruding anus. Interiorly the entire pouch accommodates itself to the shape of the deep parts, with a somewhat similar configuration to that which it possesses externally—to wit, with curved extension on either side of the anus. Each horn of itself forms a widish chamber or passage; and this leads to what, on rough examination, seem three narrow *culs-de-sac*. These, however, are continued by small orifices into as many glandular pockets situate outside the lower part of the rectum. The said flask-shaped pouches are internally smooth-surfaced, though their walls, of some thickness, are strictly glandular. The matrix in which the glands are imbedded is a cellulo-fibrous material, through which the glands pierce by pores opening into the interior of the sac itself. The three anal saccular glands on each side of the rectum, though to some extent separate from each other, have nevertheless close union, lying adpressed the one to the other, so as to represent but a single body somewhat larger than a walnut, and, like that fruit, rough and warty outside (*vide* Pl. LXIII. fig. 2, dotted lines). The above description applies to the dissected condition; for exteriorly the anal glandular chambers are enclosed in a thick, dense, muscular mass, the compressor glandulæ (*c.g*); and this increases the bulk of the bodies to the size of a small orange, as shown in fig. 1 of the Plate.

The glandular secretion is a darkish unctuous substance, with a peculiar rancid butyraceous odour, as Daubenton faithfully notes. It collects in quantity in the aforesaid cavities and passages, and doubtless exudes under pressure of the muscular apparatus, as, I believe, during sexual excitement. I have myself observed the Hyænas in the Gardens during such condition rub the boards of their den with the hinder end of their body, leaving behind traces of the odoriferous anal-gland secretion. The Hyæna's scent-bags agree in several respects with such developments in some of the Viverridæ, and thus point to relationship with that family[1].

Professor Kaup, a long time ago[2], attempted to divide the Hyænas generically according to their dentition, and laid stress on some and not others possessing an anal sacculus. The spotted species he separated as a genus *Crocuta*. Mr. Busk[3], in a recent paper of his, alludes (p. 60) to the above division, and to Dr. Falconer's proposal[4] to adopt the term *Euhyæna* for the other section. These writers have each apparently taken it for granted that *H. maculata* is deficient in anal glands.

Mr. Busk says, in a footnote (p. 71), "Having lately examined a living *H. crocuta* in the Zoological Gardens, I can confirm Kaup's statement that no trace of a pouch between the root of the tail and the anus exists, at any rate in the male of that species."

I myself was present and aided in the above most hazardous undertaking; and certainly it did seem, on hasty and tactile search, that a postanal pouch was absent. Since then I have had reason to change my opinion, inasmuch as in a very young dead male spotted Hyæna which passed through my hands, sure enough there was an ample postanal pouch and glandular development connected therewith (see fig. 2, p. 507), just as in the female *H. brunnea*.

On what grounds Professor Kaup's assertion is made I know not, and that a postanal

[1] Since this paper was read, Professor Flower has given us an account of the anatomy of *Proteles cristatus* (P. Z. S. 1869, p. 494); and therein mentions its having a supraanal follicle and lateral glandular sacs.

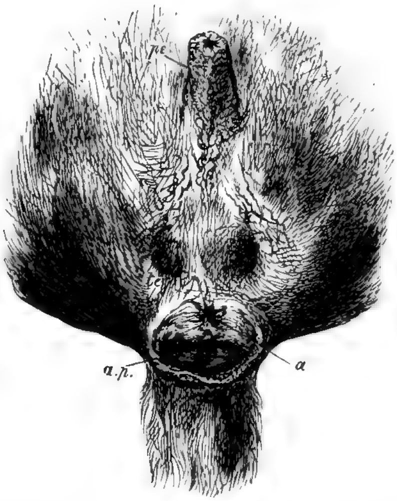
[2] Isis, 1828, p. 1144.

[3] "Remarks on the cranial and dental characters of the existing species of Hyæna," Journ. Proc. Linn. Soc. vol. ix.

[4] Palæontological Memoirs, vol. ii. p. 464.

pouch is occasionally absent I am unprepared to refute; but certainly my instance of its presence in the Spotted Hyena, and Daubenton's and Hunter's records of it in the Striped Hyena, weaken and destroy the main character on which Kaup's generic division (*Crocuta*) is based.

Fig. 2.



View of perinæum &c. of the young male Spotted Hyena (*H. maculata*): *pe*, penis; *te*, right testicle; *a*, anus; *a.p*, anal pouch.

2. *Of the Viscera generally.*

Each kidney, measuring $3\frac{1}{2}$ by $2\frac{1}{2}$ inches in diameter, is ovoid rather than reniform, the hilum being narrow but deep. Fibrous envelope structurally dense and closely adherent to glands. Five or six radial furrows, some terminally forked, are superficially visible; these mark veins which lie sunk in the renal tissue. On section the cones, eight in number, are seen to be distinct to the inner edge of the narrow cortical substance.

As in carnivora, the liver is multiple, in all six-lobed. The right lobe is of considerable size; the lobus caudatus of moderate dimensions; the Spigelian lobe small. The bifid cystic lobe is deeply cleft, its right moiety the largest and most rounded, and the pear-shaped gall-bladder is lodged on it and partially in the deep fissure marking off the left moiety. What corresponds to a left hepatic lobe is as large as all the other lobular divisions taken together; its upper border is so indented as to represent a small marginal lobule.

The flat and tongue-shaped spleen is 15 inches long, and $3\frac{1}{2}$ inches across at the broadest part.

Of the alimentary canal, the œsophagus measures about 13 inches. As contracted it has a diameter above of $2\frac{1}{2}$ inches, and below of $1\frac{1}{2}$ inch; but the walls are very dilatable and strongly muscular. The mucous membrane has numerous longitudinal rugæ. Meckel[1] justly observes that the œsophagus in the Cat and Dog is relatively less than in the Hyena, and still narrower in *Mustela*, *Lutra*, *Procyon*, *Nasua*, and *Ursus*.

The capacious stomach has neither the transverso-elongate form as in *Felis*, nor is so globular as in the Suricate (*Rhyzæna*). There is little more than an approach to a fundus, the cardiac end being widely rounded; the lesser curvature is shallow but concave. Both at the œsophageal and pyloric extremities the cavity bulges slightly. About two inches below the lesser curvature, and a little to the right of the middle, I observed a central tendon, the muscular fibres appearing to radiate therefrom, as in the gizzard of a bird: whether this is a normal structure in the species I cannot say. The gastric parietes I found thick and flabby, not, as Daubenton says, thin and transparent. The internal mucous rugæ are puckered in parallel ridges, which cross obliquely from the cardiac orifice towards the great curvature. The stomach's measurements were 9 inches from right to left, and 8 inches from less to greater curvature.

The small intestines have a length of 26 feet 7 inches; and their diameter, which is nearly uniform throughout, is about 1 inch. The great intestines, including the cæcum, are $39\frac{1}{2}$ inches long, their diameter varying from $1\frac{1}{2}$ to 2 inches. The proportionate extent of small to large gut and cæcum is thus nearly as 8 to 1, or, if minus the cæcal appendage, about 10 to 1; Meckel[2], however, gives but 6 to 1 in the Hyena. The cæcum of this *H. brunnea* closely corresponded in length with that of *H. rayée*= *H. striata* examined by Daubenton[3], being $8\frac{1}{2}$ inches; his was 9 inches, both of us therefore differing from Reimann[4], who mentions it as being 3 inches shorter in the latter species. But, after all, such differences may depend on age more than on specific variety. Nay, even as regards shape this remark may apply to some extent; for the present specimen accorded with what Cuvier and Daubenton say of the striped animal, that it is simple, narrowing from base to its obtuse extremity, whereas Rudolphi and Reimann aver it is expanded distally. Meckel observed both forms in two animals of the same speecis. There are few mucous membrane-folds, except at the rectum, where numerous longitudinal ones exist.

The right lung has four lobes, the lower one largest, the upper one with two marginal clefts. The lobus impar is divided into two acute-shaped lobules. The left lung has three irregular-sized lobes. The trachea is an inch wide above and below, but narrower in the middle.

I noted no peculiarity in the heart from the carnivore type; length $3\frac{1}{2}$ inches, and breadth at base but half an inch less. Two main vessels were given off from the aortic arch, viz. a single left subclavian, and a right branch which split into three—respectively the subclavian and carotid of that side, and the left carotid.

[1] Anat. Comp. vol. viii. p. 688.

[2] *Op. cit.* vol. viii. p. 703.

[3] Buffon's Nat. Hist. tom. ix. p. 289.

[4] De Hyæna, Berol. 1811, p. 17.

3. *Some Myological Features.*

Hyæna brunnea does not seem to have come under the scalpel of Meckel or Cuvier, who both refer less or more to the muscles of *H. striata*. In the 'Recueil' of Cuvier and Laurillard, plates 129–142 are devoted to the "Myologie de la Hyène-rayée;" it remains for me, therefore, to make some remarks on the more interesting points.

In the Brown Hyena (*H. brunnea*), as in the genus generally, the muscular system, taken as a whole, is well developed, although certain portions (corresponding to the peculiarities and habits of the animal) are more extraordinarily marked than others. The most prominent and characteristic fleshy masses are those of the head and neck. For example, the temporal muscle is enormous, even for a carnivore; and those of the neck, in a similar manner, are of a most powerful kind—in fact, almost rendering those parts of the subdermal frame-contour deformed, so great is their bulk. The shoulder-muscles are also strong; but the fore limbs in their entirety seem less developed, because of the great fulness of the head and neck. The body to a certain extent corresponds with the anterior regions. The hind quarters, on the other hand, are comparatively weaker than the parts in advance of the middle of the body; they nevertheless are firmly knit with muscular tissue. Contrasted with this old female, none of Laurillard's sketches impress one with the exceeding bulkiness of the neck and head of the bone-crushing scavenger Hyena, though he has indicated the coarseness of the superficial fibre.

Exemplifying the terrible crushing-power of mastication possessed by this creature, is the aforesaid voluminous temporal muscle. This reaches to the parieto-occipital median crest above, and is inserted into the coronoid process of the mandible below, where, as Meckel observes[1], a line of demarcation is not readily perceived between its fibres and some of those of the masseter. Additional strength and purchase is moreover given to the muscular fibres of the temporal by a most powerful central tendinous fascia. The superficial diameter of the entire muscle is several inches in extent, and, in its thickest part, in depth or bulk is nearly equivalent to this, thus representing dynamically an enormous conservation of physical force. The masseter is clearly divisible[2] into two layers, notwithstanding Meckel's[3] assertion that this is less marked in the Hyena than in the Cat. The external larger and stronger part arises from the malar arch, and, with fibres directed downwards and backwards, is fixed partially to the posterior and outer surface of the mandible; but fibres turn round the ascending ramus, and are inserted on the inner surface. The deeper and smaller layer fills the hollow of the ascending ramus, and, with tendino-muscular fibres running nearly crosswise to those of the upper layer, ends in a tendon fixed into the posterior and inner surface of the zygoma. According to Meckel[4] this tendon attaches itself to the inferior border of the pterygoid apophysis. Professor Haughton[5] shows that in the Lion, where

[1] *Loc. cit.* vol. viii. p. 654. [2] Lettered j and j^1 in the "Myologie." [3] Ibid. p. 655.

[4] *Loc. cit.* p. 655. [5] Notes on Animal Mechanics, R. I. A., 23rd May 1864.

there is nearly a similar arrangement of the jaw-muscles, part of the fibres press the condyle into the socket, and thereby prevent such dislocation, otherwise inevitable, where prey is carried in the mouth.

The digastric is short, very thick, and with only a rudimentary tendon. My dissection bears out Meckel's description and Laurillard's drawing (pl. 137, *b b*+) of a double sterno-mastoid. Deeply and below, the neck is provided with large fleshy masses. Of these the rectus anticus minor, with usual attachments, is uncovered by the rectus anticus major. The latter, long and bulky, is narrow at the basiocciput, and, acquiring volume behind, is inserted along the roots of the transverse processes from the second to the seventh cervical vertebræ. As Douglas[1] says of the longus colli in a dog ("it appears as it were divided into as many distinct muscles, by tendinous lines, as there are vertebræ in the neck"), so is it in *H. brunnea.* Indeed this character obtains in most of the carnivora. The upper segments are oblique and short; but the lowermost is straighter and runs into the thorax to about the sixth or seventh dorsal body. The short deep muscles of the back of the neck are each very powerful and well defined.

The scaleni are three in number, as in the Dog[2], though Meckel[3] limits them to two (middle and posterior) in that animal and the Hyena. The scalenus anticus in *H. brunnea* arises by a double tendon from the third and fourth cervical zygapophyses, and, broadening posteriorly, is digitally fixed upon the thorax into the fourth and fifth ribs. The scalenus medius is diminutive, lies behind the last, and is inserted muscularly into the second rib. The scalenus posticus, larger than the medius, and lying more towards the middle line, arises by tendons from the fifth and sixth cervicals, and passes to the first and second ribs. Laurillard's plates appear to coincide with the above scalene divisions, though I confess the lettering is somewhat puzzling.

The description given by Meckel of a partially united double trapezius agrees with the *H. brunnea.* His anterior portion is an immense cephalo-humeral which passes right over the shoulder, and, narrowing as it descends, is inserted along with and outside the biceps tendon, well shown in the plates of the 'Receuil' (*a* and *k*). Excepting, it may be, the thick temporalis and large masseter, no muscle in this animal is so indicative of strength. It absolutely deforms the upper part of the neck, the muscular fasciculi there being in great coarse bundles.

Another muscle, equally as strong as the transversalis cervicis, but narrower and thicker and rather longer, lies to the inside of it. The fibres of the former seem to be continued by additional attachments to the zygapophysis of the last four cervical vertebræ, and go to form the muscle under consideration, which, from the origin spoken of, proceeds to be inserted into the transverse process of the atlas.

This muscle evidently answers to what has been described as the complexus tertius in

[1] 'Myographiæ Comparatæ,' Lond. 1707, p. 53.

[2] Douglas, *op. cit.* p. 60.

[3] *L. c.* p. 158.

Hyrax. Its origin with and close attachment to the transversalis cervicis (their fibres being even blended) make it possible that it may be portion of that muscle. Certainly Meckel has described under transversalis cervicis a muscle analogous to this. Its perfect distinctness anteriorly in the *Hyæna brunnea*, however, would make it probable that the term complexus tertius adopted in *Hyrax* is legitimate, more especially as the transversalis cervicis, or continuation of longissimus dorsi, is so plain and distinct. It is equivalent to the trachelo-mastoid of some anatomists.

The two muscles (complexus major) of the opposite sides of the neck lie in such close apposition as with great difficulty to be separated. They are each large and fleshy. Origin, the prominent spine of the first dorsal and one or two of the transverse processes of the succeeding dorsal vertebræ, also all those of the neck. Insertion together with the posterior hollow of the atlas. The complexus minor and, it may be, biventer cervicis are long, very strong cordiform muscles with perfectly distinct origins, but a united powerful tendinous insertion into the occiput, beneath the occipital prominence. The innermost and longest arises by a narrow, but strong, tendon from the tips of the second anterior prominent spinous processes, and, proceeding forward (up the neck) outside the complexus major and beneath the splenius, is inserted as aforesaid. The outermost portion, rather the broadest, arises by muscular fibres and tendon from the transverse processes of the six posterior cervical vertebræ and one or two dorsal ones. It seems to have the greatest share of the tendon common to both.

The relative size of the dorsal muscles (or erector spinæ) the one to the other is unusual. The serrati postici, usually small, are here large; the sacro-lumbalis and longissimus dorsi, on the contrary, are comparatively small, although in themselves of no mean bulk; but the spinalis dorsi obtains by far the largest dimensions, and is indeed a very powerful muscle of enormous magnitude.

There is no continuation into the neck of the so-called cervicalis ascendens. The nuchal continuation of the longissimus dorsi, known as transversalis cervicis, is of greater breadth and more muscular than its derivative. It has an additional tendinous origin from the fourth and fifth dorsal spines.

The serratus magnus is an enormously strong sheet of muscle, the neck-portion being very thick indeed. Superior and inferior serrati postici are combined; their fleshy fibres forwards brace the longitudinal dorsal series. The latissimus dorsi agrees perfectly with Meckel's description (*loc. cit.* p. 265). It is peculiar in having no costal attachments; the fibres run beyond the last rib to within $1\frac{1}{2}$ inch of the crest of the ilium. There are two supracostal muscles. The innermost passes from the first to the third, fourth, and partially to the fifth ribs. The outer smaller muscle extends from the first and second to the third rib and interspaces beyond. The supracostal I believe first to have been described by Douglas as musculus in summo thorace situs.

In the Brown Hyena, as in other Carnivora, the rectus abdominis reaches the first rib. The six aponeurotic insertions, spoken of by Meckel, are not so clearly shown in the above species. No pyramidalis is present. With regard to the psoas and iliacus muscles I have found *H. brunnea* to agree with Meckel's account; as he says, the psoas parvus is considerable, and the psoas magnus double; but an additional part which he is in doubt whether it belongs to the parvus or magnus, I am inclined to regard as but part of the latter. The iliacus is small and feeble.

Including head, neck, and trunk, such are the main muscular features which characterize the frame of the South-African form of Hyena. They are in a manner typical of the genus now living, and doubtless, with possibly slight modification, existed in their ancient brethren, for example, the Great Cave-Hyæna, *H. spelæa*. To the massive fleshy development of the jaws and neck must we attribute the terrible strength of these animals, enabling them with ease to seize and drag along the carcasses of prey far surpassing themselves in size, and to crunch great bones with astounding facility. As I have hinted, the trunk is but fairly muscularly developed, the limbs relatively weaker; but as regards the muscles of the latter and their tendinous distribution, it is not my intention at present to enter upon a description of them.

DESCRIPTION OF THE PLATE.

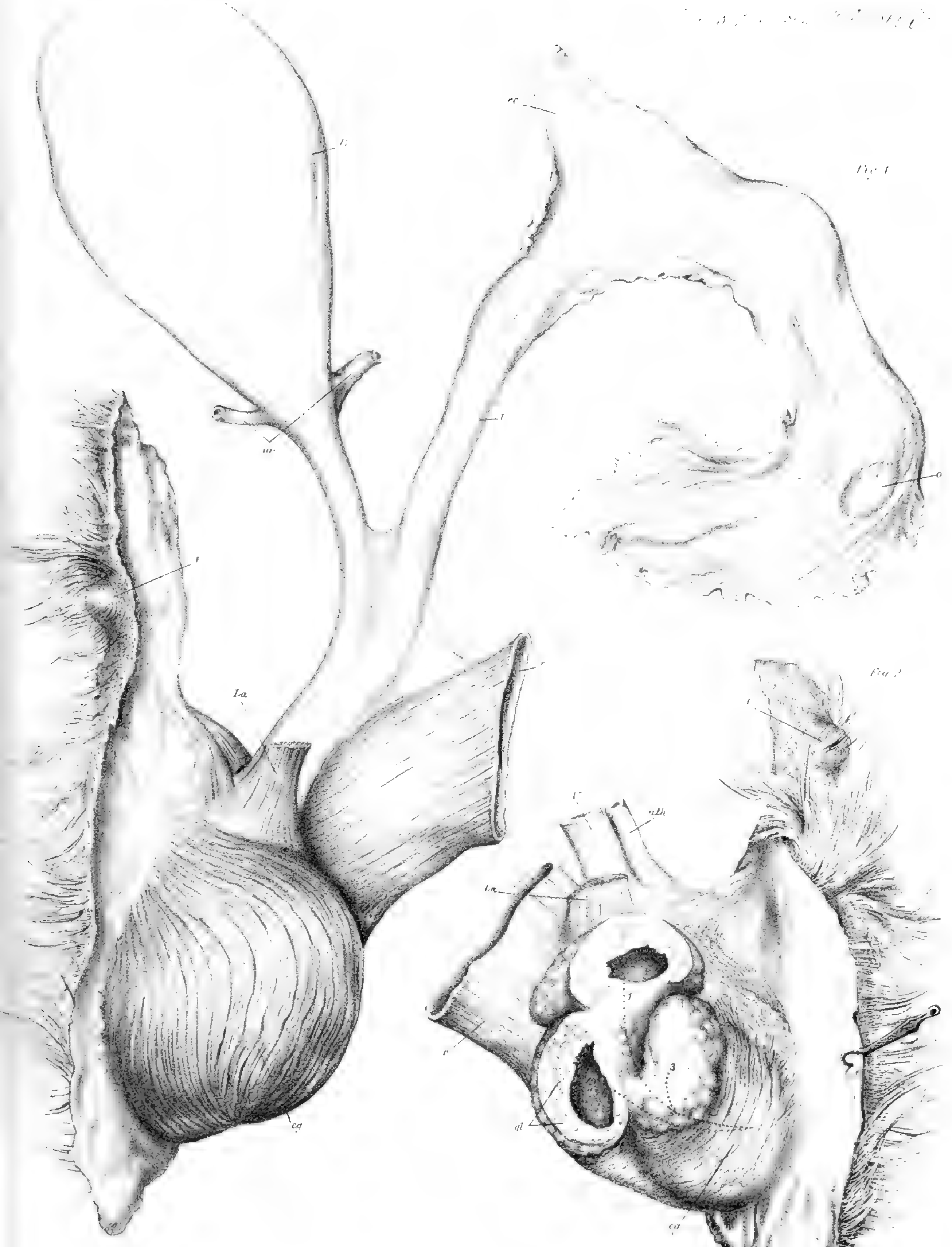
PLATE LXIII.

Fig. 1. The urino-generative parts of the Brown Hyena removed *en masse*, and seen in profile. Their natural dimensions.

U, uterus; *r.c*, the right cornu cut across at its proximal end; *O*, left ovary; *B*, urinary bladder; *ur*, ureters severed; *r*, rectum; *L.a*, portion of levator ani muscle; *c.g*, compressor glandulæ of left side; *t*, teat.

Fig. 2. A view of the opposite (right) side, showing the compound anal gland dissected.

1, 2, 3, the respective glandular chambers. Two of them have been cut through to expose their cavities and (*gl*) their glandular walls; and the third (3), intact, displays the exterior nodulated surface when the superincumbent cellular tissue and muscle (*c.g*) are cleared off. The dotted lines denote the direction of the passages towards the postanal fossa; *V* and *uth*, portions of vagina and urethra; *r*, rectum; *t*, teat; *L.a*, levator ani. Nat. size.



[illegible] del. ad nat.

[illegible] lith.

NAL GLANDS [illegible] BRUNNEA ♀ Nat Size

XV. *On the Dodo* (Part II.).—*Notes on the Articulated Skeleton of the Dodo* (Didus ineptus, *Linn.*) *in the British Museum. By* Professor OWEN, *F.R.S., F.Z.S., &c.*

Read April 18th, 1871.

[PLATES LXIV. to LXVI.]

SINCE the former communication, of January 9th, 1866, to the Society[1], in which were figured the bones of the Dodo then at my command, and, in pl. 15. fig. 1, as laid down skeleton-wise within the outline of the British Museum oil-painting of the Dodo, natural size, I have been favoured with other specimens of the osteology of that extinct bird. These, chiefly due to further transmissions by Mr. George Clarke, C.M.Z.S., from the Mauritius, justified the undertaking an articulation of the skeleton, which has accordingly been carried out ably and artistically by Mr. E. Gerard, jun.; and the specimen is now exhibited in the Ornithological Gallery of the British Museum (Pls. LXIV. and LXV.). It is not, indeed, entirely complete, there still being wanting the bones of the hand and of the tail. But one important character of the pelvis has been rectified by the acquisition of the os pubis[2], which yields an additional mark of affinity of *Didus* to *Pezophaps*[3] and the existing pigeons.

Pezophaps and *Didus* (the Solitaire and the Dodo) agree in the extent and kind of anchylosis in the dorsal region of the spine. It affects, in both, the three vertebræ preceding the last free, rib-bearing dorsal. In both species the neural spines have run together into a bony ridge, with a straight, thickened upper free border. In both the confluence of the neural arches is only interrupted by the conjugational foramina (pl. 17. figs. 1 & 5, *f f*, O.; pl. 15. fig. 51, N.), which are similar in size and shape.

My series of these coalesced vertebræ included two varieties:—one showing a feeble beginning of the hypapophysis at the fore part of the last vertebra (pl. 17. fig. 5, O.); the other a better-developed, though small, hypapophysis, but so extended as to reach, and coalesce at its extremity with, that of the antecedent vertebra, leaving a vacuity corresponding with the wider one between the first and second of the coalesced hypapophyses. In *Pezophaps* the specimen (pl. 15. fig. 51, N.) resembles the variety (pl. 17. fig. 5, O.) of *Didus*, save in the absence of any indication of hypapophysis on the third

[1] Trans. Zool. Soc. vol. vi. p. 49.

[2] I mistook that rib-like bone for one of the dorsal ribs in my former Memoir; the body of the restored rib (pl. 16. fig. 2) and the detached portion of the rib (figs. 9, 9*a*) are portions of the "pubic bones."

[3] Professor A. and Mr. E. Newton, "On the Osteology of the Solitaire, &c.," Phil. Trans. 1869, pls. 17 & 18, figs. 66, 68–70. Future references to this interesting and instructive Memoir will be made under the letter N.; those to my own Memoir, of 1866, on *Didus* by the letter O.

vertebra. And in the instructive example of the three partially anchylosed vertebræ of a young *Pezophaps* (pl. 16. fig. 60, N.) the third vertebra shows no hypapophysis[1]. In this specimen anchylosis is seen to have begun at the neural arch and spine, chiefly between the first and second vertebræ, and co-ossification of the centrums is more advanced between the first and second than between the second and third of these vertebræ.

The inference that these anchylosed vertebræ included the penultimate, antepenultimate, and the next dorsal vertebra in advance, and that only one free dorsal vertebra intervened between the coalesced mass and the sacrum, was confirmed by the specimens of *Pezophaps* (N., p. 332), as it has been by additional vertebræ of *Didus*; and the correspondence of both the extinct Mascarene species with the *Columbidæ* in this vertebral character must now be held to be well established.

One would be glad to receive the evidence of the vertebral formula which the entire skeleton of one and the same individual of *Didus* or *Pezophaps* would afford; but the discovery of such with the bones in requisite contiguity is hardly to be hoped for. The concurrence, therefore, of Messrs. A. & E. Newton, as to the number of moveable thoracic or dorsal ribs[2], with the estimate similarly formed from comparison of detached vertebræ of *Didus*[3], is welcome.

To both the Mauritian and Rodriguez extinct Ground-Doves may be referred eight pairs of dorsal ribs. For the similarity of size and proportions of some of these ribs, and of the confluent epipleural appendage, figures 5 & 7, pl. 16 (O.), may be compared with figures 63 & 64, pl. 16 (N.).

The first material discrepancy between *Didus* and *Pezophaps*, or between the descriptions of their respective osteologies here quoted, is in the number of sternal ribs.

To Messrs. Newton there appear to be only four pairs in *Pezophaps*, the last articulating with the sixth dorsal rib[4]. It is to be regretted that the mutilated lateral border of the best-preserved sternum of *Pezophaps*, one of six received by the Messrs. Newton, does not allow a certain conclusion to be arrived at as to the number of articular surfaces on the costal border.

Messrs. Newton do not entertain so much doubt on this point as I do; they write:—"A more remarkable difference is presented by the costal border in this" [their best-preserved] "specimen, which shows articular surfaces for four sternal ribs only, instead of five, which is the normal number in *Didus*; and, so far as can be determined from the broken state of the remaining specimens, there is nothing to induce the belief that they possessed more than four such surfaces"[5].

If any one will compare fig. 2, pl. 18, O., with fig. 74, pl. 18, N., he may be allowed to doubt whether the fracture following the fourth articular surface on the costal border of the least-mutilated sternum of *Pezophaps* may not have removed a fifth

[1] In other respects the last of the three anchylosed dorsal vertebræ in *Pezophaps* does "bear a great general resemblance to the same bone in *Didus*."

[2] N., p. 332. [3] O., p. 53. [4] N., p. 334. [5] N., p. 338.

narrow ridge like that (fig. 2, pl. 18, O., *c* 5) to which the fifth sternal rib articulates in *Didus*. Admitting, however, that "too much importance must not be placed on this character"[1], and cognizant of instances, like that cited by Messrs. Newton, of *five* articular surfaces on one side, and *four* on the other, yet I am unwilling to suppose that the last (in *Didus*, "sixth") sternal rib, which terminates below in a point and joins the antecedent sternal rib before attaining the sternum, had not its homologue in *Pezophaps*. I quite concur, however, with the observant and conscientious authors of the Monograph on the Solitaire that its affinity to the Dodo "is nowhere better shown than on a comparison of the sterna of the two forms"[2].

The deeper and more approximate coracoid grooves in the sternum of *Pezophaps* relate to the greater size, thickness, and breadth, especially of the sternal half and articular end of the coracoid in that extinct genus. In additional specimens of the sternum of *Didus*, the antero-median depression of the inner surface is more marked than in the subject of fig. 2, pl. 18 (O.); but in none has it perforated the bone as in fig. 74, pl. 18 (N.). Considering the peculiarity of the configuration of sternum in the Solitaire and Dodo—unlike that of any other bird known to me, as to Messrs. Newton—the degree of affinity of the two forms appears to be closer than would admit of real or intelligible generic distinction. The Solitaire is a longer-legged, more active, variety of Ground-Dove, in which the abortion of unused wings had not extended to the degree manifested by the larger, heavier, and more sluggish form.

In the articulated skeleton of the Dodo (Pls. LXIV. and LXV.) I assign twelve vertebræ to the cervical series, as in the restoration in pl. 15 of my original Memoir; and this is the estimate of the number of the cervical vertebræ in *Pezophaps* to which Messrs. Newton are led after careful comparison and analysis of the "hundred and sixty-one vertebræ" of that extinct bird in their collection[3].

In the unlikely contingency of the disinterment of the bones of any individual Dodo or Solitaire which may have lain so undisturbed as to demonstrate the precise number of vertebræ intervening between the skull and pelvis, the accuracy of our respective inductions as to the vertebral formula may be put beyond question. But should it prove that there have been one or two cervicals more or less than have been assigned to *Didus* and to *Pezophaps*, the responsibility as to the former bird will rest with the author of the Memoir of 1866, and not with the artist, as to whose figure of the skeleton of *Didunculus*, in pl. 15 of that Memoir, I must observe that there are plainly twelve cervicals given, neither more nor less, succeeded by seven dorsals, of which the three confluent ones are the fourth, fifth, and sixth, as in *Didus* and *Pezophaps*. The remark hazarded by Messrs. Newton in reference to my old, painstaking, and accurate artistic fellow-labourer Erxleben, "that the skeleton of *Didunculus* in the same plate appears to be represented as possessing fourteen cervical and seven dorsal vertebræ, being altogether two *more* than we are able to count in the very specimen, now in the

[1] N., p. 338. [2] N., p. 338. [3] N., p. 332.

Museum of the Royal College of Surgeons, which served as the subject of his pencil" (*op. cit.*, N., note, p. 332), seems to have been sent to press without due consideration.

With respect to the pelvis of *Didus*, Mr. Erxleben drew no more of the pubic bones than the specimens at that time warranted. It was at my suggestion that this portion of bone, originally detached, was brought into contact with the ischium at two points, as it is in *Didunculus*. The more perfect specimens of the long and slender pelvic hæmapophysis, since obtained and recognized, seem to show that the second junction does not take place, but that the pubis extends freely backward, with a graceful downward curve, and for an extent corresponding with the characters of the same bone in *Pezophaps*. (Compare Pls. LXIV. and LXV. of the present Memoir with fig. 70, pl. 18, N., and the restoration in dotted outlines in fig. 179, pl. 24, N.) Nevertheless a pelvis with the whole extent and entire lower border of the ischium seems still to be a desideratum in the collections of the bones of both *Didus* and *Pezophaps* which have as yet reached England. The better-preserved sacral elements of the pelvis permitted sixteen vertebræ to be counted in that extensive anchylosed mass of bone-segments. Messrs. Newton state that one specimen of pelvis of *Pezophaps*, complete in its posterior half, "has eighteen coalesced sacral vertebræ." It is to be regretted that this specimen is not figured; the subjects, at least, of figs. 66, 68, 69, & 70, in their paper, are plainly mutilated behind. The two "perfect examples" [of sacrum?] "of *Didus ineptus* show only sixteen (vertebræ), which is probably the normal number in that species." *Op. cit.* N., p. 334.

The essential characters of the pelvis show a close correspondence in *Didus* and *Pezophaps*. "The articular surface of the centrum of the last dorsal" [first 'sacral' by the character of confluence] "is in *Pezophaps* almost exactly as in *Didus*"[1]. Other pelvic correspondences are seen in the general shape and disposition of the ilia, which, however, are not developed behind in *Pezophaps* so as to give the flatness and breadth to the posterior half of the pelvis which seem to specifically characterize the Dodo. The position of the skeleton in Pl. LXV. has been selected to exemplify this peculiarity. Other particulars, especially the more essential ones, such as the length, curvature, and movable articulation of the ribs of the first sacral vertebra[2]—the confluence, shortness, and straightness of the pleurapophyses of the next three sacrals—the suppression of the rib-elements in the three succeeding vertebræ, and their reappearance in the eighth and sometimes in the ninth sacral as strong abutments against the ilia above and

[1] N., p. 334.

[2] In this, as in my former paper, I adhere to the usual characters of the sacrum afforded by coalescence. Messrs. Newton are influenced by its extent—and where it leaves the ribs free, reckon such vertebræ as "dorsal." Accordingly my "first sacral" is their "last dorsal." Anchylosis, like most of the characters of the classes of vertebræ in anthropotomy, is an artificial one, and might justify the ascription to the *Columbacei* or "*Gemitores*" of four sacrums, viz, "caudal," "pelvic," "lumbar," and "dorsal;" for the vertebræ answering to the lumbar and anterior caudals in Mammals and Reptiles are massed with the interacetabular or proper pelvic vertebræ into one extensive and complex bone.

behind the acetabula—and the indications of "prerenal," "midrenal," and "postrenal" depressions—are all correspondences with the pelvis in *Didunculus* and *Goura*, which *Pezophaps* shows in common with *Didus*.

The chief difference between *Didus* and *Pezophaps* in cranial structure is the degree in which the cancellous tissue is developed between the outer and inner "tables," the minor quantity of that tissue in *Pezophaps* leaving a flatness of the frontals above the orbits contrasting with the convexity of that part of the cranium in *Didus*. I suspect that when the part of the skull of the Solitaire may be found, supplying what is wanting in the specimens figured in figs. 149, 150, pl. 22 (N.), there will be a depression or concavity in the profile contour between the fore part of the frontals and the naso-premaxillaries, which will suggest the presence of a "frontal protuberance" differing only in degree from that so called in *Didus*. Indeed Messrs. Newton recognize the fact that "the frontals rise abruptly as in *Didus*"[1], the precise extent of the "rise" being yet to be determined in *Pezophaps*. A section of the cranium of a Solitaire, like that of the Dodo, in fig. 1, pl. 23 (O.), would, if it had been made and figured in N., have afforded ready means of judging of the degree and value of the difference in cranial structure of the two extinct Columbaceans. The orbital chambers are relatively, not absolutely, larger in the Solitaire. Taking the distance between the anterior and posterior orbital process in fig. 149, pl. 22 (N.), I find it three lines less than the same admeasurement in the skull of the Dodo in pl. 15 (O.).

In like manner I discern no essential or generic difference of character in upper or lower mandibles of *Pezophaps* and *Didus*, only such modifications of shape and proportion as may differentiate such closely allied species. With the longer proportional metatarsals of the Solitaire goes a more slender and lighter-constructed beak (fig. 179, pl. 24, N.). The authors, however, note a "remarkable variation in the size of the upper mandible in different individuals, to the extent of very nearly one half the linear dimensions between the largest and smallest specimens, of which the collection contains thirteen in all."[2] Is there an intermediate gradational series? May this difference of length of beak concur with that pointed out by Strickland in the length of leg?

Better specimens of the mandible of *Pezophaps* than had reached Messrs. Newton at the date of publication of their interesting and instructive memoir seem to be needed to solve these questions, and are indispensable for profitable comparison with that part in *Didus*. The portions of the mandibular rami described and figured in N., however. serve to show an agreement with the maxilla in the more slender and less powerful proportions. It is interesting to note that the differences in size and proportion are less in the proximal than the distal elements of the mandible.

No tympanic bone of *Didus* has yet reached me; so that I am unable to give figures of it separately, in order to compare with those of the Solitaire, figs. 163–168 in pl. 22 (N.).

[1] N., p. 347. [2] N., p. 347.

The atrophy of wings had not proceeded so far in the extinct Ground-Dove of Rodriguez as in the larger species of the Mauritius. The constituents of the scapular arch—scapula (pl. 19, figs. 97–99, N.) and coracoid (ib. figs. 76–79)—are absolutely larger, or are relatively thicker or broader (pl. 19, figs. 132, 133) in *Pezophaps* than in *Didus*; and the same difference of proportion prevails in the humerus, radius, and ulna. The expansion of the distal end of the scapula in *Pezophaps* makes the general curve of the upper and anterior border slightly concave; in *Didus*, beyond the proximal concavity of the curve of that border, it runs straight to near the distal end, towards which it curves, convexly, as in *Pezophaps*. The absence of any example of confluence of scapula and coracoid in the rich series of specimens possessed by Messrs. Newton of these bones (thirty-six of scapula, twenty-seven of coracoid) in the bird of Rodriguez, indicates a more habitual and powerful use of the appendage of the arch than was exercised by *Didus*.

The bones of the manus of the latter bird are still unknown; the desire to obtain such is increased since the discovery that the metacarpus of *Pezophaps* has, on the radial border, a large subspherical knob resembling a tumour, and compared by its describers to a callus-like mass of diseased bone. Its repetition, however, in all the perfect specimens, its association with a similar outgrowth from the radial border of the distal end of the radius in the larger examples of that bone, supposed by Messrs. Newton to be of the male Solitaire, and the notice of the same structure in the living bird by Leguat[1], show it to be normal in *Pezophaps*, though, when fully developed, perhaps sexual. Such tumefaction of the metacarpus has not been noticed in any of the accounts or figures of the living Dodo, and it may well be one of the marks of distinction between the Solitaire and Dodo. I should not be disposed, however, to assign to the metacarpal knob a higher than specific value.

In *Didus* and *Pezophaps* the metatarsal bone presents, besides difference of proportions illustrated in a paper by Strickland[2] and in the joint work of Strickland and Melville[3], differences of structure, which I fix at a like value. As the characters afforded by the articular extremities of the metatarsal of *Pezophaps* are obscured, more or less, by the stalagmitic incrustation of the bones figured in pl. 15 of 'Dodo and its Kindred,' I believe that the subjects of Pl. LXVI. of the present paper may not be deemed superflous or be unacceptable.

The metatarsus of *Pezophaps* is represented by bones of different dimensions, but may be said to be, as Strickland recognized them to be, "large" and "small," the variations in these two categories ranging within narrow limits. The two nearly perfect specimens, a right and left, presented by Professor Newton to the British Museum, are of

[1] "The bone of their wing grows greater towards the extremity, and forms a little round mass under the feathers, as big as a musket ball." Quoted by Messrs. Newton at p. 350 of their memoir.

[2] Trans. Zool. Soc. vol. iv. p. 187, pl. 55.

[3] 'Dodo and its Kindred,' 4to, 1848, pls. 11 & 15.

the large size, and would be referred by Strickland to his *Pezophaps solitaria*. I have also had under observation three metatarsi (of the right side) of the small size, by which Strickland characterized his *Pezophaps minor*[1]. The following description is from the larger metatarsi (Pl. LXVI. figs. 1–4, fig. 13). The entocondylar cavity (*a*) is deeper and wider from before backward than the ectocondylar one (*b*); it has the same transverse diameter. The intercondylar tuberosity (*c*) rises to the height of $4\frac{1}{2}$ lines from a base 7 lines in breadth, and terminates obtusely; the fore-and-aft extent of the base occupies rather more than half that of the proximal articular surface, of which a flat triangular tract (fig. 13, *d*), 6 lines in breadth posteriorly, intervenes between the back parts of the ento- and ecto-condylar cavities; and from it is continued a tract, of a breadth of 1 or 2 lines, along the back part of the ectocondylar fossa. The obtuse low summit of the ectometatarsal ridge marks the outer termination of the rising

[1] Trans. Zool. Soc. vol. iv. p. 191. One of these specimens is alluded to by the Messrs. Newton as follows:—"In addition to these *eighteen* specimens, we are informed that in 1860 or 1861 a tibia, the shaft of a tarso-metatarsal, and some fragments of the shaft of a femur, all of which belonged to the Solitaire, were sent to Professor Owen by M. Bouton of the Museum at Mauritius; but the fate of these specimens is unknown to us." They are referred to in the following letter:—

"8 Great Ormond Street, Queen Square, W.C.,
"18th December, 1860.

"Dear Sir,—By the last 'Overland' from Mauritius I received from the Curator of the Museum of Port Louis the two fragments of bones, which he suspects to be those of the Dodo, and he is anxious to have your opinion in the matter. Under these circumstances I have taken the liberty of sending them to you just as they came to me on Saturday last. The Curator writes me: 'Je les ai trouvés dans la Collection du Muséum déposés à côté d'ossements fossiles de Tortues recueillies dans un dépôt Calcaire aux Quatre Cocos, à Flacq, à une petite distance de la mer. No. 1 me paraît se rapprocher à la figure 1, planche xv. de Strickland, et dans ce cas serait un fragment du tibia droit du Solitaire; No. 2 se rapproche de la figure 2*a* de la planche xv. de Strickland. Ce serait dans ce cas le métatarse droit auquel il manquerait une portion de l'articulation inférieure et la totalité de l'articulation supérieure . . . . s'ils sont ce que je les crois être, je vous prie de me les renvoyer ensuite quand ils seront examinés.'

"As my friend mentions the district of Flacq, I know that several fossil remains have been found there; and some years ago when I was in the island, I and other friends made an examination of the locality in order to find some remains of the Dodo, at the request of Mr. Strickland, who was them preparing his excellent work on the Dodo, &c.

"If, therefore, you will do me the favour to give me your opinion on the fragments I now take the liberty of sending you, such an opinion from so high an authority will set the matter at rest.

"I remain, dear Sir,
"Very truly yours,
(Signed) "James Morris."

"*Professor Owen, &c. &c.*"

The fragment of the tibia marked No. 1, included the distal articular end and part of the shaft of that bone; No. 2 was rightly recognized by M. Bouton. Both portions belonged to the *Pezophaps minor*, Str. So named, they were returned to the Museum at Port Louis, Mauritius. The first and sole evidence of Messrs. Newton's interest in these fragments reached me with their memoir. Any previous inquiry would have, at once and most readily, received the reply given in the present note. No portion of femur, and no entire tibia, were sent to me.

between the anterior and posterior parts of the so divided ectocondylar surface (fig. 13, *b*, *k*). A difference of colour and of texture indicates that the articular cartilage was not continued upon the flat triangular intercondylar facet (ib. *d*). The extreme transverse extent of the proximal articular surface is 1 inch 6 lines; the extreme fore-and-aft extent of that surface is 9 lines. In *Pezophaps minor* (ib. fig. 12) these dimensions give 1 inch 3 lines and $7\frac{1}{2}$ lines respectively.

The side of the entocondylar division of the proximal end is traversed by three longitudinal ridges. The anterior, beginning by a slight rise of the articular border, extends along the inner (tibial) side of the entometatarsal about one third of the way down; it is the "entometatarsal ridge" (fig. 4, *e*, *e*). The second ridge begins at the highest part of the entocondylar border, and subsides after a downward course of two thirds of an inch; it is the "entocondylar" ridge (*f*). The third ridge begins at the back part of the entocondylar border, makes a curve as it descends toward the inner side of the entometatarsal, but descends before attaining that side, and is continued downward two thirds of the length of that metatarsal as the "entogastrocnemial" ridge (fig. 4, *g*). The second short ridge (*f*), in some specimens, joins the third to form the entogastrocnemial ridge. The fore part of the entocondylar expansion shows two or three oblong tuberosities, in the same transverse line, the outermost of which (fig. 3, *h*) extends down as a short ridge and forms part of the inner boundary of the "anterior interosseous depression (*i*).

This, which is due to the retrogression of the head of the mesometatarsal (III), is bounded above by the part of the confluent epiphysis developing the intercondylar tuberosity (*c*); its sides are formed by the more advanced proximal ends of the ento- (II) and ecto- (IV) metatarsals, the latter bone defining that side of the fossa by a ridge or ridge-like angle continued into the "ectometatarsal ridge" (*k*), which descends inclining to the outer side of the lower part of the ectometatarsal (IV). Into the antinterosseal depression (*i*) open the two fore-and-aft canals between the upper ends of the metatarsals, that (*l*) between the ento- and meso-metatarsal being the largest; it is vertically elliptical, $3\frac{1}{2}$ lines by $2\frac{1}{2}$ lines in diameter. The canal between the meso- and ectometatarsals opens into the fossa by a vertical slit (fig. 3, *m*), two lines long and two thirds of a line wide. Below the larger foramen is a rough surface (*n*) for the insertion of the "tibialis anticus;" it does not project. The interosseous depression (*i*) gradually shallows and contracts as it descends, or as the middle metatarsal advances into line with the outer and inner ones, the boundaries being defined by low narrow antinterosseal ridges, which, midway down the shaft, diverge as they descend, the outer one (fig 3, *o*) terminating in the groove leading to the lower interosseal canal (*p*) between the meso- (III) and ecto- (IV) metatarsals. The anterior orifice of this canal (fig. 3, *p*) is vertically oblong, about $1\frac{1}{3}$ of a line in width; the posterior orifice (fig. 2, *p'*) is minute and circular. The bar or bridge of bone (ib. *q*), from the neck of the ectotrochlea (IV) to that of the mesotrochlea (III), converts the remaining interspace behind into a vertical "adductor" canal, leading from the anterior orifice of the lower interosseal canal (*p*) to the interval between the ecto- and meso-trochleæ. The tendon of the "adductor digiti externi" traverses this canal, to be inserted into the inner side of the base of the proximal phalanx of the outer toe.

The calcaneal process (*r*, *s*) is developed from the back part of the head of the mesometatarsal (III) and the part of the proximal epiphysis confluent therewith; it is divided into ento- (*r*) and ecto- (*s*) calcaneal portions, by the tendinal canal (*t*) completed by peripheral ossification between those portions; this uniting plate of bone is impressed externally by an open shallow tendinal groove (*u*). The outer part of the ectocalcaneal process is impressed by a narrower and deeper tendinal groove. The posterior rough and flattened surface of the entocalcaneal process is elongate and contracted below; in *Pezophaps minor* (fig. 6, *r*), where alone I have seen it entire, it is 10 lines long by 3½ lines in extreme width. The ectocalcaneal process (ib. *s*) shows a similar surface, 7 lines in length and 2 lines in breadth, in *Pez. minor.* A deep and wide elongate channel (fig. 4, *v*) intervenes between the entogastrocnemial ridge (*g*) and the calcaneal process (*r*), with its sustaining buttress formed by the back part of the mesometatarsal; into the upper part of this concavity opens the canal (*l*) between the ento- and meso-metatarsals. The smaller interosseous canal (*m*), between the meso- and ecto-metatarsals, opens into the shallower depression (fig. 1, *w*) external to the calcaneal prominence. This depression is bounded externally by the ectogastrocnemial ridge (*x*), which describes a slight curve, convex backward, as it descends to terminate on the ectotrochlear ridge (fig. 2, *z*). From the back part of the mesometarsal (fig. 2, *r'*), which projects in a subtriangular form, a narrow (postinterosseal) ridge (ib. *y*) is continued, which descends for some way outside of and parallel with the one continued down from *r'*; but at the beginning of the trochlear expanse it bends outward, and terminates in the tuberosity, or thicker ridge[1] (*z*), at the outer and hinder part of the ectotrochlea (IV). The entogastrocnemial ridge[2] (*g*) terminates at the upper border of the "hallucial surface" (I). The mid ridge or hind angle of the mesometatarsal (III) runs down along the outer side of the hallucial surface, almost subsiding, but seeming to be continued by a strong oblique ridge (fig. 2, α), lost upon the back part of the neck of the entotrochlea (II). A tendinal groove (fig. 2, B) extends from the upper and outer part of the oblique ridge to or near to the interspace between the ento- and meso-trochleæ.

The posttrochlear depression (fig. 2, γ), bounded by the oblique ridges (α & *z*), and

[1] This is mutilated in the specimen figured in Trans. Zool. Soc. vol. iv. pl. 55. fig. 6.

[2] The insertions of "the strong ligamentous aponeurosis" formed by the confluence of the tendons of the *gastrocnemius internus* and *gastrocnemius externus* (Trans. Zool. Soc. vol. iii. p. 294) are represented in pl. 32. fig. 2, R, and in fig. 1; also in pl. 35. R***, of that volume, in *Apteryx australis.* The ridges termed "gastrocnemial" mark the lines of insertion of this strong aponeurotic sheath for the tendons of the deeper-seated muscles, chiefly flexors of the toes.

by the backwardly produced ento- (II) and ecto- (IV) trochleæ, is shallow, but well defined.

The entotrochlea (II) is convex anteriorly, canaliculate behind, and chiefly through the production of its inner and hinder part. The ectotrochlea (IV) is less concave, almost flat, transversely, behind, its outer and hinder border being less produced and more rounded off. The depression (*i**) on the outer side of the ectotrochlea is rather deeper and better defined than that on the inner side of the entotrochlea (fig. 4, II). The outer trochlea does not extend so low down as the inner one; and the interspace between it and the mid trochlea reaches higher up, especially behind, so that the outer part of the neck of the mid trochlea (fig. 2, III) is the longest. The mid groove of that trochlea runs from the fore to the hind part, and is deepest anteriorly (fig. 3, III).

As compared with *Didus*, the entocondylar cavity (*a*) is deeper, and the margin better defined, in *Pezophaps* (figs. 12, 13). The intercondylar tubercle is higher and less obtuse in *Pezophaps.* The hind border of the entocondylar expansion extends further in *Pezophaps* than in *Didus* before passing to the inner side of the entocalcaneal process (ib. *r*). The upper border of the entocalcaneal process is thinner in *Pezophaps.* The calcaneal canal (*t*) is smaller. The tendinal groove (fig. 1, *u*) is shallower. The ectocalcaneal process (*s*) is narrower: the groove on the outer side of that process is also narrower, and is defined by a ridge not developed in *Didus.* The short ridge or process below the posterior margin of the entocondylar cavity in *Didus* (fig. 10, *j*) is more developed; it is feebly indicated in *Pezophaps*, and is continued into the entogastrocnemial ridge (fig. 4, *g*), which is not the case in *Didus. Didus* has not the entometatarsal ridge (fig. 4, *e*) anterior to the entogastrocnemial ridge (ib. *g*), but only the latter, which is strongly marked and more internal in position (fig. 16, *g*).

The postinternal depression (fig. 2, *v*) receiving the larger of the two upper interosseal canals (*l*) is narrower, and in *Pezophaps minor* deeper, than in *Didus*, owing to the more posterior position, in *Pezophaps*, of the entogastrocnemial ridge (*g*) defining that depression internally. The antero-superior interosseal depression (*i*) is deeper in *Pezophaps* than in *Didus*; but the insertional surface for the *tibialis anticus* (fig. 14, *n*) is better-defined in *Didus.* The anterior ectometatarsal ridge (fig. 1, *k*) is more strongly marked in *Pezophaps* than in *Didus.*

The groove leading to the lower interosseal canal is more strongly marked in *Didus* (fig. 15, *p*) than in *Pezophaps* (fig. 3, *p*), and indicates a more powerful "adductor muscle," the tendon of which emerges at the interspace between the neck of the middle and outer trochleæ, in its course to be inserted into the outer toe.

The middle trochlea (III), as compared with the outer (IV) and inner (II) trochleæ, is larger in *Pezophaps* (fig. 3) than in *Didus* (fig. 15); its relative position to the outer and inner trochleæ, and the consequent curve which they describe transversely, I find, in the specimens before me, to be the same in both extinct genera.

In order to facilitate future comparisons and the following of the above descriptions, I subjoin the names of the parts and their symbols in Pl. LXVI. which appeared to me to call for special notice in this part of the osteology of *Didus* and *Pezophaps.*

Parts of Metatarsus.

	marked
Entocondylar cavity	*a*
Ectocondylar cavity	*b*
Intercondylar process	*c*
Intercondylar triangular tract	*d*
Entometatarsal ridge	*e*
Entocondylar ridge	*f*
Entogastrocnemial ridge	*g*
Entocondylar tuberosity	*h*
Antinterosseal depression	*i*
Ectometatarsal ridge	*k*
Entinterosseal canal	*l*
Ectinterosseal canal	*m*
Facet for "tibialis-anticus" tendon	*n*
Antinterosseal ridges	*o*
Lower interosseal or "adductor" canal, anterior orifice	*p*
Lower interosseal or "adductor" canal, posterior orifice	*p′*

	marked
Adductor bridge	*q*
Entocalcaneal process	*r*
Ectocalcaneal process	*s*
Calcaneal canal	*t*
Calcaneal groove	*u*
Postinternal depression	*v*
Postexternal depression	*w*
Ectogastrocnemial ridge	*x*
Postinterosseal ridge	*y*
Ectotrochlear ridge	*z*
Hallucial surface	I
Entotrochlear ridge	α
Intertrochlear groove	β or B
Posttrochlear depression	γ
Ectotrochlear depression	*i**
Entotrochlea	II
Mesotrochlea	III
Ectotrochlea	IV

The "hallucial facet" is not higher above the entocondyle in *Pezophaps* than it is in *Didus*; the greater length of the metatarsus is due to elongation of the shaft between that surface and the subsidence of the calcaneal process.

The shorter and stronger metatarsus of *Didus* indicates more powerful actions of the foot, in reference to the greater weight of body to support—perhaps, also, to more habitual and powerful applications in scratching up the soil.

The longer and more slender metatarsus of *Pezophaps* relates, as Strickland justly observes[1], to the lighter weight and more active movements of that bird, which seems to have preserved its existence to a later period (1735) than the Dodo.

In a Memoir on the *Apteryx*, read August 14th, 1838, and printed in the second volume of the 'Zoological Transactions' (p. 257), the composition of the metatarsus is described as follows:—"The upper articular surface is formed by a single broad piece. The original separation of the bone below into three pieces is plainly indicated by two deep grooves on the anterior and posterior part of the proximal extremity; the intermediate portion of bone is very narrow anteriorly, but broad and prominent on the opposite side" (p. 293). This prominence was indicated in subsequent Memoirs as the

[1] Annals and Magazine of Nat. Hist. 2nd ser. vol. iii. 138.

"calcaneal process;" but it does not form the whole upper end or head of the middle piece or metatarsal element.

In my Memoir on *Dinornis*, part 1 (1843[1]), I entered, with a view to determine the composition and processes of the metatarsal bone, into an analysis of its development, and showed, in an immature Ostrich[2], that the head of the middle of the three normal metatarsals, which middle bone may be reckoned as that of the third digit, if the rudimental metatarsus of the back toe be viewed as the innermost or first metatarsal, projects posteriorly beyond those of the other two (second and fourth), and developes the chief and commonly sole "calcaneal process." I also showed that the mid metatarsal, in its descent toward the toes, changes its relative position to the others, coming gradually forward and developing its condyle in advance of, or in a plane somewhat anterior to, the condyles of the second (inner) and fourth (outermost) metatarsals.

Messrs. Newton, in reference to the "calcaneal process," or the "inner or longest" one in *Pezophaps*, state, "This process is now regarded[3] as the head of the third (anchylosed) metatarsal," and quote Gegenbaur as their authority. I must, however, enter my dissent from that view. The process, as its name implies, is only a part of the head of the third or mid metatarsal. The portion of the head in advance of the origin of the process is wedged between the heads of the second and fourth metatarsals, and in a greater degree in *Dinornis* (*tom. cit.* pl. 28. figs. 4 & 7) than in *Struthio* (ib. fig. 2).

In a subsequent Memoir (July 14, 1846) the upper and hinder outstanding process of the middle element of the compound bone is termed "calcaneal"[4], in reference to its functional analogy to the calcaneal fulcrum in Mammals, not to indicate homology, as Professor Gegenbaur appears to have believed. The metatarsal element to which any tarsal homology might be applicable is expressly limited to the one affording articular cavities to the tibial trochleæ, and "which seems to represent a proximal epiphysis"[5].

To the three principal elements of the shaft the following names and symbols were applied[6]:—"'entometatarse' (II), 'mesometatarse' (III), 'ectometatarse' (IV)"—the numerals referring to the toes in the type or pentadactyle foot, which the three metatarsus elements respectively bore.

The "calcaneal process" is not the "head" of the mesometatarse (III), but, as the

[1] Trans. Zool. Soc. vol. iii. p. 240.

[2] Ib. pl. 28. figs. 1 & 2.

[3] "*Cf.* Gegenbaur, Arch. für Anat. und Physiol. 1863, pp. 450–472; Untersuchungen zur vergleichenden Anatomie der Wirbelthiere (4to, Leipzig, 1864), pp. 93–108, pl. 6."

[4] "The posterior surface of the calcaneal process is broad, triangular, vertically grooved, and perforated at its base" (*loc. cit.* p. 52).

[5] Trans. Zool. Soc. vol. iii. p. 243 (1843); and see ib. vol. iv. pl. 45. fig. 2 (metatarsus of immature *Dinornis crassus*).

[6] Ib. vol. iv. p. 3 (1850).

name rightly implies, is a process from the upper and back part of that element, conjoined with a corresponding projection from the part of the common epiphysis covering the mesometatarsal.

DESCRIPTION OF THE PLATES.

PLATE LXIV.

Side view of the skeleton of the Dodo (*Didus ineptus*, Linn.), articulated and displayed in the Ornithological Gallery of the British Museum.

PLATE LXV.

Oblique back view of the same skeleton.

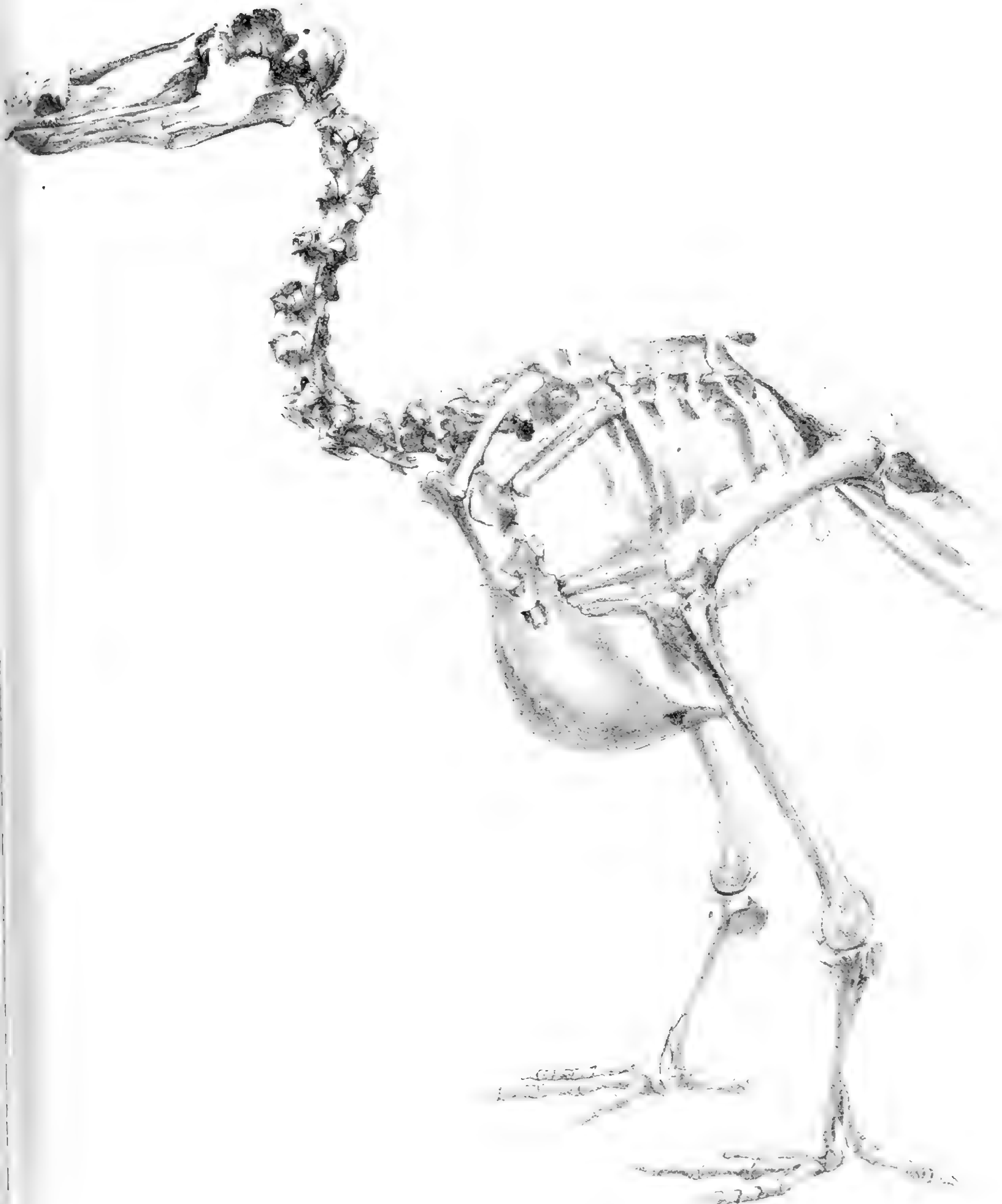
Both these Plates are taken from photographs, corrected, as to perspective and better indication of details, from the subject. The lithographs are reduced to $\frac{1}{3}$ the natural size.

PLATE LXVI.

Metatarsals of Pezophaps *and* Didus.

Fig. 1. Outer side view (*Pezophaps solitaria*, Str.).
Fig. 2. Back view (*Pezophaps solitaria*, Str.).
Fig. 3. Front view (*Pezophaps solitaria*, Str.).
Fig. 4. Inner side view (*Pezophaps solitaria*, Str.).
Fig. 5. Outer side view (*Pezophaps minor*, Str.).
Fig. 6. Back view (*Pezophaps minor*, Str.).
Fig. 7. Front view (*Pezophaps minor*, Str.).
Fig. 8. Outer side view of proximal end (*Didus ineptus*, Linn.).
Fig. 9. Outer side view of distal end (*Didus ineptus*, Linn.).
Fig. 10. Back view of proximal end (*Didus ineptus*, Linn.).
Fig. 11. Back view of distal end (*Didus ineptus*, Linn.).
Fig. 12. Proximal articular surfaces (*Pezophaps minor*, Str.).
Fig. 13. Proximal articular surfaces (*Pezophaps solitaria*, Str.).
Fig. 14. Front view of proximal end (*Didus ineptus*, Linn.).
Fig. 15. Front view of distal end (*Didus ineptus*, Linn.).
Fig. 16. Inner side view of proximal end (*Didus ineptus*, Linn.).
Fig. 17. Inner side view of distal end (*Didus ineptus*, Linn.).

All the figures are of the natural size.



$\frac{1}{5}$

On Stone by J Erxleben

DIDUS INEPTUS

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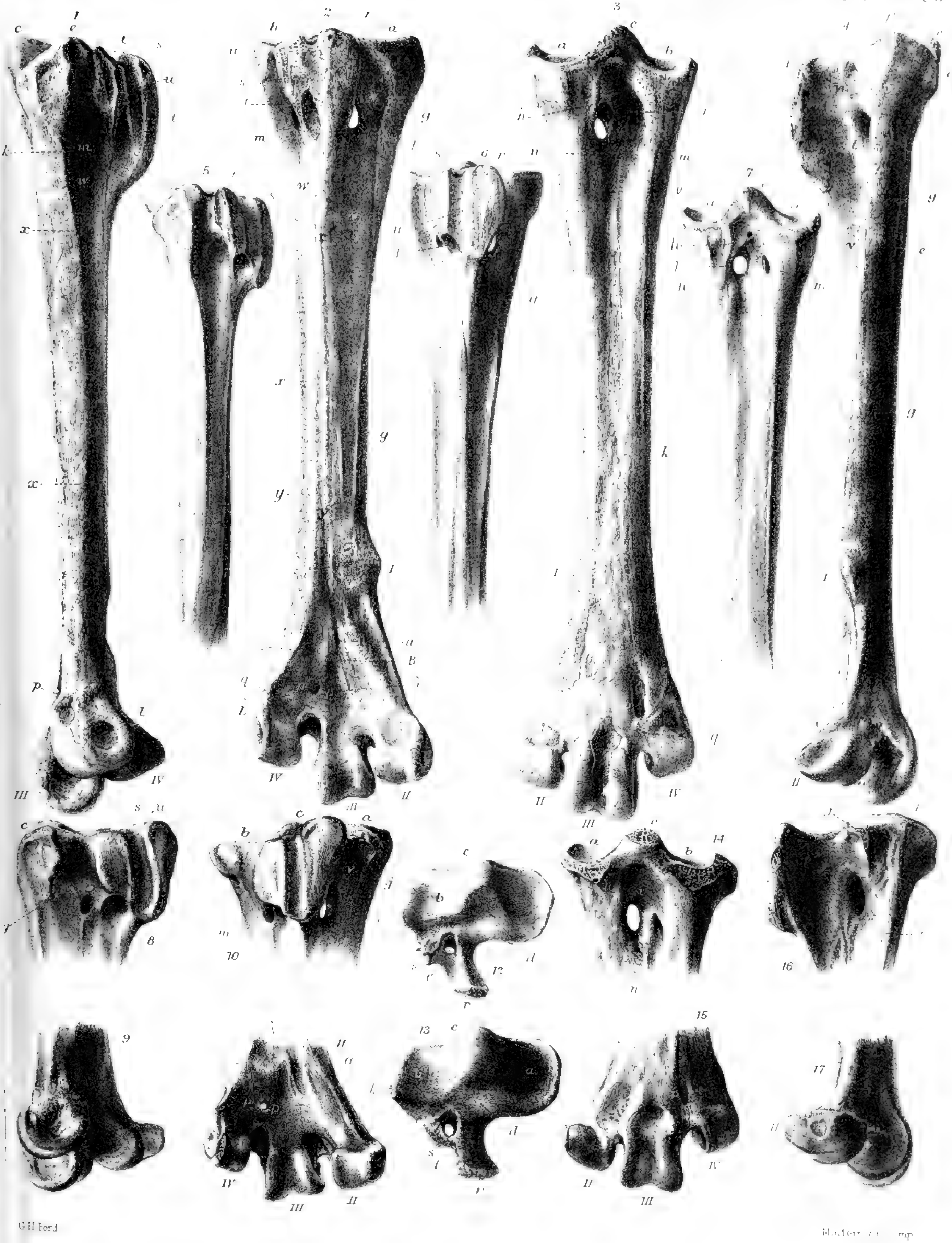
Printed by M & N Hanhart

DIDUS INEPTUS



G H Ford

Hanhart imp

1-4. Pezophaps solitaria. 5, 6, 7, 12. Pezophaps minor. 8 & 17. Didus ineptus.

XVI. *Researches upon the Anatomy of the Pinnipedia.*—Part II. *Descriptive Anatomy of the Sea-lion* (Otaria jubata). *By* James Murie, *M.D., F.L.S., F.G.S., &c., Lecturer on Comparative Anatomy, Middlesex Hospital, late Prosector to the Zoological Society.*

Read April 23rd, 1868.

[Plates LXVII. to LXXIII.]

Contents.

I. Introductory Remarks.

Although upwards of a century has rolled past since our daring and intrepid British navigators, Dampier and Captain Cook, with the latter's no less zealous naturalist and companion voyager, Mr. Foster, made known the Eared Seals (Otariidæ) to the world, so little is yet known respecting their internal anatomy and soft parts, that any observations relating thereto, even if devoid of novelty, cannot fail to be of some interest in illustration of the structure of that remarkable group. I must not omit mention, though, of Steller, who long ago, in his 'De Bestiis Marinis,' furnished a fair descriptive history and anatomical outline of the Sea-bear, *Ursus marinus*, and a short notice of the Sea-lion, Dampier's *Leo marinus*, both studied by him in their native haunts, Behring's Straits. His writings, however, difficult of access, render a further memoir not the less useful, especially as he has but passed in rapid survey many of the more important structures, and to others omitted all reference.

The present Memoir more particularly treats of the external characters and the organs of movement. The viscera, nervous and vascular systems, &c. will be included in another part, the two forming a descriptive account of the anatomy of *Otaria jubata* as a type of the group.

Originally I had intended to compare throughout the structure of this Eared Seal with the Earless or Common Seals, and with the Walrus, &c.; but, led to understand that the simple and tolerably complete descriptive anatomy of the specimen might form of itself a sufficiently lengthy communication, I simply produce it in that form.

It is greatly to be regretted that the precise age of our Sea-lion, when captured, was not ascertained with the accuracy which could be desired. What is known of its history has been to some extent already published[1]. I have besides derived information from

[1] See:—The Illustrated London News; The Boys' Own Magazine, vol. vi. No. 33, p. 214; Dr. Sclater's memoranda, P. Z. S. 1866, p. 80; Land and Water for 21st April, 1866; Dr. Burmeister's Remarks in the

Mr. Lecomte (the original possessor), and have questioned him regarding the statement of Burmeister, namely that two live specimens of *Otaria falklandica* had been exhibited at Buenos Ayres. These, however, as Dr. Gray has suggested, were not of that species, but *O. jubata*—in fact the identical specimens obtained by Lecomte, one of which, that furnishing this memoir, was afterwards brought to this country. This animal was exhibited at the Cremorne Gardens for a short interval, ultimately being purchased by this Society. It lived in the Society's Gardens from the 25th January 1866 till the 14th February 1867, when it died from natural causes (as recorded in the P. Z. S. 1867, p. 243).

II. External Characters and Subcutaneous Parts.

1. *Colour.*—Regarding this, it is essential to remark that during life the hue changes according as the animal is seen in a wet or dry condition. After emergence from the water it presents a more or less uniform burnt-umber tint, indeed almost approaching to a black. When the coat is dry the colour very sensibly lightens and a greater variety of shade is revealed. The nape of the neck then appears of a lightish yellow-brown, and a streak of the same shade runs along the forehead towards the nose. The cheeks, to the ear, are of a dark nut-brown. The abdomen generally has more of a reddish brown or tawny cast. Excepting the extremities, which towards their phalangeal ends and on the soles are dirty blackish, the remainder of the body and limbs are of a rich brown[1].

2. *Configuration and Measurements of the Body.*—When a series of proportional measurements are taken of the bodies of some animals, such as fish, many reptiles, and a few mammals (Armadillos, for example), these give not only a clue to the relation of parts, but in some respects supply substantial data of configuration. In other mammalians it is more difficult to institute measurements, either with accuracy or satisfaction, unless where the frame is firm and rigid, or there are well-defined points mapping out certain regions.

During life the Sea-lion is capable of and comports itself in a great variety of striking attitudes. In each of these the apparent proportions of the body, head, and neck alter in a remarkable manner. At one moment the entire body presents a long, cylindrical, tapering cone; in another the body seems foreshortened and the head and neck thrust out turtle-fashion to a length as astonishing as often unexpected to any visitor who may chance to be near; at other times the chest and abdomen become

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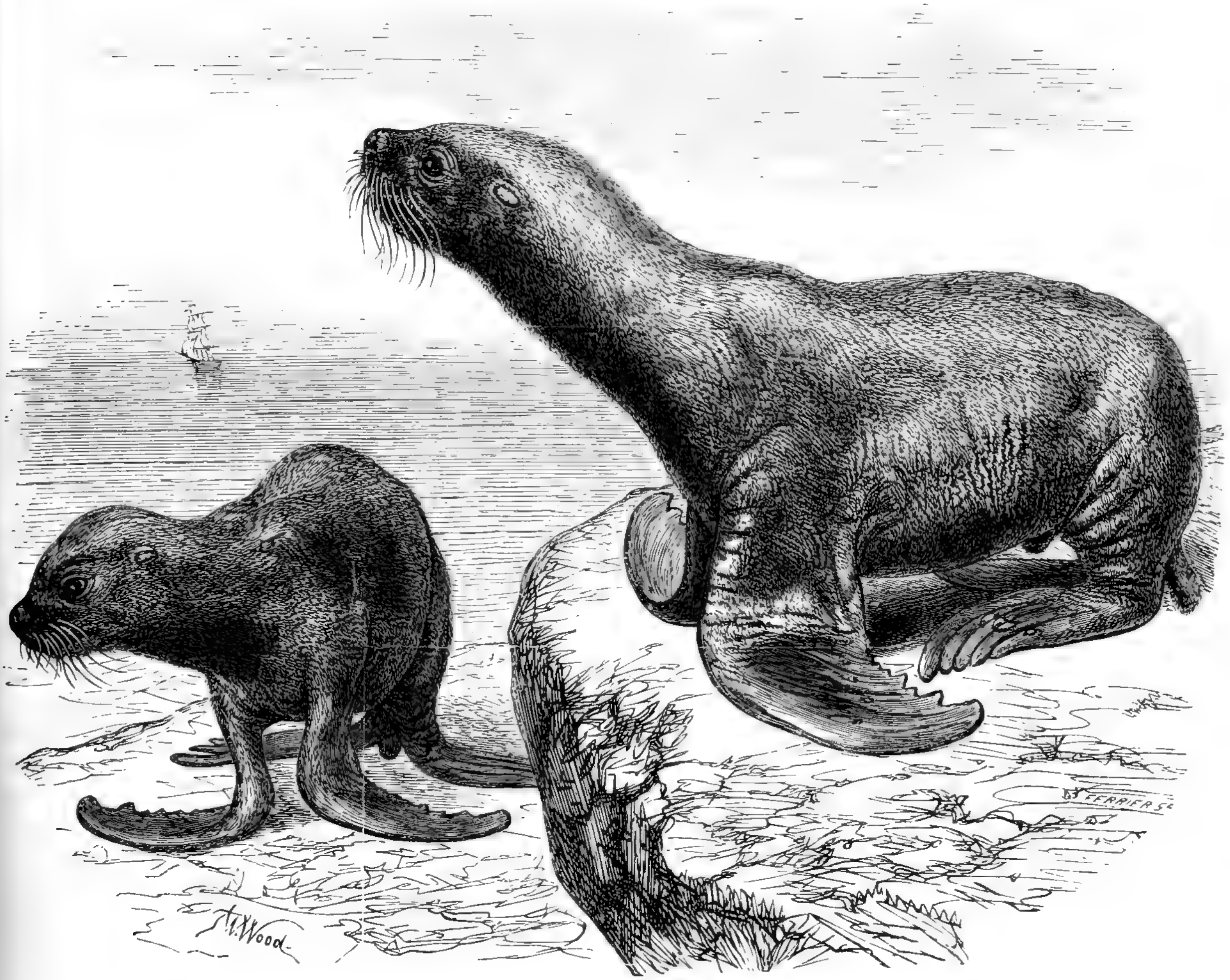
Ann. Nat. Hist. 1866, xviii. p. 99; and Dr. J. E. Gray's "Observations on Sea-bears (Otariadæ), and especially on the Fur-Seals and Hair-Seals of the Falkland Islands and Southern America," Ann. Nat. Hist. February 1868 (4th series, vol. i. No. 2, p. 108), &c.

[1] The above description applies solely to the male specimen in question. I have shown (P. Z. S. 1869) that in the juvenile, half-grown, and fully adult animals material changes of coloration ensue—and also that the females most markedly differ, their hue being very considerably lighter and greyer, as evidenced by the individual at present exhibited in the Society's gardens.

deep and laterally flattened, while the back is arched in the manner of a defiant cat. And so, waking and sleeping, walking or swimming, there is a ceaseless change of relation in the figure and proportion of the parts. This does not entirely depend on mere change of attitude, but also upon the unusually lithe and mobile nature of the entire spinal column and ribs, furnished as these are with an abundance of cartilaginous material and fibro-elastic ligaments.

Fig. 1.



Foster's Sea-lion[1] (*Otaria jubata*).

[1] This characteristic sketch, from the pencil of Mr. Wood, appeared in 'Land and Water' for the 21st April, 1866. I am indebted to Mr. Lord for kindly allowing me the use of the block.

In the general measurements of the dead body, as given underneath, it ought therefore to be remembered that the figures represent but approximately those existing during life.

	ft.	in.
The greatest length of the animal when laid out back upwards, this measurement being taken from the tip of the muzzle to the extremity of the hind flippers as these lay extended backwards . .	6	9
Length from the muzzle to the tip of the tail	5	7
Distance from the muzzle to the prominence of the shoulder-joint .	1	11
Girth taken round the neck in front of the shoulder	2	4
Girth of the thoracic region behind the pectoral limbs	3	3·5
Girth of the abdominal region in front of the pelvis	2	5
Head: length from the muzzle to the apparent occiput	1	0
Tail in length	0	3·2
Pectoral limb: length from the shoulder-joint to the furthest extremity of the manus (the cartilaginous tip of the great pollicial digit)	2	5
Pelvic limb: length from the bony prominence of the ilium to the most distant portion of the free flippers (the tip of the digital cartilage of the hallux)	2	2

When the body is stripped of the subcutaneous fat and fibrous tissue, its curious proportions come out more in relief than when the animal is alive or when still clothed with its fatty envelopment. Thus disrobed, the thorax and the abdomen present a long laterally flattened aspect, with a considerable vertical depth; the pectoral region seems proportionally very large; and the hinder extremities assume more of a Seal-like character than is exhibited under other conditions. The tail then appears much longer than it does during life. The great paddle-like fore extremities acquire prominence; and the vast pollex, with its extraordinarily lengthened distal cartilage, seems specially formed for the purpose of propulsion in a watery element, where it might enter after the manner of a wedge, to be deflected backwards broadside. The enormous thickness of the muscular neck, and the massive development of the region of the shoulders, are very conspicuous. The head, again, loses much of its rotundity or plumpness, the peculiar, somewhat parallelopiped contour of the skull becoming more noticeable.

3. *Anterior Extremities.*—In the Sea-lion both the pectoral and the pelvic extremities are indeed most extraordinarily modified axial appendages. The greatest absolute length of the pectoral limb, if taken in a straight line from the shoulder-joint to the most extreme point, as already mentioned, is 2 feet 5 inches; but the free portion of the limb, or what includes the lower part of the forearm and the manus, is little over half that. The skin &c. uniting the limb to the thorax is very flexible; and so loose and freely moveable is it in the axillary region, that according as the creature swims, raises

his body while supporting it in walking, or simply lies at rest, does the free portion of the limb apparently vary in its extent.

The girth of the pectoral limb, close to the body, is 1 foot 5 inches. Above this point it lies flatly adpressed against the walls of the thorax. As it becomes free it assumes a definitely, peculiarly broad and flat appearance; and the thickness decreases by degrees until, at the distal end of the manus, it has diminished to a few lines. That portion of the limb which is more or less free is of an elongated, flat, pyramidal shape, the apex being represented by the flap of membrane and cartilage of the enormous pollex.

The length of the anterior border of this portion of the fore flipper, following the curve, is 2 feet, whereas the posterior margin, measured in the same way (that is, from its basal attachment to its free extremity), is 18 inches. The portion (or the serrated margin) corresponding to the extremities of the digits in other animals is $10\frac{1}{2}$ inches broad from its one end to the other.

The diameter of this flipper-like extremity, at 13 inches from its free furthermost point, where it is widest, is 8 inches. At a distance of 7 inches from the tip the diameter is but $5\frac{1}{2}$ inches, and near the tip itself it is reduced to only 2 inches; from this it tapers and terminates in a slightly rounded extremity.

At the wrist-joint the thickness of the member is 2 inches; from this the manus thins very gradually until, as already said, at the free phalangeal extremity it does not surpass 1 or 2 lines in thickness. The anterior and also lower margin is thicker than the hinder one. From its thoracic attachment to the tip it has a long and low-arched curve, which is tolerably smooth at the edge.

The posterior and upper margin, or what is included between the axilla and the fifth digit, is no more than 7 inches long, and is much more elastic than the anterior margin already spoken of. This hinder, inner, or axillary margin possesses a small fold of nearly loose skin; the anterior or shoulder margin, on the contrary, is firm and tense, or with more of the Porpoise-fin-like rigidity.

There are eight rounded projections, and seven hollow interspaces, at the posterior free extremity on that margin, ending in the phalangeal cartilages. The outermost of the emarginations is the widest.

The upper surface of the manus is covered with hair; but on the fore margin there is a broad strip devoid of it; and the latter widens, stopping short of the pollicial, but almost reaching the other nails. There are few creases, except slightly between the moveable portions of the digits. The palmar surface is nearly flat, almost entirely hairless, and minutely striated by cuticular elevations. These run in sinuous but parallel lines, longitudinally or with a moderate curvature, following the contour of the palm. Here and there the ridges interdigitate at acute angles. The length of this bare palm, taken in a straight line towards the fore border, is 15 inches, but no more than 4 inches on the opposite (hind or radial) side.

The proximal half of the manus has a tolerably smooth superior or dorsal surface; the distal half has feebly marked phalangeal ridges. The free ends of the phalangeal cartilages decrease slightly in breadth from without inwards—the outermost, or pollex, at the broadest portion, measuring 2 inches.

There are indications of five nails, each represented by a small hollow or pit. The outermost or pollicial nail is placed 5 inches from the tip of the terminal cartilage of the digit; the next, or second digital nail, $2\frac{3}{4}$ inches from the free end; the third digit has it $1\frac{1}{2}$ inch, and the fourth and fifth digits $1\frac{1}{4}$ inch distant from their tips.

When the skin and subcutaneous tissues have been removed, and the deeper parts to some extent dissected, that portion of the free pectoral extremity between the elbow- and the wrist-joints presents a tolerably flattened and broad aspect.

The manus, under the same dissected condition, has a very broad palmated appearance, the pollex being of very great proportions.

Each digit diminishes in size from the pollex to the fifth, as the undermentioned respective lengths show. These measurements are taken from the roots to the tips or free extremities, thus including the long spatulous-shaped terminal cartilages.

Pollex or first digit	=14 inches.	Fourth digit	$=5\frac{1}{4}$ inches.
Index or second digit	$=10\frac{3}{4}$,,	Fifth digit	$=4\frac{3}{4}$,,
Middle or third digit	$=\ 7\frac{3}{4}$,,		

The direction of the pollex is continuous with the long axis of the forearm. The second metacarpal bone inclines slightly towards that of the first digit; but its distal phalanges form by degrees a curve, which at length veers away from those of the pollex. The third has a similar curve. The fourth metacarpal bone has a more backward angle; but this and the phalanges have altogether a straighter course. The fifth metacarpal and digit is like the hallux in the manner in which it is set and articulated with the carpal bones. This digit is more obliquely directed, or more nearly at a right angle, than are the others. The terminal cartilage of the fifth digit has a slight curve or bend forwards—indeed, just as much divarication or spreading out as the pollicial cartilage has backwards.

In the semidissected condition in question the carpal, metacarpal, and phalangeal bones are all more or less freely moveable, the one upon the other.

4. *Posterior Extremities.*—When the skin and subcutaneous tissues are removed from the groins, perineum, and ischio-rectal region, the peculiar position and general relation of the hind limbs to each other and to the above regions are best shown (see Pls. LXVIII. & LXXIII.). The two thighs are then seen to be placed at nearly right angles to the long axis of the body, whereas the tibia and fibula return to the axial line of the body, rather, however, bent inwards towards the ankle-joint. As a consequence, the position and attachment of the various muscles in the regions above alluded to are so altered as scarcely to be recognized. What ordinarily in Mammals are superficial

longitudinal muscular layers, here assume oblique or transverse directions; and as "the muscles of the posterior limb in the Seal," as Haughton[1] has remarked, "differ from those of other Carnivores principally in the shifting of their insertion to lower points of the leg," so likewise in the Sea-lion this distal transference of insertion materially masks the usual relation of parts.

Of the hind limb the free part, taken in a straight line, measures one foot and a half, the girth at the proximal end of this being 11 inches. When extended to the fullest, the greatest breadth of the foot is 10 inches; and as the phalanges are freely flexible laterally, and can override each other (*vide* Pl. LXVII. fig. 3), corresponding reduction of breadth consequently ensues according to the amount of overlap.

The free part of the posterior extremity comprises little more than the foot and the turn of the ankle, the remainder of the limb being, so to speak, bound up with the pelvic region of the body, and moving synchronous with it; the very peculiar hobbling gait of the rump and its members is caused thereby. The hind differs very sensibly from the fore foot in figure; for whilst the hallux is absolutely large and long, it still is relatively shorter, narrower, and less developed than the pollex. The great toe has certainly the advantage of length; the others are subequal, or with slight diminution from the second to the fifth; and this applies to the phalangeal interspaces, or rather vacuities, betwixt the dermally covered, spatulate, terminal cartilages.

Besides shape, the hind foot is very distinct from the fore one in the separate, raised character of the phalanges dorsally, these being firmly encased and comparatively undefined in the manus. The pes is thus a far more moveable instrument, so far as its component parts are concerned; and though the leg is limited in action by being fastened as low as the heel, yet the hind flipper and its claws subserve all the ordinary purposes of the carnivore's paw in scratching the body &c. In two of the figures (woodcuts, nos. 3 & 4) the attitudes assumed, and manner of use just spoken of, are shown as sketched from the living animal.

On its upper surface the hind flipper is covered with short, here and there rough, adpressed hairs, which run down the back of each digit to within $1\frac{1}{2}$ inch of the nails; but the interspaces or intervening web, and the whole of the free edges of the digits, are more or less bare for $2\frac{1}{2}$ inches above the point mentioned. The skin of the dorsum is longitudinally wrinkled, and in certain positions has a tendency to become diamond-outlined. Of the five nails or claws, the three middle ones are large ($1\frac{1}{2}$ inch long by $\frac{3}{10}$ inch broad) as compared with those on the hallux and little toe, which are mere rudimentary structures. The whole of the nails are situate not terminally, but at the proximal ends of the digital cartilages, and almost in a line transverse to each other.

The sole, like the broad flat palm, is devoid of hair from the heel forwards, and, like it also, is covered with hard, callous, black epiderm. This likewise is thrown into fine

[1] Proc. Roy. Irish Acad. May 1864; but consult also Duvernoy, "Sur les organes du mouvement du Phoque commun," Mém. du Mus. d'Hist. Nat. vol. ix.

wrinkles or ridges, which, however, traverse the sole in wavy parallel lines directed from behind forwards (Pl. LXVIII. figs. 4 & 5). At the calcaneum, where they are most pronounced, they assume a radiate direction, and between the phalanges interdigitate frequently. In this aspect of the foot the length along the outer border is 17 inches, the inner border being about 15 inches.

Unlike *Phoca* and other Earless Seals, *Otaria* has a well-marked scrotum (*s*, figs. 5 & 6), which changes very materially in appearance according to the position of the pelvic extremities; but further remarks thereon I reserve till speaking of the generative organs.

5. *Weight of the Body.*—Regarding the age, weight, and the growth of our specimen of *Otaria jubata*, M. Lecomte mentioned to me that when he first obtained it he believed it was about four feet long, and three or four years old. At the time of its death he thought it would be about eight years of age. Two years previously he said it had been weighed and was then 80 lbs. in weight.

The exact weight of the dead carcass I ascertained to be:—

The skin	18 lbs.
Fat on the surface of the body	28 ,,
Body deprived of the fat and skin	113 ,,
Giving an aggregate total weight of	159 ,,

6. *The Skin and Hair.*—Upon the chest and between the two pectoral extremities the skin is thrown into a remarkable series of plaits or foldings (Pl. LXIX. fig. 7). The appearance of these longitudinal folds is not unlike those present in the throat of some Cetaceans, *e. g.* the *Balænopteræ*. They evidently subserve the same purpose, inasmuch as they permit of great distention of the parts. This pliability would seem to be necessary; for, did not great elasticity of the skin and subcutaneous tissue exist, the varied movements of the fore limbs of this extraordinary creature would be limited to a considerable extent.

To proceed with a description of the skin of the thorax—in the middle line there is one central deep sulcus, having on either side of it four or five shallower ones, and between these as many elevations of the skin. The length of the middle depression is somewhere about ten inches; greater precision as regards length is difficult, from the terminal points being indefinite. Those on each side of this median one diminish in length towards the axillæ. The breadth of the raised folds or wrinkles varies from a quarter of an inch to one inch.

The direction assumed by the lines is in accordance with the curves of the body, thus being bent upwards at their anterior and posterior ends. Right under each axilla there are, moreover, from six to ten additional narrower furrows, which sweep round from the side of the chest towards the shoulder-joint. The breadth of these last varies according to the position of the flippers.

The hair is more or less of a uniform length over the whole of the body, but it is rather shorter on the limbs. Underneath the lower jaw the hair is rougher and shaggier in appearance, and, on account of its being also somewhat longer, produces a beard-like aspect. Individual hairs plucked from this part measured seven tenths and nine tenths of an inch respectively. Upon the back of the head the length of the hairs averages from five to eight tenths of an inch; and on the outer side of the pectoral limbs they are almost as long. One patch near the axilla had a very marked shaggy look, as if longer in the pile than the surrounding portions; but on accurate examination this did not turn out to be the case. On the loins this hairy coat is more uniform as regards length; it is here shortest—namely, about half an inch.

Beside the ordinary hairs of the pelage, there is a distinct crop of underwool, as in the Fur-Seals. This undercoat is not thickly set, but distributed in delicate, short and fine hairs placed at the base of the other longer ones. It appeared to exist upon the greater part of the body, excepting, it may be, on the loins, where traces were not distinctly recognized.

7. *Mammæ.*—In the *Otaria* under description there are four teats in all, and these are distributed in pairs. The hinder pair are six inches in advance of the penis, and the anterior pair are again nine inches anterior to these hinder ones. The two anterior ones are each about four inches distant from the median line of the abdomen, and three inches posterior to the hinder part of the sternum. The posterior ones differ, inasmuch as they are each but two inches distant from the median line. Expressed in other words, the front pair of teats are eight inches apart, the hinder ones but four inches.

The teats in this male animal are very slightly raised above the surface of the skin; but each of them possesses a long and capacious duct, which passes through the superficial and deep dermal tissues, and can also readily be traced for some distance among the fat.

8. *Eye.*—The appearances of the eye and surrounding structures after death are as undernoted. The fissura palpebrarum then possessed a wide elliptical form (Pl. LXIX. fig. 9), the anterior canthus being rather the lower of the two. The aperture from the anterior (*a.c*) to the posterior canthus measured an inch in a direct line, and the diameter in the middle 0·6 inch. The margin of each eyelid is of a black colour and carunculated; and the narrow palpebræ are bare of hair for not more than 0·1 of an inch. The nictitating membrane in its contracted state (*n*) occupies only a small portion of the anterior inferior corner of the orbit.

There is no trace of eyelashes.

On the right side one solitary hair (*e*) alone represents the eyebrow; but on the left side two hairs are found. The one hair on the right supraorbital region is situated at the distance of 0·8 of an inch from the anterior angle of the eye, and almost perpendicular to it. The two hairs on the left side, with a nearly similar position, are separated from one another by an interval of 0·2 of an inch. The length of these three superciliary hairs, or rudimentary eyebrows, varies from half to one inch long; and they are light-coloured and bristle-like in texture.

The ball of the eye is full; the pupil perpendicular, ovoid, and about 0·3 inch in length. This is the case under ordinary conditions; but the pupil alters in a most extraordinary manner. At times it opens full and round, even larger than the dimension just mentioned, or about equal to the circle I have shown in the diagram, no. 3, fig. 10; again, as it decreases, it assumes the vertical oval figure (no. 2), and as it contracts still more, almost to a pinhead's diameter, the shape becomes nearly triangular (*vide* no. 1). I made careful observations of this remarkable pupillar dilatation and contraction. I found that in the day-time, and especially with clear bright sunshiny weather, the maximum of contraction took place; when, however, the day was gloomy and dark, a more opened condition obtained; moreover, during the afternoon and as twilight crept on, so did the pupil slowly increase in magnitude, and had expanded ere nightfall to its fullest extent. Accompanying these changes, as marked a phenomenon of colour ensued. When contracted, the pupil glistened as a bluish iridescent point; dilating gradually, it assumed an opalescent hue, and at length looked as if a filmy curtain had passed across the ball of the eye. My attention was called to these diurnal and nocturnal changes from doubts as to whether the animal suffered from cataract. I believe them, however, to be the ordinary natural phenomena incident to the vision of this creature, although it is possible they were more apparent in this instance than usually may be the case. Doubtless physiologically some purpose is subserved, such as night-fishing, which, according to Lecomte, is the habit of the animal; but at all events this peculiarity of colour presents contrast to the full, soft expression of eye belonging to most of the Earless Seals.

9. *Ear.*—The division of the Seals into two groups, the Eared and Earless, seems a natural one. The very diminutive-sized ears, even if only viewed as a minor character in the total outward aspect, are so obviously distinctive and peculiar-looking in the living animal as to attract immediate attention.

In *Otaria jubata* the external organ of hearing is situated about the end of the middle third of the head, taking the latter in its longitudinal axis. The eye is placed, in relation to the ear, at the anterior end of the same middle third. A line carried through these organs would reach the upper part of the muzzle in front and the lower portion of the occiput behind. The absolute distance between the posterior canthus of the eye and the anterior portion of the root of the ear is 3 inches.

The pinna, or auricle, in its ordinary contracted condition, is a small conical and backwardly projecting body, an inch in length, and half an inch in breadth at its base (fig. 11). Behind it there is a slight indentation or shallow grooved depression in the skin, in which the ear, when thrown backwards, is partially embedded.

The auricle is externally clothed with short, close-set, light golden-coloured, shining hairs; and the hair in the shallow fossa already spoken of is of a similar colour. The tip of the pinna is naked. If hairs had once been there in the specimen under consideration, these must have been very effectually abraded; for both ears showed the same absence of them.

Rolled together scrollwise, as the ear usually appears, the concavity of the auricle or concha is barely, if at all, shown. When, however, its anterior and posterior borders, or what represents the helix (*h*, fig. 13), are drawn apart, the concha (*c*) is disclosed; and this has a deep narrow median sulcus running through it. The helical surface is bare, and has a minutely punctated or glandular appearance. The surface of the concha is also hairless. Antihelix, tragus, antitragus, and lobule may be said to be wanting; or at least no clear division or prominence in the parts indicates their presence.

The external auditory canal is narrow, and only admitted a fine probe, which passed up or inwards 0·4 of an inch from the conchal opening.

10. *Muzzle, Nostrils, and Whiskers.*—When the *Otaria* takes a long and deep inspiration the nostrils widely dilate, by the superior, but more particularly by their inferior lips being dragged downwards and backwards. This movement is produced through the contraction of the powerful naso-facial muscles described hereafter, p. 542. At such moments of distention the anterior nares present an egg-shape, taken from before backwards; but it is noticeable that they are more narrowed at the outer opening than within. This unequal distensibility of the parts is in some measure owing to the formation of the nasal cartilages.

When the nostrils are contracted and closed, the external apertures form a kind of V-shaped figure, each line or limb, however, having a trend or curve inwards, while the angle does not approach perfectly close. The apparent continuation of the lines of the nasal apertures below into what is really the median sulcus of the upper lip, has a resemblance to an inverted broad arrow. This cleft of the muzzle, however, is only produced by the prominence of the anterior portion of the facial muscles, and is not a perfect separation into a right and a left half.

The nose, so to speak, is somewhat pyriform when viewed in front, bare of hair, roughish, and of a very dark brown colour—indeed, almost shaded into a black. The anterior free margin of the septum narium has a median sulcus, which is 1·8 inch long.

On a transverse and perpendicular section of the nasal region being made, somewhere about an inch or so from the front, the skin and superficial tissues having meantime been removed, the following appearance is presented (Pl. LXX. fig. 18). The cartilage of the septum (*se*), a longish, strong, narrow rod, is thicker below than above. The upper lateral cartilages (*u.l.c*) expand in an arched form outwards, leaving beneath them two transversely flask-shaped openings, the inner ends of which are below narrowed by an upward projecting nipple, the inward fold of the circumambient cartilaginous arch. The flask-shaped openings already mentioned are continued down on either side of the septum, widening below. In the middle they are nearly obliterated by the close approximation of the cartilaginous edges.

The muzzle, as a whole, is slightly truncated. When at rest the long, strong, arched vibrissæ or whiskers do not project beyond the muzzle, but lie backwards and downwards, the course of their sweeping curves giving them an inclination beneath the lower jaw. These vibrissæ commence at an inch distant from the anterior nasal sulcus, and at their roots or origins extend backwards fully an inch and a half. They are small and short anteriorly and above, and increase in length and in thickness posteriorly. They range in length from half an inch to about eight inches. Their disposition is in parallel rows, whereof there are six such rows from above downwards, and seven from before backwards. The greater number of these vibrissæ are of a pale colour; but several are barred with black.

During life this creature had the power of freely moving about its whiskers. I have never seen it twist them round towards the forehead, although this was easily done in the dead condition. In this last state the vibrissæ freely rotated as much as three quarters of a circle; but I doubt if their mobility permitted such during the living condition; at least such a movement has not come under my observation.

As regards the lower lip and the opening of the mouth, the former is placed rather behind the upper lip—the muzzle, as it were, projecting slightly in advance of the mandible (Pl. LXIX. fig. 8). The shape of the closed mouth, as seen in the above figure, is a wide deep arch, the chord of which from its summit to the angle of the lip is rather more than three inches.

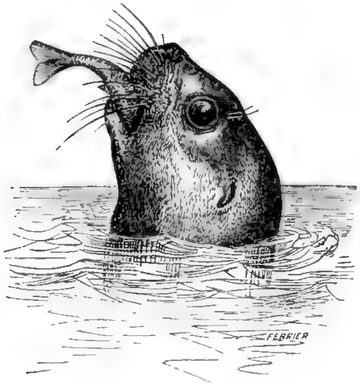
I may here insert some admeasurements of the head as a clue to the relation of parts treated of in the last three sections.

	inches.		inches.
Length	12	Depth at 1 in. behind muzzle	$5\frac{1}{2}$
Girth at occiput	25	Depth at extremity of upper lip	3
Girth at ears	24	Depth at do., including mandible	5
Girth at eyes	20	Distance from snout to mid-eye	5
Girth at posterior end of bristles	$16\frac{1}{2}$	Breadth of snout	4
Girth at muzzle, front of lower lip	11	Breadth between eyes, following curve	6
Depth at ears	$9\frac{1}{2}$	Breadth between ears	10
Depth at eyes	7	Breadth between the bristle-roots	4

11. *Subcutaneous Deposit of Fat.*—On the removal of the skin from the Sea-lion the entire body and the extremities are seen to be enveloped in a more or less dense layer of soft oily fat. This fatty substance resembles that met with in the Common Seals. It possesses appearance and properties intermediate between those belonging to the adipose tissue found on the bodies of some Carnivora and the adipose tissue of Cetacea.

This extensive sheet of adipose material is deposited in greatest quantity upon the breast and between the flippers, where it is as much as 2 inches in depth. Upon the outer side of the chest it is not much over half an inch in thickness, and it thins considerably as it reaches the middle line of the back. The shoulders, the neck, and the head are clad by a continuation of the same material, which varies in thickness from a quarter of an inch to half an inch. Towards the median line of the abdominal region there is a layer of considerable depth; this is coextensive with the sterno-pectoral mass, but does not retain the thickness of the latter as it proceeds backwards. The continuation of the fatty investment upon the loins, buttocks, and hind limbs is much thinner than on the pectoro-abdominal parts, and assumes a thickness corresponding to the deposit on the cervical and dorsal regions. As it descends on the limbs the fat thins very considerably, and ere reaching the flippers almost entirely disappears—glistening areolar tissue taking its place, while the skin adheres closely and firmly to the tendinous ligamentary structures beneath.

Fig. 2.



Manner in which the Otary usually swallows its food. Sketched from the Society's animal.

III. The Muscular System.

It may seem unusual that, in the account of the organs of locomotion, precedence should be given in the present instance to the muscular system instead of to the more solid bony axis. Such a course, I am aware, might either be defended or opposed on philosophical grounds. De Blainville[1] remarks, "la multiplicité et la mobilité des pièces osseuses, coïncidant avec la complication des parties musculaires, l'étude de ces derniers organes, qui dans la hiérarchie de l'importance relative des parties, occupent un rang supérieur aux os, inférieur au derme, est subordonnée à celle du squelette, de la forme duquel elle peut en général être déduite."

For my own part I have been induced to deviate from the more common custom for several reasons,—among others, because the skeleton of *Otaria* is already known to some extent, and has been figured by Cuvier, De Blainville, &c., also because of the very remarkable attitudes assumed both by the Otariidæ and Trichechidæ being in

[1] Cours de la Facult. des Sci. vol. ii., quotod in Meckel's Anat. Comp. vol. vi. Append. p. 495.

some measure due to the singularity of their muscular development and attachments, and, furthermore, because it has been found convenient to pursue the dissection in the course here followed.

The flesh exhibits the same dark red tint of fibre which has been remarked by many observers[1], and is characteristic, or at most is found of usual occurrence among the Seals proper. A certain disagreeable fishy odour exhaled from the body. The darkness of coloration of the muscular tissue is somewhat remarkable.

1. *Cutaneous layer of Muscle.* (Plate LXIX.)

Panniculus carnosus.—Probably no single set of muscular fibres more conduce to the peculiarity of movement and strangeness of position which the Sea-lion at times assumes, than does the enormously developed panniculus carnosus. In this respect there is some analogy between it and the Hedgehog, the Three-banded Armadillo, Porcupine, and Ornithorhynchus, in all of which, as well as in some other forms of the vertebrates, the cutaneous muscles are greatly developed, and powerfully assist the body in certain peculiar movements and postures. The entire muscle in question is part and parcel of the extensive sheet of cutaneous muscular fibres covering the whole of the trunk, neck, and head. But what most strictly answers to the panniculus is that portion which reaches from the tail to the shoulders. This is of moderate thickness, evenly distributed over the surface of the back and sides of the body, and composed of highly coloured muscular fibres spread out in coarse bundles.

Its attachments are as follows:—Posteriorly, the root of the tail, where, slightly aponeurotic, the fibres commence in a pointed manner and are fixed to the spines of the caudal and posterior sacral vertebræ. From this forwards along the spine to as far as the shoulder may be said to be the long dorsal basal line of the origin of the muscle. From the hindermost peak at the root of the tail the muscular fibres trend forwards and outwards (fig. 14, $P.c^{9}$) in the direction of the knee-joint, and, passing over and onwards from this, reach the inguinal region, where they terminate in a contracted manner, or merge into the fibrous fascia covering the inside of the leg. From the groin they stretch still forwards, but now a little upwards, and, following the curvature of the parts of the groin, pass on to the abdomen ($P.c^{8}$) in the middle line, until they reach the outer margin of the pectoralis major, to which they are intimately united. The fibres derived from the remainder of the spine in the lumbar and dorsal regions ($P.c^{7}$) have a direction forwards and downwards, the posterior slanting direction becoming more perpendicular from behind forwards towards the scapula. The broad layer above described, proceeding from the several origins, covers the whole of the side of the body; and the fibres, converging, proceed to the axilla ($P.c^{6}$), and are inserted into the humerus.

Continuous with the dorsal portion of the panniculus the short fleshy fibres stretch

[1] Steller, '*Ursus marinus*,' p. 341; Owen, "*Phoca vitulina*," P. Z. S. 1830–31, p. 151.

at the shoulder from the spine transversely and outwards towards and partly over the scapula ($P.c^5$), there overlying the trapezius and first portion of the deltoid. The fibres of this part of the panniculus blend strong fascia and fat into the delto-trapezoid layer beneath.

A similar layer of cross cutaneous fibres ($P.c^1$) runs forward on the back of the neck as far as the occiput, and even very faintly over the epicranial region, where they are lost in the rudimentary occipito-frontalis. These are of considerable thickness in the neck, and there form a strong arched envelope.

At the posterior end and side of the neck there is a short, broad layer of cutaneous muscular fibres ($P.c^4$); these proceed from the front of the shoulder-joint, and terminate in fascia about the middle of the neck.

Partly continuous with these, being chiefly connected by fascia, is another series of muscular fibres ($P.c^3$) rather more transverse in direction than the last. These cover the lower surface of the neck from below its middle to near the angle of the mandible.

On the side of the neck, above the last group of fibres, but joined to them by fascia, is still another set of fibres, which commence almost as far back as the previous ones, but are distinguished from them by running in a different plane, namely from above downwards and forwards ($P.c^2$). These, slightly altering their direction upwards, sweep anteriorly on to the cheek and face, round beneath the eye, becoming faint and indefinite in the nasal region.

Use. In the movements of walking and in climbing (for the Sea-lion, however awkward and unwieldy-looking as respects progression on land, is notwithstanding fully capable of the latter act) the whole posterior lateral mass of the panniculus as it contracts knits the skin together and drags the hind quarters forwards towards the chest or fixed point in the axillary region. An additional fulcrum is obtained in the partial adhesion to the knee and the femoral region above. The above motions markedly bring into play the hinder extremities, curving the caudo-lumbar regions and shortening the abdomen, thus causing a kind of crouching attitude behind. It may with propriety be compared to the rolling-up of the hinder segment in the genera *Erinaceus* and *Tolypeutes*; only, in *Otaria*, the large pectoral limbs and head are not tucked in abdominally. In swimming, the same expanse of the fleshy panniculus acts contrariwise. The pelvic limbs are stretched backwards, and, forming in part the *point d'appui*, make tense the lateral and abdominal fibres, which, in unison with those of the enormous latissimus dorsi and great pectoralis, act on the humerus. Their combined force plays a most important part in the great oar-like sweeps which drive the body through the water at an almost incredible velocity. The panniculus of the Sea-lion during rotation acts like that of burrowing animals, and hence in its conformation resembles in some respects its homologue in the Mole and Wombat.

The nuchal portion of the panniculus may render the skin of the back of the neck tense, and slightly lend aid when the head is bent backwards. The superficial muscular fibres on the ventral aspect of the neck and cheeks are apparently too sparse and weak to assist much in flexion of the head; their office seems rather to be corrugators of the skin and subcutaneous tissues.

2. *The Cranial Muscles.* (Plate LXX.)

An *occipito-frontalis* (Pl. LXIX. fig. 14, *o.f*) does exist, but it cannot be said to be fully developed; it is so mingled with the carneous fibres of the platysma, and particularly with the nuchal portion of the very extensive fleshy panniculus behind, that its limits are with difficulty defined. There is, however, a tolerably thickish muscular part upon the forehead and between the orbits. This merges into aponeurotic fascia as it passes on towards the nasal region.

Of facial layers the *orbicularis palpebrarum* presents a considerable broad and thick circuit of muscular fibres round the orbit (fig. 15, *o.p*), and is inserted into the tendo oculi and superior maxillary bone.

The nasal region is covered superficially by a thick fleshy expanse, which is fixed to the upper portions of the maxillary and premaxillary bones, and sweeps forwards the entire length of the fleshy muzzle. This massive layer constitutes the *levator labii superioris alæque nasi* (*L.l.s.a.n*, figs. 15 & 16).

Beneath the last is a second muscular sheet, equivalent to the *levator labii superioris proprius* (*L.s.p*). It springs from the upper maxillary limb and fore part of the orbital circuit, and is inserted along the anterior part of the maxillary and premaxillary bone, a little way above the alveolus, from opposite the premolars to the incisors.

A third, more deeply situated muscle I take to be the *levator anguli oris* (*L.a.o*). It is much smaller than the two preceding, and, unlike them, is broadest above and tendinous below. Origin, from the upper apex of the præmaxilla and from the adjoining maxilla, resting mainly on the latter bone; insertion, the canine fossa, being overlain by the infraorbital nerves and depressor nasi muscle.

Almost continuous with the fore part of the levator, fleshy fibres cover the nasal cartilages, and, whilst meeting their fellows of the opposite side above, run down laterally and partly mingle with those of the levator superioris proprius and depressor alæ nasi, besides being in part fixed to the præmaxilla. Situation and function show the muscle in question (*C.n*) to be homologous with the *compressor naris* of Man.

The *dilatator naris* (*D.n*), or what in human anatomy goes also by the name of the levator proprius alæ nasi posterior, is in *Otaria* an immensely developed and elongate muscle. Besides partially springing by fibre attached to the inferior lateral aspect of the præmaxilla and nasal cartilage in front of the levator anguli oris, the dilatator arises in common with the depressor, presently to be spoken of, from the maxillary, anterior to the infraorbital foramen. Diverging therefrom, the dilatator passes upwards and forwards, crossing the great mass of the infraorbital nerves and vessels (*Inf*), and, superficial to and mingling with the compressor, fastens itself to the alar and other cartilages at the side and fore part of the nostrils.

I regard as the *depressor alæ nasi* (*D.a.n*, *D.a.n**) a powerful muscular band which springs from the bone in front and beneath the infraorbital foramen. Running along the superior labial margin in company with and overlapping the orbicularis oris, it proceeds to the front of the muzzle, and is inserted by tendon into the premaxillary bone, whilst fleshy bundles grasp the alar fibro-cartilage and intertwine, as aforesaid, with the dilatator naris.

The *orbicularis oris* (*O.o*) is of fair volume, and, as usual, surrounds the mouth; its fibres are somewhat thicker at their fore part, and, doubtless, include the homologues of the inferior labial group.

Action. There is a certain amount of consentaneous contractility among the whole of the Sea-lion's facial muscles, the cross direction of the superincumbent planes producing a diagonal of force. Nevertheless, though this is the case, yet each set, as the names imply, perform a separate office. The levator labii superioris alæque nasi, levator anguli oris, and zygomatici, together, chiefly drag back the upper lip in snarling, an expressive action added to by the retraction of the inferior labial group. Tension of the compressor naris most effectually closes each orifice and retains it so, possibly aided by the counteracting efforts of the depressor alæ nasi. The wide, patulous condition which the nostrils at times assume, of some moment and interest as far as characteristic feature is concerned, is indubitably produced through the long leverage of the dilatator. The mass of flesh, the numerous vibrissæ, and the skin composing the muzzle and snout are plentifully supplied with nerves (*Ion*) and vessels, which come in a great bundle from the infraorbital foramen, and pursue a course straight forwards and underneath the dilatator.

As in Carnivora generally, the *buccinator* (figs. 15 & 16, *Bu*) is fleshy, and has attachments upon the upper and lower jaws, close to the alveoli. Behind, it comes from the pterygo-maxillary ligament; and in front the fibres reach forwards as far as the anterior premolars.

Temporal Muscle.—This is of large size, and consists of a partial double layer, the upper one mingling with a deep layer of the double masseter.

The main portion of the temporal muscle (Te^1, Te^{1*}, figs. 15 & 16) lies on the temporal and parietal bones, filling with fan-shaped fleshy fibres in great part the temporal fossa as high as the temporal ridge. This so-called first portion of the muscle is inserted into the coronoid process of the mandible.

The second and superficial portion of the muscle (Te^2) is semilunar in outline, its concavity being directed backwards, and one (the anterior) horn reaching above but behind the orbit. This second portion arises upon the surface of the first and deeper portion, the fibres of the former freely intermingling with the latter. It also has origin from the inner surface of the zygomatic arch, at the posterior part of which it is partially united with the small deep portion of the masseter muscle. Its insertion is into the outer surface of the ascending process of the mandible for a great part of the concavity of that portion of the lower jaw.

Masseter.—Compared with the Hyænidæ and Felidæ, the fleshy fibres composing the masseter are but moderately strong in the Sea-lion. In Man the mass of flesh and tendinous fibres denominated masseter is arranged in such a manner as to form two bundles of different dimensions, and disagreeing somewhat in direction. This partial division of the muscle also obtains in *Otaria*, but is not limited to the genus.

Its superficial and first layer (fig. 15, Ma^1) (using the term for perspicuity and accuracy of description) arises along the whole length of the zygomatic arch, and is somewhat quadrangular. With fibres directed in a backward and downward direction, it is inserted into the outer surface of the mandible, from the root of the ascending ramus to the angle. The latter portion passes well behind the articulation of the jaws.

The second or deep layer (fig. 16, Ma^2) appears as if a continuation of the fibres of the second or superficial portion of the temporal; but, although intimately united with this said portion, it is distinguished from it by arising in a tendinous manner from the posterior corner of the zygomatic arch, and is inserted upon the anterior surface of the ascending condyle and part of the outer surface of the ascending ramus.

Digastric.—Immediately below and parallel with the lower border of the superficial layer of the masseter there is an uncommonly large, strong and digastric muscle, which is fleshy and without median tendon (*Di*, fig. 15, and *Di*, *Di**, fig. 24, Pl. LXXII.). It arises from the inferior margin of the paramastoid. Continuing thence over the lower surface of the condyle and outside the descending angular process, it proceeds forwards, exterior to the inferior and narrow edge of the horizontal ramus, to within an inch of the symphysis menti.

3. *Muscular Layers of the Back and Neck.* (Plates LXX., LXXI., LXXII.)

Trapezius.—While somewhat continuous as a whole, it is nevertheless clearly divisible into two portions. I shall describe them as such.

The first and hindermost portion is very elongated in form (fig. 15, Tz^1). It is thin, muscular, and of moderate breadth. Posteriorly its fibres reach the fourth (last) rib; and here they are narrow. They become wider by degrees as they reach forwards towards the scapula, but contract again in a wedge-shape previous to their insertion into the upper portion of the scapular spine.

The second and anterior part is, like the last, thin. In front it reaches the last cervical vertebra, and behind extends backwards to about the third or fourth dorsal spine. Its fibres converge, to be inserted into the anterior surface of the spine of the scapula for its whole length; and their direction is from behind forwards and from within outwards, much according to the position of the limb (Tz^2). The second portion of the trapezius partially overlaps the anterior border of the first or hinder portion, and it again is itself overlapped at its front border by a portion of the immense cephalo-humeral muscle. The second trapezial segment, at its scapular attachment, has its fibres running on and interweaving with those of a portion of the deltoid.

The *rhomboideus capitis* (fig. 20, *Rh.c*) is a very large, expanded muscle in the Sea-lion. Its fibres reach well up towards the occiput in the nuchal region; and its posterior fibres extend behind to as far as the fourth dorsal spine. It is attached in the median line to its fellow of the opposite side. Those muscular fibres posteriorly placed are directed partly outwards, downwards, and backwards, following in this way the curves of the back and shoulder; they are inserted into the posterior half of the vertebral edge of the scapula, and into the scapular spine for half its length. A small portion of the posterior angle of this muscle is covered by a fold of the serratus magnus.

The *rhomboideus major* and *minor* in this species of *Otaria* are represented by a single muscle; and this, from the attachments, is more likely to be the rhomboideus minor. It is a broadish thin slip of muscle (see fig. 20, *Rh.mi*) arising fleshy from the fourth, fifth, and sixth dorsal spines. Its insertion is into the deep side of the superficial part of the fold of the serratus magnus, $1\frac{1}{2}$ inch behind the scapula, but having no insertion into the latter bone itself.

The *spinalis dorsi* (fig. 21, *Sp.d*), emerging from the composite erector spinæ in the lumbar region, goes on as far as the first dorsal spine and then tapers to a point. This muscle is almost equal in bulk to the other long dorsal muscles.

Two other sets of vertebral muscles may be here mentioned, the *semispinalis* ($\frac{1}{2}Sp$) and *rotatores* (*Ro*, fig. 22). Both are fully developed, and strong in their individual component parts in the dorsal region. They are each composed of broad fleshy fasciolar bundles; the former start from the roots of the transverse processes, and lie athwart the spines; the latter proceed from the tips of the transverse processes, and pass forwards to the lamina of the vertebra in advance.

The *sacro-lumbalis* muscle (*S.l*), as might be expected, is of considerable size, and in this case equals the longissimus dorsi. It has the usual origin from the lumbar region, and as it proceeds forwards it sends superficially outwards very broad, flat, strong tendons to all but the last two ribs, while deeper and on its inner side small delicate tendons are sent to all but the two anterior ribs, or rather to the articulating processes.

The *longissimus dorsi* (*Lo.d*), after its continuation forwards from the common mass of the erector spinæ, sends out tendons in a similar manner as the sacro-lumbalis, which are inserted into the eight anterior dorsal apophyses. There are, moreover, fleshy slips and tendons combined, which proceed to the metapophyses of the sixth, fifth, fourth, and third cervical vertebræ. This portion it is which represents the transversalis cervicis muscle (*T.c*).

Splenius capitis and *colli*.—These muscles reverse the condition which obtains in Man, inasmuch as they are single in insertion and double in origin. The former (fig. 21, *Sp.c*) arises narrowly by muscular fibre in the region of the shoulder and the neck, from opposite the third dorsal vertebra forwards to near the occiput, being broadly inserted into the occipital bone. The latter (*Sp.co*) arises by a single slip from the sides of the fourth and fifth dorsal vertebral spines, and besides by origin from the zygapophyses of the two anterior and the last three cervical vertebræ. The muscle increases very considerably in breadth as it proceeds forwards; but its belly continues in a straighter line than the splenius capitis. It ultimately joins the last-mentioned muscle; and the two form a common mass at their insertion, which, as it expands, stretches from the occipital protuberance to the paramastoid process.

The *complexus*, along with the *biventer cervicis* muscle, covers nearly entirely the layer of the neck. Strictly speaking, these ought to be considered one muscle; but it is more convenient, and may be clearer, to describe them as separate heads.

First, the complexus (complexus major) (fig. 22, *Co*), considerably the larger portion of the two, arises by digital fleshy slips from the metapophyses of the third, fourth, fifth, sixth, and seventh cervical vertebræ; and these, uniting, pursue a course inwards, upwards, and forwards. The single fleshy belly is inserted into the occiput outside the fossa which lies close to the median occipital crest. This broad insertion is slightly tendinous superficially.

Second, the biventer cervicis (complexus minor) (*Bi.c*) is a much longer but narrower slip, and forms the spinal border of the complexus. It arises by slips from the fifth, second, and first dorsal spines, and is inserted along with the fibres of the complexus into the occiput; but those of the biventer cervicis are attached not outside, but within the fossa itself, at the side of the median occipital crest.

Rectus capitis posticus major (fig. 23, *R.p.ma*) has a considerable volume of fleshy fibres, and, from the form of the occipito-nuchal region, a somewhat elongated thick fusiform shape. Its points of attachment, however, do not vary from what is usually found in other Carnivora. Behind, its origin from the axis is narrow and muscular; and it rests here upon the laminæ close to the spine. Anteriorly, its occipital insertion is likewise tolerably muscular, or there are but very short tendinous aponeurotic fibres.

The *rectus capitis posticus minor*, lying beneath the last and partially hidden by it (*R.p.mi*), is relatively smaller, but, notwithstanding, is tolerably fleshy. It stretches, as ordinarily, betwixt the atlas and the occiput.

The *rectus lateralis* (*R.l*), by some anatomists regarded in Man as one of the intertransversales, is here a short, broad, and distinct muscle. Its cervical attachment or origin is the inferior or anterior surface of the transverse process of the atlas; and it is inserted into the occiput, behind the paramastoid process, just posterior to the hinder end of the digastric muscle.

The *obliquus capitis superior* (*O.s*) extends from the transverse process of the atlas to the occiput. Like the other short deep muscles of the neck in this animal, it is strong and fleshy.

Of nearly equal size to the last is the *obliquus capitis inferior* (*O.i*), which is placed as usual, between the axis and the atlas, coming from the spine of the former and inserted into the entire length of the transverse process of the atlas.

Besides the foregoing set of deep muscles, there is another which ought to come under the description of this group. In size and direction it is nearly equal to, and runs parallel with the obliquus inferior (*vide* fig. 23, *). It arises from the articulating processes of the second and third cervical vertebræ, and, proceeding forwards and outwards, is inserted into the posterior surface of the tip of the transverse process of the atlas.

The *intertransversalis* and the *interspinalis* (*Isp*) muscles are each remarkably well developed. They are especially very fleshy and large in the posterior cervical and dorsal regions.

Although there is great mobility and power of neck in *Otaria*, there is no ligamentum nuchæ present.

Levatores costarum.—These in *Otaria* are fifteen in number, and thus correspond with the number of the ribs present. They have attachments similar to what is found in the human being—namely, from the transverse processes of the dorsal vertebræ to the ribs. As in Man, also, the first of these muscles comes from the last cervical vertebra (fig. 22, *L.ct*). The hindermost do not, however, present insertions into two ribs, as is often the case in Man. Each muscle, or muscular slip, considering the whole as one series, is narrow and superficially tendinous at its origin, widening gradually and becoming fleshy as it proceeds backwards and downwards to be inserted broadly into the anterior marginal costa. Those in the dorsal region are remarkably large and muscular. The action of the levators of the ribs in the Sea-lion is somewhat of a limited rotary one. Every individual slip is of a nearly equal-sided triangular form; and the plane or direction of force is from the anterior angle to the base or posterior side of the triangle. During contraction therefore the fibres, while drawing the rib directly forwards, also tilt its anterior edge outwards and forwards.

Cephalo-humeral.—This muscle, usually well developed in the Carnivora, is in the Sea-lion of most remarkable size, and, as might be expected from its attachments, powerfully affects the movements of the fore limb. Its most anterior point of origin is from the occiput; and from this the fibres extend backwards along the spinal line of the neck to opposite the vertebral border of the scapula, where the posterior fibres slightly overlap those of the anterior border of the second portion of the trapezius. The muscular fibres of the cephalo-humeral are remarkably strong, and coarse in texture. They continue from the above extensive origin as a broad sheet, and cover almost the entire side of the neck and the front of the shoulder (fig. 15, *Ch*). The fibres more or less converge as they proceed downwards and backwards; and winding round the front of the shoulder, part of them are inserted into the musculo-cellular tissue, representing the absent clavicle; the remainder, the wider and stronger portion, go down to the deltoid ridge, and are even continued on to the superior portion of the second head of the brachialis anticus. (*Vide* insertion, *C.h*, fig. 27.)

The *levator anguli scapulæ* (*L.a.s*, fig. 20) much resembles the cervical slips of the serratus magnus, but is a much broader and larger muscle, and partly hides the above towards the atlas. It has origin by a short, flat tendon, coming from the transverse process of the atlas; and the muscular slip continued therefrom proceeds to the spine of the scapula, where it is inserted into the lower third, or that portion unoccupied by the rhomboideus capitis muscle.

The *sterno-mastoid* (*St.m*, fig. 15) is apparently a single muscle, although there does exist a sulcus, or line of division, in the fibres composing it, but which does not continue the whole length of the muscular belly. Its origin or cephalic attachment is from the exoccipital bone to the paramastoid process; and the sternal insertion is into the upper and outer surface of the manubrium.

Sterno-hyoid and sterno-thyroid.—These have a common origin. Unitedly they form a very strong slip or fleshy band, an inch and a half broad, which proceeds forwards on the neck (*St.h & t*, fig. 33), lies in close contact with, and is attached by cellular membrane to, the trachea. Two inches behind the posterior border of the cricoid cartilage the superficial muscular fibres separate, and pursue a course inwards and forwards, narrowing as they pass over the thyroid cartilage; this the free portion of the sterno-hyoid muscle is inserted into a thin transverse fibrous septum, placed over the basihyal, and dividing the muscular fibres of the root of the tongue from those of the neck proper.

Equal in volume to the foregoing, the sterno-thyroid on its divergence from the muscular head common to it and the last mentioned has its fibres directed slightly outwards and forwards, being only partially covered by the sterno-hyoid, but nearly hidden by the equally broad omo-hyoid. The insertion of the sterno-hyoid is the posterior and inner margin of the curved line of the thyroid cartilage, beside its lower angular border. The origin of the thyro-hyoid intervenes between the attachment of the sterno-hyoid and the inferior constrictor, its thyro-pharyngeal portion. The outer border of the sterno-thyroid, for a short distance, touches the œsophagus, and covers almost entirely the small-sized thyroid gland. Anterior to this last it lies upon the crico-thyroid muscle, being attached to the thyroid cartilage outside the superficial anterior fibres of the crico-thyroid muscle.

The internal jugular vein, common carotid artery, and large pneumogastric nerve lie outside the sterno-thyroid muscle.

The *longus colli*, as in Man, consists of two portions; these differ slightly, however, in their attachments. Together they form a very powerful fleshy muscle, so much so that the tendons of attachment are almost entirely hidden by the muscular fibres. The first anterior or superior oblique portion (fig. 24, $L.c^1$) has a narrow origin from the body of the atlas, at its posterior portion, and from the ventral surface of the body of the third cervical vertebra. This belly, as it extends backwards, has tendinous slips of insertion into the transverse processes of the third, fourth, and fifth cervicals. The second ($L.c^2$) (posterior or vertical portion of human anatomy) is much larger and fleshy. It arises from the ventral surface of the bodies of the second, third, fourth, fifth, sixth, and seventh cervical vertebræ, and from the third and fourth transverse processes, clasping the rectus anticus major within the fork. Entering the chest, the longus colli continues backwards to the seventh dorsal vertebra.

The somewhat large and fleshy *rectus anticus major* (*R.a.ma*) arises from the under surfaces of the third, fourth, fifth, and sixth cervical vertebræ, and, continuing onwards, terminates by a narrow, but strong, insertion on the basilar portion of the occipital bone.

The two *rectus anticus minor* muscles are each rather narrow and placed wide apart, their fibres not touching at any portion of their course (*R.a.mi*). Origin, the ventral surface of the atlas at the root of the transverse process. Insertion, the basioccipital bone, behind and beneath the basilar plate.

4. *Muscles of the Abdomen and Chest.* (Plates LXX. to LXXIII.)

External oblique.—Correspondent in length with the elongated costo-abdominal region, this extensive and fleshy sheet (figs. 15 & 33, *E.o*) arises forwards, on the side of the thorax, by digitations from the fifth to the fifteenth ribs. The hindermost seven of these interdigitate with those of the latissimus dorsi. The muscle of either side forms the median abdominal line backwards from the ensiform cartilage, which is about opposite the cartilage of the eighteenth rib. The other attachments are, as usual, the lumbar fascia and crest of the ilium. The insertion, which is into the symphysis pubis, extends as far back as the pubic arch, but outside the rectus. The external abdominal ring is barely visible, and little over half an inch in length. It is narrow, and oval in shape.

Internal oblique.—This muscle (*I.o*, fig. 33), which is of moderate thickness, has the following attachments,—the crest of the ilium, the lumbar fascia, and the tips of the cartilages of the three hindermost ribs. The fibres have the usual downward and forward direction; they may be said, however, not to pass the outer edge of the rectus; at this place they interblend with the transversalis muscle by fibrous tissue. From the crest of the ilium backwards the fibres of the internal oblique are nearly transverse in direction, and they reach almost to the pubis. They do not take any share in Poupart's ligament, which is formed solely by the external oblique.

Cremaster.—This muscle is present although diminutive. It is, as usual, formed by the terminal fibres of the internal oblique.

The *transversalis* is attached forwards to the six hindermost rib-cartilages; but its fibres do not quite reach those of the diaphragm. The muscular bundles of fibrillæ are, as usual, transverse in direction, and quite reach the middle line of the abdomen. Its further attachments are the lumbar fascia, and that derived from the transverse processes of the vertebræ between the ilium and the ribs. The posterior border of the muscle reaches no further back than about opposite the iliac crest (fig. 33, *Tr*).

Rectus abdominis.—This altogether is a rather broad strip of muscle. Its narrower end (*R.ab*, fig. 33), that of origin, is from the os pubis, nearly its whole length, and in the median line. Proceeding forwards, and with its inner margin touching that of its fellow of the opposite side in the abdomen, it diverges slightly as it comes opposite the ensiform cartilage, and, then passing over the hinder free and sternal cartilages, has a fleshy insertion into the cartilage of the sixth rib. The external oblique and a few of the fibres of the internal oblique lie in front of or superficial to the rectus for about a distance of three or four inches from the pubis. The remainder of the muscle, between the point spoken of and the thoracic cartilages, has the strong, fleshy transversalis and aponeurotic tendon of the internal oblique behind or placed deeply to it; but the external oblique remains superficial or covers it. It cannot be said that there is any distinct or strong fibrous tissue (the so-called sheath of the rectus) binding the muscles together.

The *latissimus dorsi* (*La.d*, fig. 15) is a very broad, extensive, and powerful muscle. It arises from the middle line of the back, and also has digital slips of origin from the last seven ribs. There is little fascia in the spinal region; but what exceedingly thin muscular fibres there are, lie closely adherent to the serratus magnus and the long dorsal muscles. The fibres of the latissimus, as they proceed forwards on the chest, dip downwards and pass into the axilla behind, being inserted finally on the inner bicipital ridge.

Serratus magnus (figs. 20, 21, *S.mg*).—On the thorax this muscle has attachments by serrations and slips to the anterior ten ribs; besides the form of the body, this circumstance gives the muscle an unusually elongated appearance. The elongation of the muscle is increased as it runs up the neck as far as to the atlas, being inserted by muscular slips into each transverse process of the cervical vertebræ; the cervical muscular slips, however, are tolerably fused together, so that they form but one continuous broad sheet.

The serratus, as in Mammalia generally, has an insertion along the whole vertebral border of the scapula. There are two upper nuchal slips, however, which have an insertion quite on the dorsal surface and superficial to the remaining scapular insertion. These two slips just spoken of cover in part the supraspinatus muscle. The line of attachment of the serratus magnus to the side of the body and neck is a peculiar one; and hence this muscle has by anatomists had its fibres divided into three or more sets. Commencing at the tenth rib, and continuing forwards, the fibres reach the atlas very little above the level of the posterior horizontal plane.

Scaleni.—There are two scaleni muscles in the Sea-lion. That which answers to the scalenus posticus (fig. 21, Sca^2) arises from the transverse process of the seventh cervical vertebra, and partly by a few fibres from the sixth, and, passing backwards, is inserted into the first rib.

The scalenus anticus (Sca^1) has an origin almost identical with the above—namely, fibres from opposite the transverse processes of the sixth and seventh cervicals. This muscle, as it diverges from the previous one, proceeds to be inserted into the third rib and the interspace before it, just where the rib becomes cartilaginous. Both the scalenus anticus and posticus are of moderate size.

Supracostal.—In the species of *Otaria* under consideration, as well as in the Common and Ringed Seals (*Phoca vitulina* and *P. fœtida*), I have found a broad, flat, but strong layer of muscle representing the above (*Sct*, figs. 21 & 33). In the Sea-lion it lies to the sternal side of the scalenus anticus, a small portion of its origin being covered by that muscle. This well-marked supracostal arises from the middle third of the first rib, broad, and partly tendinous. The fibres are directed in a slanting manner towards the sternum, downwards and backwards, and are inserted into the cartilage of the third rib and upon the costal interspace behind.

Intercostal Muscles.—These (*It*) are remarkably broad and fleshy planes of fibres, and almost devoid of the tendinous intersections commonly found in them. The layer termed the intercostales externi reaches from the head of the rib to about the middle of the sternal cartilages. The sternal ends, which slant very much, are inserted in such a manner that the portion which is attached to the rib itself is prolonged beyond the other.

Triangularis sterni (fig. 25, *T.s*).—In accordance with the length of the thorax, this muscle is long; and relatively to its transverse diameter it is broad. It is composed of five pyramidal or triangular-shaped flat and strong slips. The base and origin of each of these is the sternum, upon its pleural surface, but not quite reaching the median line. Their fibres are directed upwards and outwards; and the five slips are inserted into the seventh, sixth, fifth, fourth, and third rib-cartilages respectively. Towards the sternal ends the inner surface is glistening and tendinous, but at the rib-cartilages strongly muscular. Each slip crosses one portion of rib-cartilage behind it before reaching its own insertion.

Diaphragm.—This extensive plane of inspiratory muscular and tendinous fibres, as might be expected, is well developed. Its substance is not so thick as obtains in some Carnivorous animals, *e. g.* the Lion; but the fleshy fibres are equally and evenly distributed throughout the whole of the organ. It is further overlain and entirely covered both on its thoracic and abdominal surfaces by a thick layer of strong white glistening aponeurotic fibres, which nevertheless permits of the fleshy fibres beneath being traced.

The distribution of the thicker tendinous portions of the diaphragm (the so-called central or cordiform tendo diaphragmatis), the direction of the ensheathed muscular fibres, and the openings are best observed upon the thoracic surface; I shall consequently describe them from that point of view. Figure 19, Pl. LXX., shows in a partially diagrammatic manner the diaphragm as seen from the thorax.

The central tendon of human anatomy (*c*) is represented by a fibrous interspace, free from muscle, of a spearheaded shape, and about a couple of inches long by fully an inch broad. The two fibrous alar tendons (*r* and *l*) are given off from the neck of this central tendon. They are each at first of considerable thickness, but not very broad, and, as they describe a semicircle backwards, narrow still further, and terminate almost linearly near the ligamenta arcuata. The central tendon with its divisions is compared in the human being to a trefoil leaf; here in the Sea-lion it assumes a form which might be likened rather to a pair of callipers. The muscular fibres outside the tripartite tendon have a radiate direction, those towards the sternum being directed forwards, those to the ribs and rib-cartilages forwards, outwards, or backwards, according as they are anteriorly, laterally, or posteriorly situated. The muscle inside the aforesaid tripartite tendon differs in the direction of its fibres. It forms two semilunes, whose concavities face each other and powerfully enclose the œsophagus: in a line behind this the pericardial fold is attached. The left fleshy crus (*l.c*) is far more fully developed than is the right one. There is no very clear definition of ligamentum arcuatum internum and externum, as in human anatomy, the loin-muscles entering the chest but meagrely. Instead, an arched or funnel-like fascia enclasps the aorta, fastens down the musculo-tendinous parts, and joins the fleshy constricted portion of the diaphragm, which ends in a tendon fastened to the bodies of the third and fourth lumbar vertebræ (*vide D*, fig. 36, Pl. LXXIII.). The opening for the vena cava (*v.c*) is situate between the central tendon and the right alar tendon.

5. *Muscles of the Loins and Tail.* (Plate LXXIII.)

Psoas.—Although the Otary seems to have great power and mobility in the lumbar region, so far as wriggling movement is concerned, yet there is a certain weakness in the loins; for the flexibility of movement is in great part due to the great thickness of the intervertebral cartilages, and not to immense power in the psoas muscles, which latter, comparatively speaking, are weak and long.

If insertion is taken as indicative of a certain muscle rather than the origin of the muscular belly, then the psoas magnus is not present in the Sea-lion; or at least what would correspond with the psoas magnus is so incorporated with what may represent the psoas minor (described below) that no separate description is needed. On the other hand, if origin and general appearance have most weight, the psoas parvus must be absent, and that here named the psoas parvus be the psoas magnus.

It would appear contrary, then, to the general development of these psoas muscles, that in this case the psoas parvus is much the greater in bulk (fig. 36, *Ps*, *Ps**). If such it is, the belly is long, and its terminal tendon rather short than otherwise. It arises by four long delicate tendons from the ventral surfaces and posterior ends of the first, second, third, and fourth lumbar vertebræ. These origins are covered by the belly of the muscle, which extends outwards to the tips of the second, third, and fourth lumbar vertebræ; and the muscle, narrowing as it runs backwards, is inserted by a short, strong tendon into the prominence representing the ilio-pectineal eminence.

The *iliacus* (*Il*) is only of moderate bulk. It arises from the sides of the bodies of the penultimate last lumbar and first sacral vertebra, and from the transverse processes of the former with fibres also from the ilium. The belly of the muscle is slightly sulcated or divided into three slips, the external cutaneous nerve passing between the middle and outer slip. The iliacus is inserted by a small, short and strong tendon into the inner trochanter.

Quadratus lumborum.—As in some of the Carnivora, as well as in the Lemuroidea, this muscle is composed of many fleshy and tendinous slips. There are six or seven of these muscular slips (*Q.l*), arising from the bodies of the last three dorsal, and more or less from the whole of the lumbar vertebræ. These slips give off five long tendons, four of which are inserted into the tips of the transverse processes of the lumbar vertebræ, and a posterior one into the rim of the ilium. In the thorax the first two bellies unite and form one tendon, which goes to the first lumbar transverse process. The next two slips give off a tendon apiece. The fifth and sixth bellies together supply another tendon, while the last broad part is single.

The conjoined *pubo-* and *ilio-coccygeus* (*P.&Ic*, fig. 36) cover, as a thin musculo-tendinous elongated fan-shaped layer, the inner surface of the pelvis, from the ischial end of the obturatory foramen to a short distance behind its opposite extremity. The muscle thus lies compressed between the internal obturator muscle and the great ischiatic ligament on the one (outer) side and the sacro-coccygeus and caudal vertebræ on the other (inner) side. The musculo-tendinous belly continues thickish as it passes backwards, and is attached to the transverse processes of the last two sacral elements and as many caudal vertebræ. A fleshy part of the muscle, ending in a strong flattened tendon, moreover slants inwards and across the sacro-coccygeal tendons, to be inserted on the inferior surface and median line of the body of the caudal vertebra.

Sacro-coccygeus.—Notwithstanding the shortness of the tail, this muscle and its tendons are well developed. A long compressed muscular bundle, with a considerable amount of strong glistening aponeurosis outside it, stretches upon the sides and fronts of the sacral and caudal vertebræ from the sacro-iliac synchondrosis to opposite the tuberosity of the ischium, where the outer sheath appears to separate into a number of tendons, sent on to the tail. Four of these tendons, the uppermost broadest and strongest, the others decreasing in size, go to be implanted on the sides of the caudal vertebræ. Four more, finer tendons come off from the inner and fleshy side of the muscle, and are inserted on the middle and under surface of the terminal vertebræ behind the transverse levator ani, the fleshy fibres of these running lower and lower from without inwards, the hindermost springing from the caudal elements opposite the levator caudæ. The whole of the tendons spoken of penetrate the pubo-coccygeus, or, rather, pass under the lower median tendon of insertion.

The *infracoccygeus*, both in muscle (belly) and tendon, is with difficulty separated from the sacro-coccygeus, the whole being more or less invested with dense fascia, which, especially towards the extremity of the tail, enwraps and binds firmly together their caudal tendons, the sparse fibres of the intertransversalis mingling with the proper aponeurotic fascia of the caudal vertebræ. What may be regarded as the infracoccygeus, is therefore but the small inner portion of the sacro-coccygeus, the fibres of the former hardly running so high as the latter. It terminates in a strongish aponeurotic tendon inserted on the under surfaces of the caudal vertebræ, underneath the levator ani.

Levator caudæ externus.—This has an elongated fusiform belly fitting on to the outer surface of the levator caudæ internus, both being firmly encased by a dense aponeurosis, and this again overlain by the gluteus medius, maximus, and biceps muscles. The former muscle, that in question (*L.c.e*, figs. 34, 35), arises by aponeurosis from the superior posterior spinous process of the ilium, and from the outer edge and partly superior surface of the transverse processes of the sacrum; thence becoming very strongly tendinous, it may be said to be inserted into the first and second caudal transverse processes, though still continuing by fascia on the tail.

This muscle from before backwards lies upon the gluteus minimus, pyriformis, gemelli, and obturator internus, and has the long deep sacro-peronæus muscle springing from its outer side. Its name expresses its function.

The *levator caudæ internus* (*L.c.i*, *L.c.i**) lies upon the dorsal surfaces of the transverse process of the sacrum and caudal vertebræ, between the levator caudæ externus and the prolonged insertion of the erector spinæ. Its origin, much covered by the erector spinæ, is by a short tendon from the articulating process of the last lumbar vertebra; then, becoming fleshy, it is attached to the upper surfaces of the sacral transverse processes. At the commencement of the caudal vertebræ it becomes highly tendinous, and can be resolved into separate tendons, which are inserted, four into the lateral and four into the dorsal prominences of the caudal vertebræ. The tendons decrease in thickness from before backwards.

6. *Muscles of the Anterior Extremity.* (Plates LXX. & LXXII.)

Pectoral Muscles.—The normal division into pectoralis major and pectoralis minor is in the Sea-lion somewhat obscure; for while there are at least three layers of muscular fibres in the position of the pectoral muscles, differing entirely in direction, two of these may, notwithstanding, only be different portions of the pectoralis major, and not the pectoralis minor; or these muscles are so conjoined in one of the layers as not to be separable. The third and smallest division, again, is not the representative of the pectoralis minor, but may either be an altered subclavius, or the costo-coracoid of some writers.

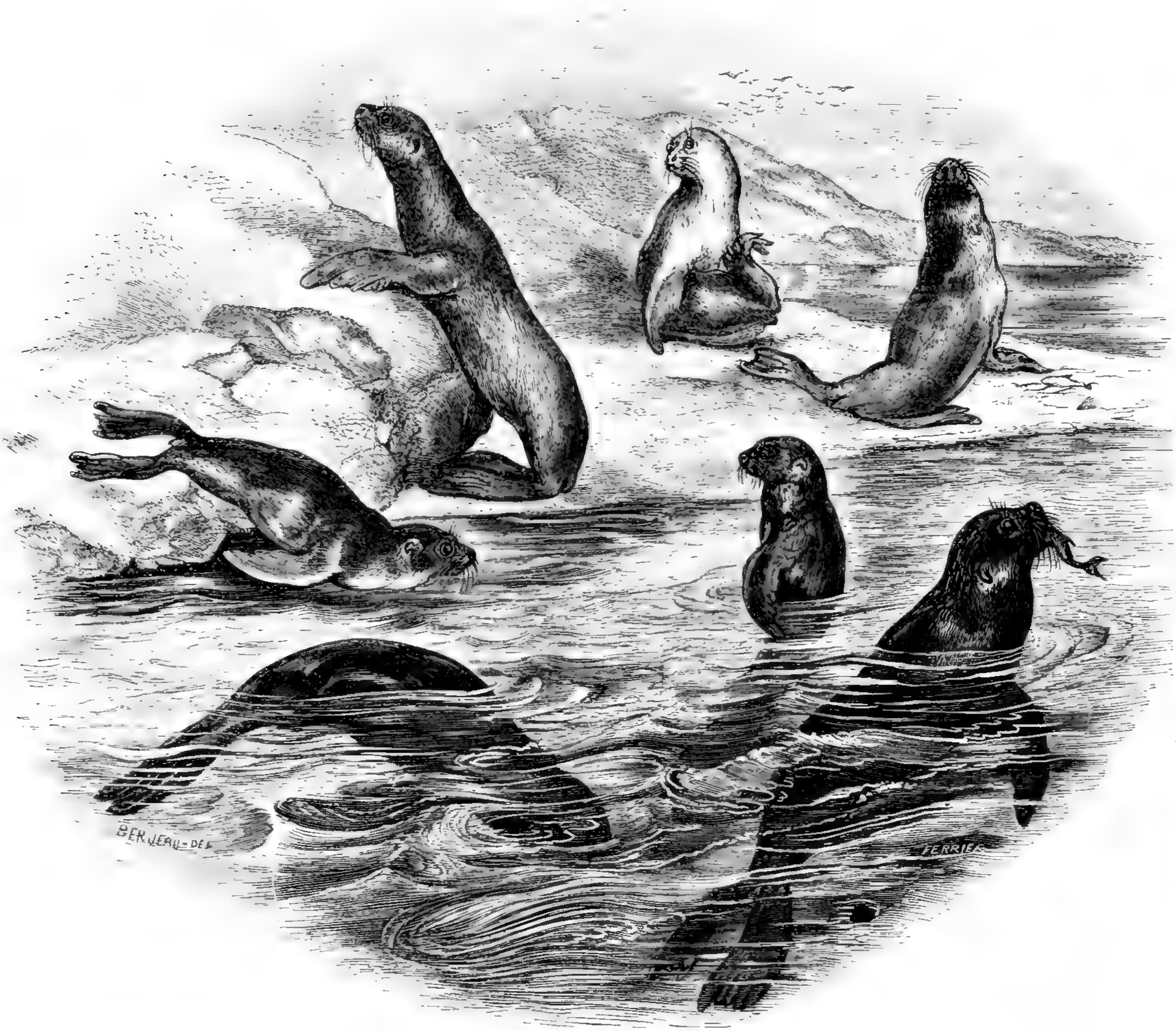
The first, anterior and most superficial division (Pl. LXXIII. fig. 33, *P.ma*[1]) has its fibres pursuing a course nearly transverse to the long axis of the thorax. This broad and strong portion has an origin which extends from the manubrium backwards as far as the cartilage of the fifth rib. The muscular layer stretches outwards into the axillary region, where the anterior border is in a line with the shoulder-joint, and the posterior border covers the axilla proper. This humero-axillary end terminates by a somewhat semilunar-shaped fascia, the anterior part of which is firmly inserted into the humerus from the head of the bone to below its middle; the posterior or axillary part joins the fascia of the forearm on the inner side.

The second division is the largest and most elongated (*P.ma*²). It arises upon the thorax opposite the first and second ribs, and reaches backwards in the median sternal line to the ensiform cartilage. The intersecting fibres are directed forwards and outwards, and proceed to the axilla, where they end abruptly in a semilunar form, much in the same manner as does the superior layer already described. Their insertion is also partly by a fascia which joins the aponeurotic fascia of the forearm; but this layer is attached by delicate fibres more over the humerus and upon the biceps muscle than is the superficial layer. A strong aponeurotic tendon, however, goes to be inserted along with the portion of the first division already spoken of.

The third and smallest division is a narrow strip, quite separate from the others, which arises from the manubrium and passes in a straight line outwards towards the head of the humerus, near which its fibres join those of the superficial layer (or first portion), but rather below it. Though including the above third muscle among the pectorales, I have no hesitation in classing it as the *sterno-scapular* (*St.s*).

Remarks concerning the Pectorals.—With such a modified pectoral extremity as is possessed by the Sea-lion, and one so well fitted in many respects for sweeping forcibly through a watery element, it would be strange if we did not meet with some muscular coadaptations in the member. While the digits are in a great measure held in abeyance as grasping or burrowing implements, the whole palm (and, indeed, forearm) is called into active unison during the propulsive strokes of swimming. As we have seen, the upper arm is lashed forwards chiefly by the great cephalo-humeral, partially rotated by the deltoid, and powerfully dragged backwards by the relatively enormous latissimus dorsi, great pectoral, and extensive panniculus carnosus. But combination of force applied ever so much to the humeral end of the limb would not of itself effect the power and steadiness of the sweep which the forearm and flipper are capable of, unless the latter were duly strengthened and rendered somewhat rigid. This to some extent is provided for in the dense skin and firm superficial aponeurotic sheath which encase the muscular apparatus. More, however, seems to be required to transmit the power from the proximal to the distal end of the limb, and, it may be, to regulate the tension of the parts. Whatever is the precise mechanical explanation, or the necessity for extra superficial muscular development, we have at least a well-marked example of it in the inner radio-ulnar region of the animal under consideration. It has been shown that the axillary portions of the panniculus carnosus and latissimus dorsi stretch across the inner aspect of the cubital region from the one border almost to the other; and in so doing they limit to some extent the muscular arc, whereof the base is the body itself. But it may be said that continuity of fleshy fibre, altered, however, in direction, carries their stages of contraction and relaxation onwards to the palm, through the subcutaneous musculo-tendinous sheet of the pectoralis major, which clothes in great part the inner surface of the forearm.

Fig. 3.



Group representing the Sea-lion (*Otaria jubata*) in a variety of positions on land and in the water. Each of the figures is from an original drawing, taken whilst the specimen was exhibited in the Society's gardens.

A deeper layer of voluminous muscle and wonderfully strong carpal tendon is another potent agent which partially fulfils similar functions. This is accomplished, however, through the medium of the scapula as a fixed point, the triceps, dorsi epitrochlear, and flexor ulnaris muscle as combined levers, with the enlarged olecranon as a fulcrum.

The fibres at the bend of the elbow (or here broad cubital region) form a well-marked arch, traversing crosswise from the anterior condyloid edge to the posterior olecranon border. From this downwards to the wrist there is a continuation of aponeurotic tissue which covers almost wholly the inner surface of the forearm. This fascia at the anterior or outer radial border forms a thick ligamentous-like band, which proceeds onwards to the carpus, joining the tendon of the extensor ossis metacarpi and pollicial moiety of the deep palmar fascia—ultimately being inserted, beneath the tendon of the ulnaris, into the proximal and plantar surface of the first metacarpal bone. On the ulnar side the fascia is weaker, adherent to and conterminous with that of the palmaris secundus.

Deltoid.—This muscle is composed of two layers, the superficial one of which is by far the larger of the two. The first portion (Pl. LXX. fig. 15, D^1) arises from the whole length of the spine of the scapula, its posterior border covering the infraspinatus muscle as its fibres proceed downwards. With somewhat of a flattened-arch contour in front, and a straight edge behind, this first part of the deltoid, becoming pointed below, proceeds to be inserted into the deltoid ridge. A narrow roundish slip, almost like a separate muscle, is moreover continued (fig. 27) down the front and outside of the forearm, and ultimately joins the tendon of the supinator longus.

The deeper second and smaller layer or portion of the deltoid is only perceptible as a broadish, but very thin and sparse, band of muscular fibres arising from the shoulder-joint, and inserted on the outer but deep side of the deltoid prominence (fig. 27, D^2).

On the opposite (right) side of the same animal no distinct slip of fibres constituting the above second part could be detected. It may have been incorporated with the cephalo-humeral; but no definite line of demarcation existed.

Action. The powerful deltoid, with extensive origin and slanting direction of fibres attached low on the humeral shaft, drags backwards the limb whilst rotating it outwards.

The *supraspinatus* (*S.sp*, figs. 20, 26) is, in relation to the infraspinatus, the broader muscle of the two. It has the usual origin from the supraspinous fossa, and insertion by a very strong broad tendon into the outer humeral tuberosity. What may be described as a second portion of this muscle, is the part which more directly arises from the superior and anterior edge of the bone. This portion, although barely divisible in the fleshy part (or so-called belly) of the muscle, has nevertheless a more or less separate insertion of a muscular kind into the inner border of the radial tuberosity.

This latter-mentioned division has, moreover, a still further separation, and into what, with more propriety, might be considered an individual muscle *episubscapularis* (figs. 26, 27, *Ep.s*). The origin of this portion or muscle is in close union with that portion described above as the second part of the supraspinatus. It arises, therefore, from the superior rim of the scapula, from the angle half the length of the border, as far as the prominent part. In its course it overlaps and partly covers the subscapularis, and it is inserted into the capsular ligament; but, besides, by a strong flattened tendon it is continued into the inner tuberosity, and there covers the insertion of the subscapularis muscle. This division of the supraspinatus is of great strength, and may be said regularly to roll round the (upper) anterior border of the scapula. It is apparently the same, I have found, in the Giraffe &c., and not identical with Mivart's epicoraco-humeral in the Echidna.

Action. The supraspinatus proper with its double point of insertion acts as a direct extensor of the extremity on the scapula; but, furthermore, the additional longer insertion into the front of the great tuberosity, rolling round that humeral prominence, must add to the movement inwards of the arm—in fact, supplant the ordinary clavicular attachment of the deltoid, here wanting. The latter action is still further increased by the equally massive and more rounded direction of the fibres of the episubscapularis, the double insertion of which produces a longer lever.

The *infraspinatus* (figs. 20, 27, *I.sp*), of an elongate wedge-shape, is, comparatively speaking, narrow. It barely covers the infraspinatus fossa, and is not very thick in fibre. As it passes downwards it has a partial attachment to, and, indeed, penetrates the capsular ligament, strengthening it, and resting on the shoulder-joint; but it is finally inserted by its broad, long, and strong tendon into the pit on the outside of the head of the humerus.

Compared with the supraspinatus, the flexing power of the infraspinatus is greatly reduced; its strong tendon entering the joint lends support to this otherwise weak and lax union.

Subscapularis.—This muscle is broad, corresponding in this respect with the proportionally wide and somewhat Cetacean-like character which the scapula itself possesses. The subscapularis muscle (*S*) overlaps both the superior and the inferior borders of the bone, and reaches the spinal border, except the posterior corner; it is inserted by a short but powerful tendon into the inner or lesser tuberosity of the head of the humerus. The exact point of its attachment is rather towards the upper part of the tuberosity. The double insertion of the episubscapularis covers that of the subscapularis on its axillary and anterior sides. The thick flat fibres do not all run parallel with each other, but form two or more groups converging to a central line, or slight groove, wherein the vessels chiefly lie.

Action. Tensor and fixer of the inner head of the humerus. The penniform arrangement of the fibres may alter the power either to the upper or lower border of the scapula, and in this way create a *point d'appui* for the powerful cephalo-humeral—latissimus dorsi and triceps, &c. Of course the power alters in the forward and back stroke; subscapularis, therefore, is a kind of gearing to the bone, which does not receive support from its diminutive acromion and rudimentary coracoid processes.

The *teres major* (fig. 26, *T.ma*) is of considerable size, and consequently must occasionally powerfully flex the upper portion of the limb. It arises below the subscapularis, at the posterior inferior angle of the scapula, upon the inner surface of that bone. It continues tolerably equal in breadth and of considerable thickness towards the humerus, and is inserted from the middle of the shaft upwards to the internal condyloid ridge, in close adhesion with the dorsi epitrochlear and first head of triceps.

The *teres minor* (*T.mi*), in close union with the teres major, occupies the lower margin of the scapula, from where the fibres of the teres major tend towards the humerus, to the glenoid cavity itself. Near the latter-mentioned part the fibres of the teres minor are sparse; and there appears to be no distinct point of insertion—the muscle being lost as it were upon the second or scapular head of the triceps, at its inner side or border.

Triceps.—In the case of *Otaria* the name of this compound muscle is unfortunate, as it is composed of four portions and as many heads. Taken as a whole it has a nearly equal-sided triangular shape, and is of most extraordinary strength. It is tolerably thick and somewhat flattened, in this latter respect adapting itself to the mould of the body.

The posterior division, head, or belly, in reality the *dorsi epitrochlearis* (figs. 15, 20, 26, *D.ep*), is of a wedge-shape, the broad end upwards, very flat, narrow, and long. This first portion arises from the outer and inferior angle of the scapula, and is inserted, almost quite separate from its fellow portions, into the tip of the immense and projecting olecranon process. The muscular fibres, however, run onwards, and proceed until they reach the forearm, covering its posterior border or edge.

The true first division of the triceps (T^1) has also a scapular head of origin; and it is this portion which corresponds with the long head of the triceps in human anatomy. Somewhat shorter than the dorsi epitrochlearis, it nevertheless is very massive. It arises by muscular fibres, having a breadth of 2 inches, from that portion of the posterior margin of the scapula between the glenoid cavity and the first head; continuing downwards, it joins the common cubital insertion of the triceps.

The second division of the muscle (T^2) is quite as strong and muscular as the last described. This portion, which represents the external head in Man, arises from the back of the shaft of the humerus, from the head of the bone to the middle of the shaft. Above, it embraces the head on both sides of the bone, and partly covers the brachialis anticus muscle. Below, it joins the other tricipital divisions as they go towards the elbow-joint. It has also a partial origin from the neck of the scapula and the capsular ligament of the joint. These origins are sparse ligamentous bands, and have two openings, through which vessels &c. pass.

The fourth, smallest and shortest division of the triceps arises from the posterior surface of the shaft of the humerus, and covers the intercondyloid fossa. It unites with the second and third divisions, and all three are together inserted in a fleshy bundle into the upper part of the olecranon process.

The third division of the triceps may, indeed, be that representing the short head of Man. It lies immediately beneath the second head, and is so very intimately united with it that the two appear almost as one. The second division, however, has a more aponeurotic origin, and can be distinctly dissected from the third. The latter it is which is closely applied to the bone from the neck of the humerus to the intercondyloid fossa. It is in close apposition with, but does not overlap the long brachialis anticus, the fibres covering the whole of the flat back of the shaft of the humerus. It is inserted by short roundish tendon into the upper surface of the olecranon, the tendon, however, being much fused with the other insertions of the triceps and anconei.

Anconeus internus.—This is a transverse slip of muscle, of considerable thickness (*A.i*, fig. 26), attached both to the third head of the triceps and to the origins of the three long palmar muscles. It arises from the inner condyle, along with the latter muscles, and is inserted into the olecranon beneath the upper ridge and between the head of triceps and third long palmar head. Action—a short flexor of the upper ulna.

The *anconeus externus* (*A.e*) is slightly broader and more fan-shaped than is the internal muscle. It arises from the outside of the external humeral condyle, and also to its inner or olecranon side, filling in part the said fossa and also lower half of humerus; it passes backwards transversely, to be inserted into the upper and outer edge of the olecranon. The second head of the triceps overlies and partially hides this muscle.

Biceps.—While the triceps muscle is of vast bulk and with an additional head of division, the biceps, on the contrary, is only of moderate dimensions and single-headed (*B*). Its origin is by the usual long tendon from the upper edge of the glenoid cavity of the scapula; and, as inferred above, with but a moderate development of muscular belly, it terminates below in a tendon inserted into the bicipital tuberosity of the radius. The flexing power of this muscle is very limited; but its rather strong tendon above steadies the head of the humerus.

There is no *coraco-brachialis* muscle; but a part or continuation of the tendon of the extra supraspinatus appears to take the place of it.

The *brachialis anticus* has two very distinct heads of origin. The first head, which is large and fleshy, comes from the deltoid prominence, and, going downwards to the forearm, is inserted directly by tendon into the ulna opposite the biceps tendon. This so-called first portion of the muscle ($B.a^1$, fig. 27) has a strong muscular belly; and its fibres above seem almost to be continuous with and derived from the extensive muscle of the shoulder, viz. the superficial layer of the deltoid. The second head of the brachialis anticus ($B.a^2$) arises from the outer side of the neck of the humerus. It winds below this partially round the bone, and joins the first head on the outer side of the elbow-joint. This second portion in some respects represents the ordinary brachialis anticus. At its lower end and outer side it has intimate union by muscular fibres with the supinator longus, while it is also partly covered by that muscle and by the second abnormal head of the supinator longus arising from the deltoid ridge.

The *supinator longus* is double-headed (*S.l*[1], *S.l*[2]). One belly has a broad fleshy origin from the middle and outer side of the humerus at the upper end of the external condyloid ridge; it ends in a strong tendon, which is inserted broadly upon the outer side of the styloid process of the radius. About the middle of the forearm, and at the commencement of its tendon, the supinator longus is joined by a strong muscular slip, the second head. This additional belly of the supinator arises from the deltoid ridge, and, in fact, appears a continuation of the scapular portion of the deltoid, with a moderately thick belly, but rather smaller than the first head; it goes halfway down the radius, ultimately merging with the aforesaid belly at the commencement of the tendon of the proper supinator longus.

The *supinator brevis* is likewise strong and broad, but almost entirely fleshy (*S.b*). Its broadest, short, aponeurotic origin is from the outer condyle, this origin being crossed by the external lateral ligament of the elbow-joint. Another point of origin is from the head of the radius; and a third, very small, flat, tendinous slip also comes from the ulna, below the coronoid process. The muscular fibres of the supinator brevis cover the side and front edge of the radius as far as the prominence at the middle of the bone.

The *extensor carpi radialis longior* (fig. 15, *E.c.r.l*) arises, in a common fleshy mass, along with the extensor carpi radialis brevior (*E.c.r.b*), from the outer condyloid ridge. While their heads of origin therefore form almost a single, elongate, flattened, muscular triangle, their tendons are distinctly separate, of equal magnitude, and run side by side to the wrist-joint. The tendon of the longior is inserted rather broadly, in an aponeurotic manner, into the proximal end of the metacarpal bone of the pollex. The tendon of the brevior is inserted in a similar manner into the indicial metacarpal, but rather towards the radial side of its dorsal surface—the two, however, together forming a broad aponeurotic bridge between the roots of the first and second metacarpal bones; the latter is overlain by the great pollicial tendon of the muscle.

Extensor pollicis et indicis.—The very powerful muscle which I shall describe under the above denomination, may, in fact, represent the extensor primi internodii pollicis, and not be, as I have named it, the extensor pollicis et indicis. The name proprius pollicis is appropriate functionally; for through the enormous tendon is extension and power in the pollex chiefly derived. By whatever name the muscle is noticed, it is distinguished by its possessing an unusually broad, pyramidal, fleshy belly, which arises from the hinder end and outer projecting grooved side of the olecranon process, and from the upper and posterior half of the ulna. Its extraordinarily broad and powerful tendon commences just about the distal end of the ulna, and, crossing the dorsum of the manus, is inserted into the proximal end of the proximal phalanx of the pollex. At this part it widens out and intermingles with the sheath of fibrous tissue here forming the periosteal covering of the bone.

Extensor ossis metacarpi pollicis.—This muscle is broad, flat, fleshy, and strong. The origin is from the outer surface of the olecranon, and from the ulna to as far as about the middle of the latter. As usual, its direction is slanting, or crossing that of the forearm, and it winds round the styloid process of the radius. Its tendon lies in a radial malleolar groove and passes underneath the binding ligament, being at length inserted by a remarkably powerful broad tendon into the proximal and anterior or outer corner of the metacarpal bone of the pollex.

The *extensor primi* and *extensor secundi internodii pollicis* are wanting.

Common Extensors.—There appears to be a double set of long deep extensor muscles of the forearm in the pectoral extremity of the Sea-lion. If these represent different muscles, they nevertheless arise by fleshy fibres in one common mass from the outer condyle, and proceed together downwards in a united condition for three-quarters the length of the forearm.

1. The anterior portion of the above muscular belly may more truly be regarded as representing the extensor communis digitorum. Its origin is as above stated. From below the middle of the forearm downwards it is superficially covered with tendinous aponeurotic fibres. Opposite the lower end of the radius it divides into three broadish tendons, which supply respectively the index, middle and fourth digits (see *E.c.d*). The first two, or inner tendons, separate below the wrist-joint; the third, or outer one, divaricates higher up than these two. At the proximal ends of the first phalanges each tendon spreads out, so that at the distal end of the phalanx it covers, as by an aponeurosis, the whole breadth of the bone, and is finally inserted into the proximal end of the second phalanx. It may furthermore be remarked that its fibres interblend with others on either side of the digit, which go on as far as the proximal end of the last digit.

2. The middle portion of the common muscular origin, while intimately united above, becomes by degrees definite and distinct as it proceeds downwards. Dissection shows such an intervention of cellular tissue between the muscular fibres as to constitute a muscular belly, extensor medii digiti (*E.me.d*). This muscular belly is much smaller and less broad than the first portion, already described. It divides at the level of the divarication of the outermost tendon of the former part into two tendons, the largest of which is inserted into the fifth digit, and ends in a similar manner as the three already spoken of in describing the first portion of the muscle. The smaller inner tendon lies deeper than the outer one, and proceeds below the fourth digital tendon to the outer side of the third digit, mingling at last with the common fibrous tendinous expansion of the digit.

3. The third or outermost portion of the common extensor muscle may be said to represent the extensor minimi digiti (*E.m.d*). This appears as a narrow muscular belly lying alongside the middle extensor belly already spoken of. It likewise ends, as the middle portion does, in two tendons, but differs in these tendons being more nearly equal in size. The outermost tendon is inserted into the distal end of the outside of the fifth metatarsal bone. The innermost tendon proceeds as far as the divergence of

the fourth and fifth digits, where it expands, and is partly attached by fascia to the proximal end of the fifth metacarpal; but the tendon proper runs along the outer side of the fourth digit in manner similar to the inner tendon of the second or middle portion of the common muscle; namely, it is inserted into the proximal and outer end of the second phalanx.

A muscle which seldom alters or varies in its attachments, the *extensor carpi ulnaris* (*E.c.u*), is here also, speaking in a general way, normal. It arises as a broad muscular layer from the olecranon process, above the last-mentioned two muscles, and ends in a long narrow tendon inserted into the outer edge and near the middle of the fifth metatarsal bone.

Long Superficial Palmar Muscles.—If my interpretation be correct, the palmaris longus in this species of *Otaria* is represented by three unequal-sized and differently shaped muscles, which I shall describe as follows:—

a. Palmaris longus primus ($P.l^1$). What may be considered the proper and usual long palmar muscle, inasmuch as it lies immediately to the ulnar side of the flexor carpi radialis, is of moderate size in belly and narrow and diminutive in tendon. It arises, partly muscular and partly tendinous, from the inner condyle of the humerus, from the surface of the internal anconeus, and with interlacing musculo-fleshy fibres from the radial side of the second long palmar muscle. With a somewhat fusiform belly it proceeds about halfway down the forearm, where it forms a narrow tendon, which is at last implanted and lost on the under surface of the great oblique palmar tendon mentioned further on.

b. Palmaris longus secundus. This portion is thin and much broader than the preceding. It has origin along with it from the internal condyle, but also as an extensive sheet from the surface of the palmaris next to be described, and partly from the edge of the dorsi epitrochlearis and the ulnar side of the terminal muscular arch of the pectoralis major. The muscular fibres stretch ulnarwise for nearly half the breadth and length of the forearm, mingle with the superficial aponeurosis of the forearm, coextensive with the pectoralis major, and go to be inserted on the superficies of the ulnar side of the palm; a special broad and strong slip, moreover, passes to the distal end of the fifth metacarpal.

c. Palmaris longus tertius. I venture to designate by this name a muscle which, as far as origin, size, and fleshy union are concerned, might with equal grounds be considered an upper layer of the flexor carpi ulnaris. But as its insertion is so widely different from that of the ulnaris, and moreover its terminal ligamentous expansion so resembles in function that of the usual palmar fascia, I think it ought to be classed under the occasionally multiple long palmar muscles, with the additional affix tertius.

This muscle is remarkable alike for its strength, anomalous position, and for the influential purpose it subserves in nearly all the movements of the manus. It arises by a moderate amount of fibre from the internal condyloid prominence, and by a broad, thick, muscular mass from the whole inner surface of the enlarged and flattened olecranon. The muscle below the olecranon process is intimately fused with the true flexor carpi ulnaris, the broad, flat, powerful bellies of the two forming a protuberant mass on the ulnar side of the limb. The direction of the palmaris longus tertius is oblique, the fleshy fibres stopping short about the middle of the arm, where a thickish, flat, ligamentous tendon, $1\frac{1}{2}$ inch broad, commences, and is continued downwards and across the wrist to the radial side of the pollicial metacarpal. The latter insertion extends from the carpus above the extensor ossis metacarpi tendon forwards to the distal extremity of the first phalanx, and, indeed, by continuity of fascia to the terminal phalangeal cartilage itself. At the wrist the deep flexor tendons pass beneath the oblique ligament.

Flexor carpi ulnaris.—This is closely interwoven with the fleshy origin of the so-called palmaris longus tertius, and hardly to be separated from it above, but it is much more distinct and differently inserted below. It springs, along with the aforesaid muscle, from the olecranon, but chiefly from the sharp edge below the protuberance, and extends thence down the entire shaft of the bone; it forms, as it were, a septum between the anterior and posterior muscles of the forearm (*F.c.u*), which on the ulnar side considerably overlap the bone. In this way, having the great pollicial extensor closely applied to it on the one side and the great pollicial flexor on the other, the belly of the flexor ulnaris being wrapped between them as would the leaves of a book, the flexor carpi ulnaris is attached muscularly to the summit of the outstanding fusiform bone; but a second strong tendon of insertion goes on to the deep palmar fascia at the root of the fifth metacarpal.

The *pronator radii teres* (*P.r.t*) is short, broad, and well developed. It arises, in close adherence with and partially covered by the flexor carpi radialis, from the inner condyle and advances halfway down the radius. At the same time it occupies about half the breadth of that bone, which is unusually flattened to adapt itself to the peculiar compressed paddle-like extremity.

The *flexor carpi radialis*, compared with some other muscles of the pectoral extremity of this creature, is of small bulk, although absolutely of fair size. Its origin, as usual, is the inner condyle, and in conjunction with the pronator radii teres. The muscular belly, which is fusiform, reaches halfway down the forearm; and the terminal long strong tendon dips beneath the deep palmar fascia and ligament, passing over the surface of the scaphoid and trapezium to be inserted into the proximal end of the first metacarpal (figs. 15, 26, 31, *F.c.r*).

Flexor sublimis digitorum (*F.s.d*).—This muscle has two heads of origin, of about equal size, but neither are large. The one arises from the inner condyle, the capsular ligament of the elbow-joint, and from the inner head of the ulna. The other, second, shorter head arises from the ulna, its inner surface, below the olecranon, to as far as the middle of the shaft of that bone. At the latter place the two heads join, and, while narrowing as they proceed downwards, still remain fleshy to the distal end of the ulna, where they lie directly on that bone, and at this place form a short, broadish tendon, widening distally, and which ultimately splits into four main divisions.

The tendon given off the highest goes to the last phalanx of little, fifth, or outer digit, being joined by a small slip from the tendon of the fourth digit. A little below this first division the main tendon of the sublimis splits into three, which respectively supply the fourth, third, and second digits; but it is noteworthy that each of these three tendons is composed of two separate tendons, which, however, lie so close together as to have only the appearance of a single one. The tendon which goes to the index is partly fused with the tendon of the profundus muscle.

The *flexor profundus digitorum* (*F.p.d*) is broad, flat, and so attached to the interosseous membrane and sides of the ulna and radius that its fleshy belly seems also to include the flexor longus pollicis muscle.

At the carpal bones of the wrist-joint a strong, broad, flat tendon comes off superficially, and proceeds outwards and downwards, supplying the distal phalanx of the enormous thumb. This tendon it may be which represents the flexor longus pollicis. Below where the above pollicial tendon is given off from the main tendon of this compound muscle there occurs an aponeurotic expansion. This fascia is fully half an inch broad, and on its inner side joins the index tendon of the sublimis. To the inner side, and passing over the tendon spoken of, is a small tendon which goes to the third digit, joining at the distal end of the metacarpal with the tendon of the flexor sublimis.

Another tendon is given off distally to this; and this one appears pierced by that of the flexor sublimis going to the index. This broad tendon goes to the proximal end of the proximal phalanx of the index.

A third tendon is derived from the aforesaid fascial expansion, which also supplies the index, proceeding, however, to the furthermost distal phalanx. This tendon is joined by the flexor sublimis; and although it has the general aspect of a single broad tendon, in reality it represents the perforatus and perforans, the sublimis being more clearly divergent at the proximal end of the distal phalanx.

Besides this junction with the sublimis, this profundus tendon has a part of the fascial tendon crossing and forming a binding slip; this portion joins the deep, broad, first-mentioned tendon of the index. Still another tendon is sent to the pollex; and this one is inserted into the inner side of the proximal end of the first phalanx.

Action of the deep Flexors.—The intercrossing of the tendons, and more or less union by fascial expansion of the sublimis and the profundus, and the intimate muscular and partly tendinous conjunction of the latter with the longus pollicis, produces a certain simultaneous movement of the whole palmar surface of the manus when the muscular bellies are contracted. This, added to the interdigital fibrous bridges and the extraordinary development of the superficial and deep palmar fascia, gives to this modified fore foot, under certain conditions, that powerful, flat, oar-like movement so capable of impelling the body forwards in a watery medium. It also causes the encased flippers, along with their tendino-fascial expansions, to strike the ground in a clumping manner during progression on land. But the deep and superficial flexor tendons of the manus, here in one plane and not superimposed on one another, have, besides their synchronous action, powers more or less independent of each other; that is to say, the tendinous distribution does not influence each digit alike. First, then, the main tendon of the pollex is considerably stronger than the others, though not equal in size to its opposed enormous extensor on the dorsal surface. Flexion of the phalanges of the thumb on the metacarpal bone is supplemented by the broad and strong tendinous ligament continued on from the deep palmar fascia to the proximal end of the distal phalanx. The extra inner pollicial tendon, which is inserted into the root of the first phalanx, moreover helps to flex the enlarged thumb; and the action of the tendons, besides their bending movement, has somewhat of a pronating character. This latter oblique change of force appears to render assistance to the extensive ligamentous sheet of the palmaris secundus muscle inserted all along the margin of the first metacarpal and phalangeal bone; thus the combined action of the tendons of the flexor longus pollicis with it, doubtless produce that tilting inclination and consequent curvilinear angle or feathering of the flipper when swimming. Secondly, the tendinous slips of the flexor profundus are the chief flexors of the second and third digits, the pollicial division to the second digit in part representing the perforatus. Lastly, the multiple divisions of the sublimis are benders of the fourth and fifth digits, and partially so of the third. The high branching and tangential direction of the tendon to the fifth digit, besides flexion, gives it a slight divaricating power, which may be useful in walking on all fours or for natatory purposes.

No development of a *pronator quadratus* is appreciable, the narrow, but immensely strong, interosseous ligament taking its place as a binding hinge of the radius upon the ulna.

There is a well-developed *flexor brevis minimi digiti* (fig. 23, *F.b.m.d*). Its origin is from the outermost ulnar border of the ligamentous palmar fascia, from the tendon of the flexor carpi ulnaris, and from the pisiform bone; it is inserted by a broad tendon into the distal end and ulnar side of the fifth metacarpal.

Abductor minimi digiti.—What appears to represent this muscle is a short, strongish, broad band of fibres arising from between the fourth and fifth digits and from the deep palmar ligamentous fascia (*Ab.m.d*). It is inserted into the radial side of the fifth digit at the metacarpo-phalangeal articulation.

Lumbricales with muscular bellies are absent; but it is possible that the extra diminutive slips of tendon which are given off from the flexor profundus may be lumbrical remnants.

Interossei.—In the manus of the Sea-lion these muscles are well defined, full-bellied, and fleshy. As in some groups of a higher order (the Lemuridæ for example), besides the ordinary double interosseous muscles to each metacarpal bone, there are two extra superficial ones, which, along with the abductor minimi digiti, may be said to form an upper series of short metacarpal flexors.

Superficial Layer of Interossei. What I shall describe as the first of these is a moderate-sized fusiform muscle (fig. 28, *S.I*[1]). This arises by tendinous fascia, as much as by a defined tendon, from the broad carpo-metacarpal palmar ligament to the ulnar side of the third digit; passing forwards and towards the radial side of the third metatarsal bone, it is inserted by tendon. The second superficial interosseous muscle is of about equal size with the last. It also (*S.I*[2]) is fusiform, and arises by tendon from the same deep palmar fascia or ligament. It, however, crosses the tendon of the first-mentioned muscle; and its direction is the reverse, viz. from the radial towards the ulnar side, being inserted by tendon to the radial side of the fourth.

Deep Layer, or Interossei proper. 1st. The pollex has a single, large and powerful interosseus muscle (1), which lies to the outer (radial) side of the metacarpal bone. It has origin, along with the outermost indicial interossei, from the deep fascia and palmar carpo-metacarpal ligament, and is inserted by a longish strong tendon into the sesamoid cartilage on the radial side of the pollex, at the proximal end of the first phalanx. 2nd. The index has a pair of interosseous muscles (2) of smaller size than the pollicial one. The ulnar one of these two arises along with that described as going to the pollex, and is inserted into the ulnar side of the second digit. The radial one arises, partly tendinous and partly fleshy, from the deep palmar carpo-metacarpal ligament to the radial side of the second digit. It is inserted, by a short but strong tendon, into the radial side of the same digit. 3rd. The third digit is in like manner supplied by a double interosseus muscle (3), one belly to the radial and the other to the ulnar side. 4th. The fourth digit is also provided with a pair of these muscles (4), which, while palmar, are divisible into a radial and ulnar one. They, however, while still fleshy, are shorter than those already described; in this respect they agree with the retrogressive shortening of the metacarpal bones from the first to the fifth digit. 5th. The pair of interossei of the fifth digit (5) are more closely united than the others. They are altogether smaller, and lie more upon the middle and plantar surface of the metacarpal bone. They are both inserted upon the outer side.

7. *Muscles of the Posterior Extremity.* (Plates LXX. & LXXIII.)

In none of the larger Mammalia, not even in the Earless Seals, are the muscles constituting the buttocks so altered in their relations and general appearance, and yet withal so well developed as in the *Otaria* and *Trichechus*. This arises mainly from the curious position which the femur has assumed, and by that banding together, as it were, of the lower legs—the natural position of the hinder extremities, when the animal is walking, reminding one of the position of the frog's legs when flexed preparatory to the act of striking outwards and backwards in swimming.

Gluteus maximus.—This double muscle is insignificant in proportion to the gluteus minimus, which latter not only exceeds it in dimensions, but also occupies the anterior gluteal region, while the biceps covers the gluteus maximus posteriorly (*vide* respectively figs. 15, 34, & 35).

The first part of the gluteus maximus (*G.mx*[1]) arises spinally opposite the head of the femur, but with no direct origin from the ilium, the fibres rather coming from the third dorsal spinous processes or median line of the sacrum. Here the muscle has a breadth of fully two and a half inches, and lies on the surface of the muscular portion of the levator caudæ muscles posterior to the gluteus medius; outwardly it covers the pyriformis &c. Narrowing in the manner of an inverted pyramid, the fibres terminate narrowly in a tendon which is inserted into the peroneal or great trochanter.

The second portion of the gluteus maximus (*G.mx*[2]) (for as such I take the moderate-sized fleshy strip or band which takes origin on the same level, namely above the levatores caudæ and immediately behind the gluteus maximus primus) passes over the gemellus inferior and the insertion of the long, oblique sacro-peroneus and quadratus femoris. It winds round beneath the great trochanter, and is inserted on the outside of the shaft of the femur for more than its upper half, where it mingles superficially with the adductor longus primus, and is in close conjunction with the border of the vastus externus. It is covered entirely by the first portion of the biceps.

Action. The transverse direction of the moderate-sized upper segment of the gluteus maximus rotates the femur inwards and slightly backwards; whilst the attachments of the deeper second portion causes it to be a flexor and rotator outwards of the femur.

The *gluteus medius* (*G.md*), as already mentioned, partly lies superficially and in advance of the gluteus maximus. The muscle is, as usual, fan-shaped, thinnish spinally, but thick and fleshy at its outer border. It has origin from the anterior crest of the ilium, the surface posterior to the lengthened erector spinæ—from the sacral vertebræ for a breadth of over one and a half inch—from the surface of the levator caudæ muscles, in front of the gluteus maximus, where these join the ilium at the posterior lumbar region—and, lastly, from the outer edge of the ilium, wrapping round and ensheathing, as it were, the gluteus minimus. The convergent muscular fibres from these origins are inserted outside the great (or peroneal) trochanter on a level with, but anterior to, those of the gluteus maximus.

This muscle drags forward the trochanter, and helps the gluteus maximus to drag the thigh (femur) outwards.

The *gluteus minimus* (*G.mi*, fig. 35) is short, thick, and very fleshy. It arises from the whole of the outer surface of the ilium, except the ventral margin occupied by the gluteus medius, and is inserted into the upper and anterior part of the great trochanter, being surrounded on three sides by the gluteus medius. Its median border lies in close proximity to the origin of the levatores caudæ superiores.

Use. It acts along with the gluteus medius in protracting the trochanter.

Biceps femoris.—Here enlarged to a remarkable degree, this muscle plays an important part in the peculiar movements of the hind legs. It may, indeed, be said to form the hinder half of the buttocks, which seem as if extended even backwards to the extremity of the lower leg. It is this curious shifting downwards of the insertions of muscles which gives the awkward gait to the hind limbs in land progression, while it adds power, and may be said to produce the long-lever screw-like movement of the after parts in natation.

The biceps more or less continuous as a great dorsal sacro-tibial sheet of coarse muscular fibres, nevertheless indicates consistency of two portions—more, however, from the direction and overlapping of the fibres and points of insertion than in perfect separation into two elements. The united origin is over the caudal muscles and investing fascia of the dorsal region. A strong aponeurosis reaches from the third sacral spinous process to about the fifth caudal one; and from this the coarse fleshy fasciculi trend outwards, and terminate in a strong fascia, which reaches from the knee-joint to the ankle. The thicker fibres of the anterior and somewhat smaller half ($B.f^1$, figs. 15 & 34) have a slight curve forwards and outwards, and are inserted by a strong, short tendon into the tuberosity of the outer condyle, close to the lower end of the shaft, and upwards from this along the outer line of the bone to near the great trochanter. Below the condyle the muscle is firmly fixed over the outer aspect of the knee-joint and tibio-fibular region downwards for its upper third.

The so-named second, slightly larger portion of the biceps ($Bi.f^2$) stretches over five caudal vertebræ or thereabouts, the anterior border (median border) partially overlapping the first portion of the biceps, the posterior border again overlapping the levator ani. As it comes towards the latter the caudal origin changes from the dorsal to the lateral surface of the vertebræ, continuous fascia, however, still overlapping the levatores caudæ tendons. The attachment and insertion by aponeurotic fascia is along the lower and outer two thirds of the tibia, the fascia slanting below and being fixed into the fibular malleolus, where it joins the levator ani.

Relations and Action. Both portions of the biceps partly cover the superior caudal muscles and tendons. The anterior half lies next the gluteus maximus, and overlies what appears to be the second portion of it. It is also superficial to the quadratus femoris, ischiatic nerves and vessels, and another abnormal deep obliquely set leg-muscle, the sacro-peronæus. It crosses the outer head of the gastrocnemius, peronæi, and is in close relation with the vastus externus. The hinder half covers the remainder of the sacro-peronæus and those of the calf; it is also in relation with the semimembranosus, a muscle here also peculiar in its relations. Functionally it is an adductor of the lower leg, flexor of the knee, and rotator outwards of the limb.

The remarkable muscle which I term *sacro-peronæus* (*Sp*, figs. 34 & 35), is a thickish, flat, nearly uniformly broad band of fleshy fibres, which arises from the outside of the caudal muscles at the hinder end of the sacrum, occupying the surface of the superior and inferior layers and transverse process for about a couple of inches, and also in part springing from the sacro-ischiatic ligament. Folding outwards from its origin, it covers the ischiatic vessels and nerves, and glides over the hinder upper edge of the ischial tuberosity and origin of adductor magnus. Proceeding thence outwards and downwards, under cover of the biceps and levator ani, and itself lying upon the gastrocnemius, it is inserted by a short broad tendon into the deep fascia above and inwards to the fibular malleolus. This fascia is common with that of the biceps and levator ani.

Action. A powerful flexor of the leg to the tail; and it may be a rotator outwards.

Levator ani.—Behind the preceding is another broad muscular band reaching from the tail to the lower leg, and in close relation with it above the ankle-joint. This muscle appears to be homologous with the levator ani, although its insertion differs widely from that of the higher Mammalia. The two muscles of opposite sides are intimately blended together mesially, and are muscularly fixed to the inferior aspect of the tail for the breadth of an inch or more opposite or underneath the fourth or fifth caudal vertebra. They run outwards and backwards, and are each inserted firmly by a very short tendon into the outer fibular malleolus.

Relation. Mesially the tail, infracaudal muscles and tendons; the anus; the testicles, when these are thrown down into the ischio-rectal fossa; the sacro-peronæus muscle as already mentioned. The biceps, the posterior border portion, partly overrides its anterior border. It binds inwards the peronæi above the ankle.

Action. Adductor of lower leg, and rotator outwards of the limb. Besides restraining the lower limbs towards each other, the muscles of opposite moieties drag the tail from side to side.

Transversus perinæi.—A sparse layer of fibres is situate in the perinæum (*T.p*), and, lying in front of the anus, crosses from the ischio-rectal fossa on the one side to that on the other. It helps to render the said fascia tense, and may also assist in pressure against the rectum during expulsion of the fæces &c.

The somewhat triangular-shaped and flat *pyriformis* (*Py*, fig. 35) muscle has an origin between the ilium and the sacral vertebræ in front of the acetabulum for an inch or more; passing outwards and slightly backwards, it is inserted fleshy in the upper and outer side of the great trochanter behind the gluteus minimus. It rotates the head of the femur forwards and inwards.

Gemellus superior.—This is not quite so broad as the pyriformis; it also is pyramidal, its broader end arising from the deep surface of the median sacral vertebræ, opposite the hip-joint. It runs nearly directly outwards (*G.s*), and is inserted by a short, strong tendon into the summit of the great trochanter. This and the gemellus inferior so closely fuse themselves with the tendon of the obturator internus that force has to be used in defining the limits of each.

The *gemellus inferior* (*G.i*) is rather the broader of the two; it arises from the edge of the ischium, behind the lesser ischiatic notch and for a breadth of above an inch. Directed forwards in company with the obturator internus, the two are inserted together between the greater and lesser trochanters. The surface of this muscle is superficially tendinous at its origin.

Obturator externus.—This covers the obturator membrane exteriorly, a few fibres overlapping it anteriorly. It is rather a thick fleshy muscle (*O.e*), its tendon passing upwards and forwards to be inserted into the crown of the lesser trochanter. It drags the head of the femur backwards, and steadies that bone in walking-movements.

The *obturator internus* (*O.i*) deeply covers entirely the obturator membrane; and partly muscular and partly tendinous, but greatly flattened, it passes round the ischiatic notch and mingles with the gemelli; although intermingled closely with these, it has a strong tendon, which is inserted as aforesaid.

The three above-mentioned muscles act more or less together, and drag the upper end of the femur through the great trochanter upwards and inwards, thus serving as outward rotators of the upper leg.

Quadratus femoris.—Elongated and narrow. It has a fleshy origin from the ischium, just behind the gemellus inferior and to the outer side of the bone. It slants forwards and downwards (*Q.f*), crossing the anterior portion of the obturator externus, and is inserted by a short but strong tendon on the outer side of the lesser trochanter, beneath the aforesaid muscle.

Action. A rotator outwards and backwards of the femur.

The *tibialis anticus* (fig. 15, *T.a*) arises from the front and upper half of the tibia. It forms a considerable-sized muscular belly as large as that of the extensor communis digitorum. Its tendon commences above the binding ligament, then runs underneath it, and below divides into two, whereof one tendon ($T.a^1$), is inserted into the ento-cuneiform bone, widening into an aponeurosis; the other ($T.a^2$) goes on to the dorsal surface of the proximal end of the metatarsal bone of the hallux.

The *extensor proprius hallucis* (*E.p.h*) is a muscle of more than usual volume. It arises from the upper two thirds of the fibula and the interosseous membrane. Its rather strong distal tendon passes to the proximal end of the proximal phalanx of the hallux, there spreading out in fascia.

Extensor longus digitorum.—This muscle arises from the external condyle and the outer surface of the fibula, and continues muscular (*E.l.d*) to the ankle. It here forms a broad, flat, and strong tendon (*E.l.d**), which rather increases in breadth to below the tarsal bones, where it divides into four tendons, which supply the four outer digits. That to the second digit is given off highest; the three others divaricate about one level. The four tendons are inserted, like those of the manus, into the proximal end of the second phalanges, where they each broaden out and form a strong aponeurotic sheath.

The *extensor brevis digitorum* is composed of two widely separated lips. The first or innermost portion has origin from the dorsal surface of the astragalus and cuboid bones, and forms a long delicate tendon at the proximal end of the metatarsus; this goes to be inserted on the outer side of the proximal end of the distal phalanx of the second or inner digit. The second or outermost slip of the extensor brevis of the foot ($E.b.d^2$) has a double head of origin; the longer one arises from the outer surface of the astragalus, and afterwards joins the second head of origin, which comes from the cuboid. The two heads form one belly, which gives off a single tendon, ultimately inserted into the outer side of the third digit.

The *peronæus longus* (*P.l*, fig. 15) is of good size. It arises by a short, broad tendon from the external condyle of the femur, and then forms a considerable belly, which reaches downwards for about two thirds of the length of the limb. Its inferior long and strong tendon passes behind the outer malleolus in a separate groove, and beneath the posterior and outer border of the biceps, and, as it goes behind the outer prominence of the cuboid, proceeds to the plantar surface, to the head of the metatarsal of the hallux, but joins by fascia to that of the fourth.

The *peronæus brevis* (*P.b*) and the peroneal muscle next to be described arise together, the whole length of the fibula, upon the outer and posterior surface; the tendon of the former is inserted into the proximal end of the fifth metacarpal bone.

Peronæus quinti digiti.—As already mentioned, this muscle arises in very close union with the peronæus brevis; but it lies above and higher than it, having an origin from the upper third of the fibula. The tendon of the peronæus quinti digiti lies the more superficial of the two, and on the outer side of the dorsum of the foot. It continues strong to its insertion (*P.5.d*), which is on the outer side of the proximal end of the proximal phalanx of the outer or fifth digit, where it finally becomes very wide.

Both the *peronæus tertii* and the *peronæus quarti digiti* are absent.

Pectineus.—A short, moderate-sized muscle, nearly transverse to the long axis of the body (*Pe*, figs. 33, 36), and cutting the angle formed by the femur and lower leg. It arises by a broad, short, strong tendon from the brim of the pelvis, immediately behind the prominence where the psoas is inserted, and, passing outwards and forwards, is fixed into the upper part of the tuberosity of the internal condyle of the femur.

Use. This muscle, with others, restrains the movements of the leg by its remarkably low attachment to the femur. It acts also as an inward flexor—for instance, when the knees approach.

The *rectus femoris* (*R.f*) is shorter and only a little thicker than the combined tensor vaginæ femoris and sartorius; it is in great part covered by the latter muscle. It possesses only one head of origin; this is fleshy, and arises from the lower half of the hollow between the acetabulum and the spinous process of the ilium. The muscular belly broadens considerably, and is inserted into the upper part of the patella. It is a flexor of the thigh.

The *vastus internus* (*V.i*) is small. It arises the whole length of the inner side of the shaft of the short femur, and is inserted into the inner side of the patella and partly into the capsule of the knee-joint.

The *vastus externus* (*V.e*, fig. 34) is a powerful and strong, though necessarily short muscle. It covers the vastus internus in part, and is attached to the whole anterior surface of the femur, from the neck of the bone and the great trochanter to the ligament of the knee-joint, being inserted as usual into the upper portion of the patella.

If a *crureus* is present, it is so intimately united with the vastus externus as to be inseparable.

Gracilis.—This is represented by a very broad, somewhat triangular-shaped, and but moderately thick plane of fleshy fibres. This, from low insertion and peculiar shape, can scarcely be recognized as the homologue of the gracilis of human anatomy, which nevertheless it undoubtedly is. The origin, which is the narrower end, has a double layer of fibres. The most superficial of these arises along the whole line of the symphysis pubis. A few of the fibres overlapping those of the external oblique, the deeper layer runs partly along the brim of the pelvis, and appears as rather dipping beneath the obliquus externus. The fibres from both these layers of origin take nearly a similar direction (namely, outwards and backwards), and, as they fuse together, form a broad sheet, which is inserted into the inner margin of the lower three fourths of the tibia. At the lower extremity it joins the semimembranosus, the two (but chiefly the gracilis) forming a strong aponeurosis, which is inserted into the plantar fascia, much as does the palmar fascia in the manus.

Action. It restrains the lower leg towards the pelvis, and in walking rotates the tibia inwards.

The Femoral Adductores.—According to my dissection there are altogether six of these. Of the adductor magnus primus there can hardly be doubts regarding its interpretation, although the origin and insertion are slightly altered from their ordinary condition. The passage of the femoral vessels and nerves determines its homology, which the increased numbers of the adductores might otherwise render uncertain. The muscle (*Ad.m*^{1}, fig. 33) is of large size, and almost entirely fleshy. As seen when the thigh-parts are in position, it is partly hidden by the origin of the broad and unusually placed gracilis, and the insertion is in part overlain by that of the adductor magnus secundus. It arises from the outside of the ischium, posterior to the obturator foramen. Directed upwards and outwards, with fibres of a prismatic form, the muscle is inserted broadly upon the inner side of the lower half of the shaft of the femur, upon the internal condyle and upon the upper front of the tibia for a couple of inches. The vessels of the thigh pierce the flesh at its upper border, a pencil of fibres dividing and allowing passage to the vessels.

Adductor magnus secundus. This (*Ad.m*^{2}) is smaller than the preceding, and, except in degree, has quite the same action as the foregoing. As already mentioned, it partly covers it. It arises from the outside of the pubes, anterior and superficial to the last. Insertion the outer condyle, fibres covering or running into the ligament of the knee-joint.

Adductor longus primus. If this is really a separate muscle from what is termed the adductor longus secundus, it is only divisible on account of the rather different place of insertion from the latter. It arises by a broad, short, thin, flattened tendon from the outer side of the brim of the pelvis, close to the crest and spinous process (*Ad.l*[1], figs. 36 & 35). Proceeding outwards and upwards, the muscle is inserted into the middle of the shaft of the femur for the breadth of an inch along the linea aspera. The deep vessels of the thigh wind round the lower bodies of the insertion as they dip between the fibres of the adductor magnus.

Adductor longus secundus. A larger muscle (*Ad.l*[2]), lying on the same plane as the preceding, the fibres being deeply compressed as they cross from the pelvis to the thigh. They arise from around the obturator foramem and on the bone between that and the symphysial crest, deeper, however, than the last muscle. The muscular insertion extends from the great trochanter to the middle of the femur, covering all the bone behind. The adductor longus secundus is in relation with the small adductores, the great adductores, deeply with the obturator externus, quadratus femoris, and the extra slip of the gluteus maximus.

Action. The two magni bring the femur and tibia towards the pelvis. The adductor longus primus is an adductor and rotator inwards of the thigh. The adductor longus secundus is an adductor and rotator outwards, the latter because the insertion is far behind.

Adductor brevis primus. A short, fleshy muscle arising from the outer side of the pectineal eminence, anterior to but beneath the pectineus muscle (*Ad.b*[1]). The adductor brevis primus rolls fleshy round the hip-joint, and is inserted into the femur, below the neck and trochanteric fossa.

Adductor brevis secundus (*Ad.b*[2]). Arises posterior to the pectineal eminence and muscle, and closely adjoining the obturator externus. The direction of the fibres is at a slight angle to those of the primus; and they are inserted fleshy into the back of the femur, between the linea aspera and the trochanter.

Use. These two adductors of the thigh rotate outwards the head of the femur.

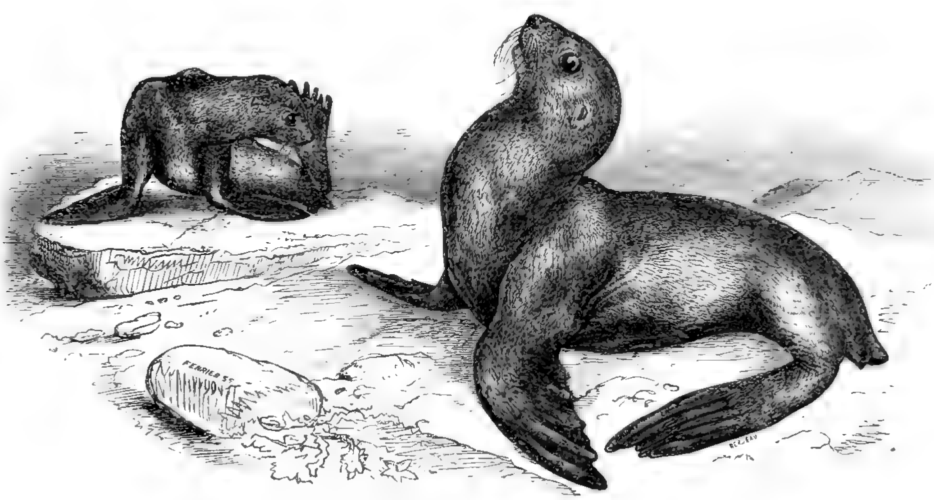
Semitendinosus.—A muscle which I take to be the semitendinosus, because of its insertion corresponding to what is ordinarily regarded as such, arises as a broad strip from the outer border of the ischium, and, passing almost straight across to the tibia as a muscular band, is inserted by membrane into the middle of that bone (*St*, fig. 33).

The relations of the semitendinosus are:—at its origin, the adductor magnus primus; behind or deeply, the ischiatic nerves and arteries and enlarged lymphatic gland; the gastrocnemius and popliteus; whilst it lies across the sacro-peronæus muscle, which is posterior to it, but in close relation at its insertion. Lastly, the great broad gracilis lies over and hides the semitendinosus when the parts are undisturbed. This is an adductor of the lower leg towards the pelvis, and consequently rotator inwards.

Semimembranosus.—It is a great, flat, thinnish, fleshy expanse (*Sm*, figs. 33, 34, & 36), which, like the semitendinosus, crosses the abnormally placed groins to the lower leg. It arises by a short broad aponeurotic origin from below the transverse processes of the first four caudal vertebræ; and the muscular expanse, directed transversely and slightly backwards, is attached by membrane to the inner edge of the tibia from its middle (posterior to the semitendinosus) to the malleolus, where its tendon mingles with that of the gracilis, the two proceeding to the sole of the foot. This muscle is somewhat narrowed at its middle, and is much broader at its insertion than at its origin.

Relations &c. The sacro- and ilio-coccygeus lie beneath it, at the tail; and continued behind is the (transverse) levator ani. It partly hides the lymphatic gland and the deep ischiatic vessels, &c. It crosses the gastrocnemius and long flexors of the foot above the ankle, and itself is covered by the gracilis. The broad biceps, and additional belly of the same, are situated behind or dorsally. Adductor and rotator inwards of the lower leg; or, when the leg is fixed, it drags the tail to the side.

Fig. 4.



Additional attitudes at times assumed by the Sea-lion. From life.

There is only a single broad inner head to the *gastrocnemius* muscle (figs. 34, 36, & 37, *Ga*). Its attachment is the inner condyle of the femur, its lower border, by a broad flat semitendinous origin, also the inner side of the head of the tibia and over the internal lateral ligament of the knee-joint. The muscular belly is broad, and only moderately thick, and, as it pursues its course downwards, lies obliquely upon the inside of the leg, instead of posteriorly, as is usual when it is double-headed. It is fleshy to within a couple of inches from the heel, and ends in a strong flattish tendon inserted into the os calcis, running partly over it, and apparently continuing or giving rise to the extensor brevis digitorum.

Action. The broad single femoral origin of this muscle and its comparative obliquity of belly have a remarkable influence on its use. Thus it drags the os calcis inwards, and in so doing prepares the foot (semitwisted) to be thrown forwards, the inner margin being partly raised, so that the long hallux does not catch the ground until the after part of the foot has first touched it. While this takes place, the long extensor muscles are tense.

Popliteus.—Proportionally this is a very large muscle. It arises from the outer condyle of the femur, but chiefly from the capsular ligament of the knee-joint by a short aponeurotic tendon. Becoming fleshy and of considerable breadth, it rolls round behind the head of the tibia, and is inserted into the inner edge of the upper half of that bone. The popliteus passes above the head of the fibula, and not crossing over it. Its fibres reach no further than the internal lateral ligament of the knee-joint (*Po*, fig. 37), which latter passes downwards and over it about the central line of the tibia.

Action. A powerful rotator of the tibia inwards. The tendon of origin of the popliteus greatly strengthens the posterior ligament of the knee-joint, which is weak outside.

The *soleus* (*So*) is represented by a large, fleshy, broad, thick, longitudinally triangular and flattened muscle. It is attached the whole length of the fibula and into the os calcis, which is drawn towards the fibula. The upper half of the soleus arises from the fibula by a very strong aponeurotic fascia, which becomes fleshy and gradually thickens towards the free edge of the muscle, the fibres being directed downwards and backwards. At the lower end the muscle is wonderfully enlarged and leaves no space between the fibula and the os calcis. The tendinous superficies of the insertion of the soleus is outwards, the inner fleshy insertion reaching well round the inner side of the os calcis. A bursa exists at the extremity of the os calcis. A slip of this muscle takes origin from the outer condyle of the femur along with the popliteus muscle.

Action. The soleus must exert considerable influence on the rotation of the foot inwards, as from its high origin outwardly and muscular belly rolling round inwardly, attached to the entire end of the os calcis, a lever of great power is obtained.

The *tibialis posticus* (*T.p*, figs. 36 & 38) is of moderate size. It arises fleshy from the upper half of the interosseous interspace and membrane, and from the neighbouring parts of the tibia and lower three fourths of the fibula, and it partly passes between the bones in front and to the outer side of the tibia. Passing obliquely inwards and downwards, it becomes tendinous only at the inner malleolus, where it glides through the innermost groove behind the malleolus; the tendon continues on the inner edge of the sole, to be inserted into the scaphoid bone. A powerful abductor inwards of the foot.

The *plantaris* (*Pla*) is of considerable dimensions. Its fleshy origin is the outer condyle of the femur, along with the popliteus. It forms a muscular belly fully half as large as that of the gastrocnemius, and equally thick. This lies upon the soleus, and is partially covered by the belly of the gastrocnemius, its position being towards the inner and posterior aspect of the limb. About an inch above the ankle-joint a strong tendon is given off; this passes in a groove on the inner side of the os calcis, and as it reaches the sole of the foot it is covered and intimately united with the superficial plantar fascia.

At the distal end of the calcaneum the tendon enlarges and thickens, and muscular fibres are found on its deep surface; these may represent the *flexor brevis digitorum* (*F.b.d*, fig. 36). From these muscular fibres four tendons are derived. The first, highest and innermost tendon goes to the second digit, forming the perforated tendon of that digit; the second proceeds to the third digit, the third to the fourth digit, and the fourth to the fifth digit. The insertions of these perforated tendons are the distal ends of the second phalanges; they do not split, as is commonly the case, to permit the perforans to go onwards, but they form a strong tunnel or tube of fascia for about an inch and a half, in which the perforans is enclosed.

The plantaris, through the elongation of the flexor brevis digitorum, is a direct flexor of the four outer digits; and it appears to be this muscle which bends the digits when the animal scratches its body, shown in woodcut No. 3, upper middle figure, and in woodcut No. 4. It also draws the toes together, when overlapping takes place (see Pl. LXVII. fig. 3).

Lumbricales.—These are very large and numerous. They arise altogether broadly from the plantar surface of the united plantar fascial expansion of the long flexors (fig. 37, L^1 to L^6). Separate, long fusiform muscular bellies, ending in tendons, are given off to each of the digits; but there is an additional muscle to the little toe; hence there are six lumbricales altogether.

The first is given off highest, from between the long flexor tendons of the hallux and second digit; it is inserted into the peroneal side of the first phalanx of the great toe. The second arises between the long flexor tendons of the second and third digits; this one ends in the perforated tendon of the second digit derived from the plantaris. The third and fourth arise together, very fleshy, superficial to the third and fourth long flexor tendons; and their fleshy bellies seem to run into or join the (tunnel-like) perforated tendons of the third and fourth digits supplied by the plantaris. The fifth lumbricalis springs from the peroneal side of the fourth lumbricalis, and is inserted into the tibial side of the proximal end of the first phalanx of the fifth digit. The sixth lumbrical muscle is derived from the outermost tendon of the flexor longus digitorum. It is inserted along with the fifth lumbricalis.

Flexor longus digitorum.—The fleshy belly of this muscle is of moderate thickness, and about equal in bulk to that of the flexor longus hallucis, this last partially covering it (figs. 36, 37, *F.l.d*). It lies in the deepish hollow between the tibia and fibula, and arises from the lower two thirds of the shaft of the fibula and the lowermost third of the tibia and the intervening interosseous membrane. From the muscular belly a strong flattish tendon is derived just at the ankle-joint; this runs in the groove between the os calcis and the scaphoid, and continues to the distal border of the tarsus, where it forms a broad, strong ligamentous union with the flexor longus hallucis. From the superficial surface of this broad aponeurotic fascia the lumbricales are given off. The flexor longus digitorum appears to give tendons to the four outermost digits; of these that to the second, third, and fourth digits is strengthened by tendinous fibres from the flexor longus hallucis; together they form the perforans.

The *flexor longus hallucis* (*F.l.h*) arises from the head and upper fourth of the shaft of the fibula. Its fleshy belly, as already said, crosses the flexor longus digitorum, and is itself partly covered above by the single gastrocnemius. Its tendon, which commences above the malleolus, runs in the outermost groove of the two, behind the tibial malleolus, and, on the plantar surface of the pes, joins, as aforesaid, the flexor longus digitorum. A strong tendon pursues its course to the hallux, being inserted into the distal phalanx by an expanse of aponeurotic fascia. But besides this the flexor longus hallucis, as already mentioned, sends tendinous slips, which unite with those of the flexor longus digitorum, supplying the second, third, and fourth digits.

Interossei of Hind Foot.—These exist only on the plantar surface of the pes, and are true flexores breves; they are but partially seen on the dorsal surface, and even there only when the strong fascia between the metacarpal bones has been removed. There is a superficial and a deep layer, perfectly distinct from each other as in the manus.

Superficial Layer. This, one continuous broad flat expanse of fleshy fibres, somewhat semilunar or crescentic in shape, stretches from the hallux to the fifth digit. It arises from the deep plantar fascia at the proximal ends of the metacarpals; and its semilunar anterior free border reaches to about the middle of the metacarpal bones of the second, third, and fourth digits (see fig. 38, dotted line).

One horn of the crescent, the larger and thicker of the two, proceeds to the hallux, partly joining, or lying on the outer side of, the interosseus muscle of the hallux, and, running on with it in the form of a tendon, inserted into the distal end of first metacarpal ($S.i^1$). The second, outer horn or belly (Sc^2) goes to the inner side of the fifth digit, and terminates fleshy at the distal extremity of the fifth metacarpal; but strong interarticular fascia is continued over the joint to the proximal end of the first phalanx.

Use. These approximate the metacarpal bones, and are also short flexors.

Deep Layer. This consists of one single and four double muscles. 1st. The single interosseus muscle (1) supplying the hallux has the largest belly and is the longest of the deep interossei. It arises by tendon from the internal cuneiform bone, and is inserted into the fascia covering the metacarpo-phalangeal joint of the hallux. 2nd. The second, deep and double, interosseus muscle (2) arises from the proximal ends of the first and second metacarpals. The smaller moiety of this muscle, that next the hallux, has also a partial origin or attachment to the superficial layer of interosseous fibres and hallucial metacarpal. Insertion by tendon and fascia into the sesamoid cartilage at the metatarso-phalangeal joint. 3rd, 4th, and 5th. Double interossei

(3, 4, 5) arise from the proximal ends of their respective metatarsals, and are inserted into the distal ends and sesamoid cartilages. Although each is double, the muscular fibres run well together.

These altogether act as short flexors and also as abductors of the metatarsals, because each muscle in part has origin from the metatarsal outside of it.

Two anomalous small deep plantar muscles exist; these may, indeed, represent the adductor and flexor brevis hallucis muscles of the great toe, which otherwise are absent.

The first and more superficial of the two (*Ad.h*, fig. 39) has origin from the plantar surface and fibular side of the scaphoid and from the strong fascia covering that bone. Its tendon of origin, which is flat and broad, extends to near the middle of the internal cuneiform, where it becomes fleshy, but quickly becomes tendinous again, and is inserted into the outer border of the proximal end of the first metatarsal bone.

The second of the muscles in question (*F.b.h*) is shorter, lies deeper and to the fibular side of the first mentioned. It is chiefly composed of fleshy fibres, which arise from the scaphoid bone and from the ligamentous union between the external cuneiform and the scaphoid bones. The flat muscular belly derived therefrom lies upon and is inserted into the hollow on the peroneal border of the internal cuneiform.

The two muscles just spoken of are not visible until the deep plantar fascia and the superficial crescentic lumbrical muscular expansion have been removed. In their action both are flexors:—the second, deeper one, of the internal cuneiform upon the scaphoid; and the first or superficial one a flexor and adductor of the first metatarsal bone.

The flexor brevis minimi digiti.—As stated below, this muscle lies partly between the distal separate portions of the abductor minimi digiti, and is superficial to the inner one of these. Its condition is different from that of the abductor, inasmuch as it arises by a double tendon and is inserted by a single one. The inner origin (fig. 38, *F.b.m.d*[1]) is a strongish tendon derived from the deep plantar fascia and sheath of the peronæus longus; the outer origin (same fig. and letters, line marked 2) is by a long narrow tendon, which comes from the middle of the fleshy substance of the abductor muscle; but the tendinous fibre can be traced backwards almost to the os calcis. These outer and inner tendons embrace the inner portion of the abductor minimi digiti, and, joining upon its surface, give rise to a moderate-sized long fusiform belly, which is inserted by a short, strong tendon, in conjunction with the second portion of the abductor minimi digiti, into the metacarpo-phalangeal fascia at the distal end of the fifth metacarpal; this fascia contains two small sesamoid cartilages, and is continued to the proximal end of the first phalanx of the fifth digit.

Abductor minimi digiti.—This is by far the largest muscle in the sole of the foot, and functionally is equally important, especially when regarded in connexion with the remarkable and very ungainly movements of the pes.

The muscle in question (*Ab.m.d*) arises fleshy and also superficially by aponeurosis from the plantar surface of the os calcis, its origin almost seeming a continuation of the tendon of the gastrocnemius. Its thick fusiform belly fills the interval between the os calcis and the fifth metacarpal, ending, however, in a double belly and insertion. One of these, the shortest and thickest, ends in the proximal end of the fifth metacarpal bone; the outer and longer belly continues to the distal end of the same metacarpal, and to the proximal extremity of the first phalanx of the fifth digit, being inserted there by tendon along with the flexor brevis digitorum. Between the two bellies and points of insertion of the abductor minimi digiti the flexor brevis digitorum lies.

The shortest of these muscles or bellies may represent Huxley's *abductor ossis metacarpi quinti* (*Ab.o.m.*5)?

IV. Ligamentous System.

1. *Spino-cranial Connexions.*

The articulations of the head and trunk manifest considerable likeness to those of other Carnivores, their chief difference being laxity and fulness. This, of course, admits of great mobility of the parts; and hence in those wonderful movements and attitudes the bones glide one on the other in a manner not even equalled in the manifold contortions of the human acrobat. The peculiar softness and thickness of the intervertebral cartilages moreover conduce to spinal flexions of an unrivalled character, so varied and so graceful are they. The head sits upon the atlas very loosely indeed; and therefore twisting of the head in almost every direction occurs with ease. In the diagram (fig. 42, Pl. LXXIII.) I have shown in profile the posterior occipito-atlantal ligament (*p.o.a*), which has a moderate development in thickness. It and the anterior occipito-atlantal ligament are considerably strengthened, however, by a triangular, oblique, and strong accessory band (*ac*), which stretches from the vertebral lamina to the basioccipital bone.

2. *Articulations of the Fore Limb.* (Plate LXXII.)

Shoulder-joint.—The capsular ligament of the shoulder-joint is of moderate strength, and has the usual mammalian attachments—namely, between the scapula and humerus. The coraco-humeral ligament is barely distinguishable from the capsular, excepting in a slight increase of thickness in the ligamentous substance of that part.

Scapular Ligaments.—The ordinary coraco-acromial ligament of the scapula is absent. The acromio-glenoid ligament is short and narrow but strong. It passes between the diminutive coracoid process and the outer side and middle of the neck of the scapula. It forms a small foramen.

Elbow-joint.—The flattening which the limb undergoes, the radius being placed completely in advance of the ulna, does not in the main greatly affect the distribution, number, or position of the cubital ligaments and those of the wrist-joint, as might at first be supposed from the altered relation of the parts. The change of position, however, has a marked influence on the movements of the bones the one upon the other.

The anterior ligament (fig. 29, *a*) has considerable thickness of fibrous tissue. It descends from the lower portion of the shaft of the humerus just immediately above the joint, and passes to the neck of the radius, but not to the ulna, which in *Otaria* lies behind, and not, as usual, side by side with that bone. The anterior has, however, the ordinary union with the lateral ligaments, notwithstanding the aforesaid displacement of the bones.

The posterior ligament (*p*, figs. 29 & 30) comes rather broadly from the back of the distal end of the humerus, and goes to the base of the olecranon, at which part it is contracted and narrow.

The external lateral ligament is of considerable strength (*e.l*, fig. 29). It passes from the external condyle to the outside of the neck of the radius. Although narrow, it is nevertheless, as said, a very strong tendinous band.

The internal lateral ligament (*i.l*, fig. 30) is much broader than the external lateral ligament, and is also very strong. It passes between the internal condyle and the inner, anterior, border of the ulna. It is also partly derived from the olecranon process, while below its fibres reach almost as far as the middle of the shaft of the ulna.

Radio-ulnar ligaments.—The orbicular (*orb*, fig. 29) is very strong indeed where it joins the external lateral ligament. At this part it has the form of a broad band of glistening fibres. Its attachments are the lesser sigmoid cavity and the anterior neck of the ulna generally.

The interosseous ligamentous union is not a wide, thin, aponeurotic membrane, as more ordinarily it is found to be, but here in the Sea-lion it is represented only by a narrow, nearly transverse, band of uncommonly strong and thick tendinous fibres. This band (*i*, figs. 29 & 30) passes between the shafts of the radius and the ulna about their middle, hinging, as it were, the one bone upon the other.

Movements. The position of the bones of the elbow-joint are such that the articulating surface of the humerus rests entirely upon the radius and very little on the ulna. The inner capitulum of the radius, furthermore, is flatly rounded, and so fits into the concave trochlea of the humerus that the two have very perfect freedom of rotation, the head of the radius thus being permitted to twist almost completely round its long axis. To this freedom of motion the force of stroke and feathering action of the forearm are mostly due. The ligamentous surface of the olecranon supports the humerus behind; and this surface presents a very shallow sigmoid notch, so that much side play to the ulna accrues. The coronoid process is unusually and relatively very small. It is so grooved outside that great freedom of motion is given to the head of the radius. The position of the ulna to the radius, and the looseness of the ligamentous articulation and ginglymoid nature of the interosseous band, allow the radius to be either alongside the ulna or quite anterior to it. The muscles, by thus being swerved round in conjunction with the altered positions of the bone, acquire additional force and power by their extra pulley.

Deep Palmar Fascia.—Beneath the long flexor tendons of the palm a broad expanse of strong ligamentous fascia exists, which affords a powerful support to and renders tense the otherwise loosely connected and mobile carpal and metacarpal bones. This remarkably firm aponeurosis, though more or less interlaced into a single broad sheet, may nevertheless, for convenience' sake and mode of action, be described as two planes of fibro-ligamentous tissue. 1. The longest and thickest band ($D.p.f^1$, fig. 31) appears as a continuation of the flexor carpi radialis, and arises as a semilune from the lower end of the ulna. Widening the breadth of the first and second metacarpal bones, it runs onwards and lengthwise to their distal extremities, where, inserted into the two sesamoid bones of the respective digits, it merges into the palmar and lateral ligaments which brace together the distal articular end of the metacarpal and proximal end of the first phalangeal bone. 2. The shorter and thinner aponeurotic ligament ($D.p.f^2$) is partly continuous with the first, but placed rather underneath. Besides attachment and continuity with the wrist-joint, it likewise arises by a firm attachment from the carpal bones, and, spreading more transversely than the first band, is fixed to the surface of the ligaments of the carpus—processes, however, diverging to the second, third, fourth, and particularly and strongly to the proximal end of the fifth metacarpal bone.

Use. As mentioned, the entire ligament is a steadier and bracer of the carpus. It likewise furnishes origin to the interossei, thus in some respects acting as a flexing agent. The longer pollicial moiety may be considered a powerful agent in flexion through the direct continuity and long leverage of the flexor carpi radialis &c.

Wrist-joint and Carpo-metacarpal Ligaments.—Of the former of these articulations, on the dorsal surface of the wrist the ligamentous substance is considerably interwoven together, and constitutes a wide sheet of glistening fibre of fair thickness, rather than separate well-defined bundles. What properly represents the posterior ligament (*po*, fig. 29) is a broad oblique plane fixed to the end of the radius and scaphoid, and from this stretches across the carpus towards the metacarpal bone of the fifth digit. Another, deeper carpo-metacarpal plane of fibres strikes more directly forwards than the last from the carpal to the metacarpal bones. With a trifid division, but intimately connected the one with the other, it passes to the three middle carpo-metacarpal joints. There is, besides, an oblique segment of this carpo-metacarpal sheet (*c.m*), which runs outwards to the root of the pollicial metacarpal bone. The internal lateral ligament of the wrist (*i.l**) is almost entirely dorsal, bridges the joint betwixt the ulna and posterior ligament, sending fibres to the cuneiform, but hardly any to the pisiform bone. The external lateral ligament (*e.l**) lies partly upon the outer edge of the inferior end of the radius, but is chiefly palmar in situation; it is broader and stronger than its fellow internal ligament. The anterior ligament of the wrist (*an*, fig. 30) is stout and triangular-shaped. The narrow end springs firmly from the radius, above its epiphysis, and with a somewhat oblique direction; the fibres spread fan-shape, sending semidetached portions to the roots of the four inner metacarpals. A similarly shaped deeper plane of ligament, which from attachments may be termed ulno-carpal (*u.c*), rises higher up and from the radial border of the ulna, and, with a fastening to the pisiform, forms a deep sheet attached to the several carpal bones, and intermingles with the so-called anterior carpal ligament. A transverse ligament (*t*), of considerable importance and strength, connects the proximal ends of the metacarpals, a broad band or fork running upwards to the trapezium and binding down the tendon of the flexor carpi radialis. Fasciculi pass between the individual carpal bones and betwixt these and the ulna and radius, severally enclosing synovial sacs, partially intercommunicating, loose and easy-fitting. The ligamentary union of the metacarpals and phalanges presents no feature of importance.

Motions. From the flexibility of the wrist, carpus, and metacarpus, an unusually great freedom of motion ensues, partially restrained, however, by the powerful deep palmar fascia as above described. The posterior ligament mainly influences the exterior margin of the manus, particularly lashing the fifth metacarpal, needful in the forward swing of the member. The anterior ligament similarly acts on this digit, but equally has a firm hold on the fourth, third, and second, so as to cause unison of movement in the acts of pronation, supination, and circumduction. The ulno-carpal plane being set almost crosswise to the last, causes the diagonal of force to run in a line swerving only slightly from the long diameter of the limb, while at the same time the double obliquity of the two ligaments enables a kind of hinge-movement to be performed as the radius and ulna twist upon themselves, which they do to a remarkable extent. The external lateral ligament has a kind of pulley-action as it swerves round the extremity of the radius. Laxity of the component parts of the whole joint is predominant, a condition necessary to the varied movement the manus is capable of.

3. *Articulations of the Pelvis and Hind Limb.* (Plate LXXIII.)

Pelvic Articulations.—The pelvis is firmly and closely united with the sacrum by the sacro-iliac synchondrosis.

Posteriorly a short but strong continuous ligament binds the ilium to the first and second sacral vertebræ. The fibres of this band (*p.s.i*, fig. 43) are placed obliquely forwards and outwards, and pass from the transverse processes to the posterior inferior (superior in this case) spinous process of the ilium.

The opposite moieties of the symphysis pubis are held loosely together by a thick and very strong fibro-cartilage, which extends a short distance upon the brim of the pubis.

There appears to be but one sacro-ischiatic ligament, which is more or less continuous with the deep pelvic fascia, and stretches from the ischium upwards and forwards to the side of the sacrum (*s.i*).

Between the transverse and spinous processes of several of the anterior caudal and last two sacral vertebræ, there are strong ligamentous slips binding the one to the other. Fibres less distinctly pronounced also pass from the articulating processes to the sides of the spines.

Hip-joint.—The head of the femur is set almost horizontally at a right angle to the acetabulum, whereas the axis of the shaft of the bone assumes a perpendicular right angle to that of the pelvis; hence it follows that while the femur has considerable power of rotation, its chief movement is somewhat after the manner of a pendulum on the side of the pelvis. An extra ligament, presently to be spoken of, restrains the motion forwards, while the peculiar attachment of the muscles also limits free action in other respects.

The capsular ligament (*c*) is of considerable strength all round, but more lax inferiorly. Upon the upper or dorsal surface it is very much strengthened by a thick, aponeurotic, triangular-shaped portion, which arises broadly from the dorsal curved margin of the cotyloid cavity, and, running directly outwards, narrows as it is inserted into the anterior inner and upper surface of the great trochanter. Partly united with the above, but yet to some extent sufficiently distinct, is an elongated slip with a posterior concave border, which comes from the ischium just behind the other, and slants forwards and outwards upon the posterior surface of the great trochanter. This latter band (*is.f.*) is evidently the homologue of Macalister's ischio-femoral accessory ligament, described by him as of occasional occurrence in Man[1].

These accessory ligaments form, so to speak, a firm unyielding roof to the head of the femur, so that all chance of dislocation upwards is prevented. The hinder one, when on the stretch, checks or counteracts the force of the multiple short adductors.

There is no distinct ilio-femoral ligament, the capsular fibres being of nearly uniform thickness where the ilio-femoral accessory band ought to be found. The short adductor muscles may supply this want.

No ligamentum teres exists—the head of the bone being covered by a moderately thick, smooth layer of cartilage. A considerable-sized synovial sac fills the triangular-shaped depression at the bottom of the acetabulum, and passes underneath the transverse ligament; this sac supplies the lubricating media of the joint.

The fibro-cartilage constituting the cotyloid ligament is thickest at the upper or dorsal margin of the acetabulum. That portion of it termed the transverse ligament is a strong, narrow, tendinous-like band bridging the oval notch.

Knee-joint.—The so-called ligamentum patellæ (*l.p*, fig. 35), or union between the lower border of the patella and the tibia, is very strong. Within the joint there is a fatty cushion adherent to it, which acts as a soft elastic buffer or pads the roomy joint.

The internal lateral ligament (*i.l*, fig. 37) and external lateral are fully developed.

The semilunar fibro-cartilages correspond in contour to the shape of the articulating surface of the tibia. They resemble those of Man inasmuch as the outer is more

[1] "Notes of Two Undescribed Ligaments of the Human Body," Proc. Roy. Irish Acad. (read 23rd April, 1866), vol. ix. pl. iv. fig. 2.

circular than the inner one, the latter being more elongated from before backwards. They are only moderately thick at the edges, and, as a whole, are comparatively flat and discoid. The popliteus muscle is firmly adherent by tendon to the posterior border of the outer one.

Peroneo-tibial articulations.—There is very little interosseous membrane or ligament present. A thin band, less than an inch broad, is found near the middle of the shafts of the tibia and fibula (i^1, fig. 40); and a narrower, but thicker and stronger, fasciculus exists fully an inch below this (i^2). Both are oblique in direction, the tibial end being highest. The paucity of interosseous ligamentous substance of the lower leg admits of moderately easy movements of the bones towards each other, though this is less than in the forearm.

A strong set of aponeurotic fibres firmly unites the inferior extremities of the tibia and fibula together; these are oblique in direction above, and transverse below, and doubtless represent the anterior inferior, the posterior inferior, and the transverse ligaments of the tibio-peroneal articulations (*i.t.p*, figs. 40 & 41). These allow of a very limited gliding movement between the lower articular surfaces of the tibia and fibula.

Ankle-joint.—The most remarkable feature in this joint, as will further be referred to, is the oblique position and manner of flexion of the articulating bones. Notwithstanding their anomalous position and movement, the ligaments binding the bones are normal in number and attachments, although their precise relative dispositions to each other are somewhat changed.

The anterior ligament (*a*, fig. 40) is of moderate thickness. It extends across from the tibial to the fibular malleolus, and stretches from this downwards to the astragalus, in front of its articulating surface. The anterior ligament is considerably strengthened by a strong accessory ligamentous tendon (*acc*), which crosses obliquely in front of the ankle from within outwards, and, as it passes round the outer articular prominence of the astragalus, spreads out, and is inserted partly into the anterior portions of the astragalus and os calcis.

Internal lateral ligament (*i.l*, figs. 39 & 41).—This is a very strong, thick band of tendon, which is attached superiorly to the tip of the internal malleolus, and from this stretches backwards and downwards to the inner surface of the hinder prominence of the astragalus, but not reaching the os calcis or the scaphoid. It is not of a deltoid form as in Man and the Higher Primates, but is a straight, uniformly powerful band half an inch broad.

Action. When the foot is thrown forwards and inwards, as occurs in this animal's mode of walking, at such times the internal ligament is tense. Again, when the foot is thrust backwards and pronated, as in swimming, the ligament is still kept moderately on the stretch. In all other movements it is in a state of relaxation.

External lateral ligament.—The three fasciculi or slips of which this ligament is usually composed are present. 1. The anterior fasciculus or band is short and strong ($e.l^1$, fig. 40). It passes from the fibular malleolus downwards and forwards to the astragalus, crossing the upper end of the middle fasciculus. 2. The middle fasciculus ($e.l^2$, figs. 40 & 41) is much stronger and longer than the first fasciculus. It arises from the extremity of the fibular malleolus, and passes downwards and backwards to the outer side of the calcaneum, being inserted between the hinder margin of the articulating surface of the joint and the posterior end of the os calcis. 3. The posterior fasciculus of the lateral ligament is intermediate in length between the anterior and middle slips; but it is as strong as the outer middle fasciculus. Its attachments are from the inner border of the fibular malleolus to the inferior hinder edge of the astragalus, being oblique in direction as in the Primates ($e.l^3$, fig. 41).

There is an additional well-marked and separate accessory slip of the posterior fasciculus of the external lateral (*p*, fig. 41). Besides the ordinary thin fascia covering the synovial membrane of the joint posteriorly, the above strong fasciculus may be regarded as a posterior ligament of the ankle. Its fibular attachment is close to the posterior inferior ligament connecting the tibia and fibula together; and, with a direction similar and nearly parallel to that of the third fasciculus of the external lateral, it is inserted into the posterior pit of the astragalus. Its function is like that of the third external lateral fasciculus—namely, an oblique check on the astragalus, preventing its shifting its position inwards, or proceeding too far backwards.

Action. The anterior ligament, while admitting of the ginglymoid or hinge-joint movement of the ankle-joint, is sufficiently lax to allow of the semirotary action which happens when the foot is placed forwards and inwards, or backwards and outwards. The anterior and posterior fasciculi of the external lateral ligament are respectively fixed joints from which the astragalus rotates obliquely upon the tibio-fibular extremities. The middle fasciculus binds the fibula and calcaneum together. Along with the anterior fasciculus the two limit the motion of the astragalus and os calcis upon each other. When the foot is advanced forwards and inwards, the middle band of the lateral ligament checks the progress of the foot, the calcaneum acting as a lever upon the astragalus or fulcrum, being stopped by its becoming tense. In all other movements of the foot its tendinous fibres are relaxed.

Astragalo-calcaneal ligaments.—All four separate portions of ligament connecting the astragalus with the calcaneum may be noted for their strength.

1. The external of these is broad, and passes between the advanced protuberances or heads of the astragalus and calcaneum. This fasciculus is strengthened by superficial fibres. 2. The anterior internal fasciculus is uncommonly broad and strong, and is partly covered by the deep plantar fascia ($a.c^2$, fig. 39). The fibres have an oblique direction downwards and backwards, uniting the heads of the astragalus and calcaneum. 3. The posterior internal fasciculus ($a.c^3$, figs. 39 & 41) is rather narrower than the last, but equally short and strong. It fills the groove between the posterior

extremity of the astragalus and the inner surface of the backwardly projecting os calcis. 4. The middle and deep internal fasciculus of the astragalo-calcaneal articulations lies in front of that designated as no. 3. It differs in direction from the other two internal ligaments, inasmuch as it passes deeply inwards, downwards, and forwards. The attachments are the inner anterior surface of the posterior calcaneal protuberance and the upper surface of the neck of the astragalus (vide $a.c^4$, fig. 39).

Action. These four astragalo-calcaneal ligaments, together with the middle fasciculus of the external lateral ligament of the ankle-joint, harmoniously restrain the gliding movement of the os calcis upon the calcaneum to that of an out and inward oscillation, but somewhat of an excentric kind.

Calcaneo-scaphoid ligaments.—As in Man, two ligaments connect the calcaneum and the scaphoid, although the bones themselves do not come into contact.

1. The dorsal one (fig. 40, $c.s^1$) is broad and aponeurotic, passing from the upper surface of the head of the calcaneum inwards and forwards to the posterior border of the os scaphoides, but with an attachment also to the head of the calcaneum. This ligament is in connexion with the astragalo-scaphoid, and partly covers the accessory portion of the anterior ligament. 2. The plantar ligament (fig. 39, $c.s^2$) is uncommonly strong, indeed, and of great breadth. Posteriorly it is attached to the anterior and inner border of the calcaneum (the sustentaculum tali of writers on human anatomy); broadening as it proceeds forwards and inwards, it is inserted into the entire hinder edge of the scaphoid.

Action. The two ligaments just described, the plantar one of which is continued, as it were, on to the two small muscles situated on the internal cuneiform bone, would seem to carry, through the intervention of the scaphoid, a powerful influence on the steadiness and strength of the foot. It is the case of a long lever, the scaphoid acting as a fulcrum to transmit to the hallux that power of flexion and adduction which is seen every time the foot is thrown forwards in walking, as also in some of the feathering movements of swimming.

The astragalo-scaphoid ligament is bound up with the dorsal calcaneo-scaphoid ligament, as has been mentioned.

Calcaneo-cuboid ligaments.—Three short, but nevertheless strong, bands attach the calcaneum and cuboid in ligamentous union.

1. The superior ligament (figs. 39, 40, $c.c^1$), which is placed partially on the dorsum and partly on the plantar surface of the foot, passes from the anterior outer process of the os calcis to the outer and upper surface of the cuboid. 2. The superficial fasciculus of the plantar ligament (which in Man receives the name of the long plantar ligament) is here only of moderate length, and less than half an inch in breadth ($c.c^2$, fig. 39). Arising from the anterior inferior surface of the calcaneum, the ligament continues forwards and slightly outwards, being inserted into the tuberosity of the cuboid bone. 3. The deep plantar calcaneo-cuboid ligament ($c.c^3$) is quite as strong as the preceding,

and runs almost parallel with it. Its attachments are:—posteriorly, the front and deep surface of the calcaneum; anteriorly, the hinder surface and inner side of the cuboid bone.

Scapho-cuboid ligaments.—Two in number, an internal dorsal (fig. 40, *s.cb'*) and a narrower plantar one. These simply connect the said bones in the manner of a hinge-joint; but the two short deep plantar muscles already spoken of, lying on the peroneal side of the plantar ligament, also flex the cuboid upon the scaphoid.

Deep Plantar Fascia.—Covering or superficial to those ligaments on the sole of the foot above described, is a thick, uncommonly stout layer of plantar fascia (*D.p.f*, fig. 38). It reaches from the heel forwards to opposite the proximal ends of the metatarsals, and there, binding down the tendon of the peronæus longus, fastens itself partly to the bones and deep interossei, and a portion is continuous with the semilunar musculo-tendinous sheet of the superficial interosseous layer.

Use. This fascia, whilst admitting of some amount of yielding by the posterior segment of the sole, also performs the office of a rigid plane to the foot, similar to what is supplied by the deep palmar fascia. There is this difference, however—that its extension forwards to the great toe is less marked than what obtains in the pollex. Hence there is less firmness in the foot's step, especially comparative diminution in rigidity of the two inner toes; and as the interdigital membrane also is looser, the entire pes is far more flexible than is the manus.

DESCRIPTION OF THE PLATES.

PLATE LXVII.

Fig. 1. Upper surface, right fore extremity (manus). Reduced $\frac{1}{3}$ from nature. The numerals correspond to the digits.

Fig. 2. Dorsum of hind flipper (pes) with its digits expanded.

Fig. 3. The same in its contracted condition. Both $\frac{1}{3}$ nat. size.

PLATE LXVIII.

Fig. 4. Palmar aspect of the fore flipper. $\frac{1}{3}$ nat. size.

Fig. 5. Portion of hinder end of the body and the entire left posterior limb seen ventrally: *P*, penis, protruding from sheath; *s*, scrotum, partly hiding *A*, the anus; *T*, tail.

Fig. 6. Reduced sketch of the scrotal sac (*s*) as it bulges when the two limbs are closely approximated.

PLATE LXIX.

Fig. 7. A portion of the body, displaying the pectoral skin-ridges. The chest is seen sideways, right side uppermost: *C*, central sulcus; *Ax*, the shorter axillary plaits and furrows; *R*, right upper, and *L*, left lower surface of the flippers as they lie on the sides of the thorax; *Th*, segment of throat.

Fig. 8. Throat and muzzle, seen from below.

Fig. 9. Right eye and surrounding skin, about nat. size: *a.c*, anterior canthus; *n*, nictitating membrane; *e*, single hair representing the eyebrow.

Fig. 10. Diagrams illustrating the varying shape and diameters of the pupil: 1, vertical triangular form when contracted to the utmost; 2, oval, when moderately distended; 3, circular, when fully expanded. All about nat. size.

Fig. 11. Right ear, when contracted: ad nat.

Fig. 12. Outer surface of the same in repose or relaxed.

Fig. 13. Conchal aspect of the same: pinna, with helical lips (*h*), forcibly everted to show the shallow fossa of the concha (*c*) and its glandular pitting.

Fig. 14. Semidiagrammatic view of the Otary in natural attitude of walking, but with entire skin and subdermal tissues removed to expose cutaneous muscular layer: Pc^1 to Pc^9, portions of panniculus and platysma, and *o.f*, occipito-frontalis, as described in text; *T*, triceps; D^1 & Tz^2, conjoined deltoid (primus) and trapezius (secundus); *P.ma*, pectoralis major; *Bi.f*, biceps femoris.

PLATE LXX.

Fig. 15. Myology of the entire body of *O. jubata*, the panniculus carnosus having been removed.

Head and Neck.

O.p. Orbicularis palpebrarum.
L.l.s.a.n. Levator lab. sup. alæq. nasi &c.
Z. Zygomaticus.
O.o. Orbicularis oris.
Bu. Buccinator.
Ma^1. Masseter (superficial portion).
Te^1., Te^2. Temporalis (two layers).
Di. Digastric.
My.h. Mylo-hyoid.
St.h. Sterno-hyoid.
St.m. Sterno-mastoid.
C.h. Cephalo-humeral.
Sp.cp. Splenius capitis.
S.gl. Submaxillary gland.

Trunk.

Tz^1, Tz^2. Trapezius, first and second portion.
La.d. Latissimus dorsi.
$P.ma^2$. Pectoralis major, second division.
E.o. External oblique.
$P.c^6$. Portion of panniculus.

Pectoral Limb.

D[1]. Deltoid (first portion).
D.ep. Dorsi epitrochlearis.
T[1]., *T*[2]. Triceps (two bellies).
A.e. External anconeus.
S.l. Supinator longus.
S.b. Supinator brevis.
E.c.r.l.&b. Separated tendons of the united-bellied extensor carpi radialis longior and brevior.
E.c.d. Extensor communis digitorum (three tendons).
E.me.d. Extensor medii digiti (two tendons).
E.m.d. Extensor minimi digiti (trifid tendon).
E.p.& i. Extensor pollicis et indicis.
E.o.m.p. Extensor ossis metacarpi pollicis.
E.c.u. Extensor carpi ulnaris.
I^1, I^2, I^3, I^4. Interossei, seen dorsally.
P.l[1]. Palmaris longus primus.
P.l[2]. Palmaris longus secundus.
P.l[3]. Portion of great deep belly of palmaris longus tertius.
Pa.f. Its continuation into palmar fascia.
P.r.t. Pronator radii teres.
F.c.r. Flexor carpi radialis.
F.s.d, *F.s.d**. Flexor sublimis digitorum.
F.p&l.p., *F.p&l.p**. Flexor profundus and longus pollicis.
F.c.u. Flexor carpi ulnaris.
I, *II*, *III*, *IV*, *V*. Digits respectively.

Muscles of the Pelvic Limb.

T.v.f. Tensor vaginæ femoris.
R.f. Rectus femoris.
V.e. Vastus externus.
G.mx. Gluteus maximus.
G.md. Gluteus medius.
Bi.f[1 & 2]. Biceps femoris (1st and 2nd portions).
T.a. Tibialis anticus; and
T.a[1], *T.a*[2]. Subdivision of tendon.
E.p.h. Extensor proprius hallucis.
E.l.d, *E.l.d**. Belly and tendon of the extensor longus digitorum just above where it subdivides.
P.l. Peronæus longus.
P.b. Peronæus brevis (its tendon).
P.5.d. Peronæus quinti digiti.
E.b.d[1]. Extensor brevis digitorum, first division.
E.b.d[2]. Extensor brevis digitorum, second division.
A.b.m.d. Abductor brevis minimi digiti.
A.o.m.[5] Abductor ossis metacarpi quinti.
L.a. Levator ani.
Pla. Plantaris.
T.p. Tibialis posticus.
F.l.h. Flexor longus hallucis.
F.l.d. Flexor longus digitorum.
I, *II*, *III*, *IV*, *V*. The digits.

Fig. 16. The right side of the head in profile, exposing the middle layer of muscles. The contents of the orbit have been removed: *O.o*, orbicularis oris, mandibular fibres, strongest anteriorly; *Bu*, buccinator; *Ma*[2], masseter (2nd layer); *Te*[1], temporal (1st portion); *Te*[2], temporal (2nd portion); *L.sp*, levator superioris, reflected; *L.a.o*, levator anguli oris; *C.n*, compressor naris; *D.n*, depressor nasi; *D.a.n*, depressor alæ nasi; *a.c*, auditory canal; *Io.n*, infraorbital nerves.

Fig. 17. Anterior segment of the same side of the skull, displaying the deepest naso-facial muscles. The dotted line in front marks the limits forwards of the nasal cartilages, which were removed along with the skin; *n*, openings of nares. Letters of cut muscles apply as in preceding fig. 16.

Fig. 18. Transverse and vertical section of the narial cartilages one inch behind the muzzle: *u.l.c*, upper lateral cartilage; *n*, patent narial orifice of left side, remainder closed by spring of lower lateral cartilage; *a*, alar cartilage; *se*, septal cartilage.

Fig. 19. Reduced view of the thoracic surface of the diaphragm after removal from the body: *c*, central tendon; *r*, right alar tendon; *l*, left alar tendon; *v.c*, opening of vena cava ascendens; *œ*, œsophagus; *l.c*, left crus; *pl*, pericardial attachment, cut through; *ao*, aorta; *t*, dotted line indicating the diaphragmatic tendon, which arises from the bodies of the lumbar vertebræ (in the present case it is represented as if turned upwards or forwards).

PLATE LXXI.

Superficial and deep muscular layers of the spine and shoulder.

Fig. 20. Partially dissected segment of body between the cranium and dorsal region.

La.d. Latissimus dorsi (cut across).
S.mg. Serratus magnus.
I.sp. Infraspinatus.
D.ep. Dorsi epitrochlearis.
T[1]. Triceps (first head).
Rh.mi. Rhomboideus minor.
Rh.c. Rhomboideus capitis.
L.a.s. Levator anguli scapulæ.
O.h. Omo-hyoid.
Co. Portion of complexus.
Sp.c. Splenius capitis.
Te[1]. Temporalis (first part).
Di. Digastric.
A.c. Auditory canal.

Fig. 21. Same segment, but with the scapular and superficial muscles removed, and showing the next, deeper or third layer of thoracico-spinal muscles: *Sp.d*, spinalis dorsi; *Lo.d*, longissimus dorsi; *S.l*, sacro-lumbalis, its tendon reaching as far as the first rib; *T.c*, transversalis cervicis tendons; *C.a*, cervicalis ascendens; *S.mg*, serratus magnus, cut short, but exhibiting its costal and cervical attachments; *Sct*, supracostal muscle; *Sca*[1], *Sca*[2], scaleni; *It*, intercostals; *Sp.co*, splenius colli; *Sp.c*, splenius capitis; *St.m*, sterno-mastoid.

Fig. 22. Fourth layer of spinal muscles: *Co*, complexus; *Bi.c*, biventer cervicis; *R.l*, rectus lateralis; *, trachelo-mastoid? *R.a.ma*, recticus anticus major; *Itr*, intertransversalis; *Ro*, rotatores; $\frac{1}{2}$*sp*, semispinalis; *L.ct*, levatores costarum; *Isp*, interspinalis.

Fig. 23. View of the skull from behind, with three whole and part of the fourth cervical vertebra *in situ*, to show attachments of deep, short neck-muscles: *R.p.ma*, rectus capitis posticus major; *R.p.mi*, rectus capitis posticus minor,

of both sides; *O.s*, obliquus superior; *O.i*, obliquus inferior; *, extra short muscle; *R.l*, rectus lateralis; 1, 2, 3, 4, consecutive cervical vertebræ.

PLATE LXXII.

Muscles of the deep ventral aspect of the neck, of the inside of the sternum, of the fore limb, and the interossei. Ligaments of the elbow, wrist-joint, and palmar fascia. Hard palate.

Fig. 24. Deep head, neck, and part of the thorax: *R.a.ma*, rectus capitis anticus major of the right side (it has been removed on the left); *R.a.mi*, rectus capitis anticus minor; *R.l*, rectus lateralis; $L.c^1$, $L.c^2$, longus colli, its two portions; Sca^1, Sca^2, scalenus anticus; *S.ct*, supracostal; *it*, intercostal; *Di*, *Di**, digastric muscle, portion of its belly has been removed on the left side; *Ma*, masseter; *Pt.i*, pterygoideus internus; 2, the axis.

Fig. 25. Sternum and sternal cartilages, seen from within: 1, præsternal segment or manubrium; 8, xipho-sternum; 9, ninth costal cartilage; *It*, portions of intercostalis; *T.s*, triangularis sterni.

Fig. 26. Dissection of left pectoral limb, bringing into view the inner scapular and deep flexor muscles of the manus:—*S*, subscapularis; *C.h*, cephalo-humeral; *S.sp*, supraspinatus; *T.ma*, teres major; *T.mi*, teres minor; *P.r.t*, Pronator radii teres; *S.mg*, serratus magnus; *La.d* and *P.ma*, humeral insertions of lat. dorsi and pect. major; T^1, T^2, T^3, triceps, three heads; *D.ep*, dorsi epitrochlearis; *A.i*, anconeus internus; *B*, biceps, tendon of insertion indicated by line, that of the brachialis anticus by dots; *F.c.r*, flexor carpi radialis, close to which is unhooked tendon (*E.o.m.p*) of the extensor ossis metacarpi pollicis; $P.l^1$, separated belly and tendon of palmaris longus primus; $P.l.^2$, palmaris longus secundus belly; $P.l^3$, deep palmaris longus tertius, which continues into the superficial palmar fascia (*Pa.f*, *Pa.f**), which is divided and reflected outwards; *F.s.d*, flexor sublimis digitorum; *F.p.d*, flexor profundus digitorum; *I* and *V*, thumb and little finger.

Fig. 27. Diagrammatic sketch of front humero-radial borders, showing relative positions of muscular insertions. The lettering corresponds with fig. 26; but besides note:—*If*, tendon of infraspinatus; $B.a^1$, $B.a^{1*}$, origin and insertion of brachialis anticus primus; $B.a^2$, brachialis anticus secundus (belly); $S.l^1$, $S.l^2$, double-headed supinator longus; *S.b*, supinator brevis; *E.c.r.l & b*, extensor carpi radialis longior and brevior, single-headed, split below; D^1, deltoid (insertion).

Fig. 28. Interosseous and small flexor muscles on the palmar surface of the manus: *I* to *V*, digits, cut short just beyond the metacarpo-phalangeal joints; $S.I^{1\,\&\,2}$ first and second *superficial* interosseous muscles; 1, interosseous muscle of

the pollex; 2, pair of interossei to the index, the radial and ulnar bellies being quite separate; 3, the double and deep interossei of the third digit, crossed in part by the so-called first *superficial* interosseous muscle; 4, the fourth digital pair of deep interossei (the ulnar one is hidden for half of its course by the so-called second superficial muscle); 5, double interossei of the fifth digit; *F.b.m.d*, flexor brevis minimi digiti; *Ab.m.d*, abductor minimi digiti.

Fig. 29. Partial outer view of bones of left fore limb, showing their ligamentous union: *a*, anterior; *e.l*, external lateral; *ob*, oblique, and *p*, posterior ligaments of elbow; *i*, interosseous ligament; *i.l** and *e.l**, internal and external lateral ligaments of wrist-joint; *po*, posterior carpo-metacarpal ligamentous sheet; *c.m*, ditto to pollex; *l*, lateral pollicial metacarpo-phalangeal band; *s*, synovial ligament fibres of the same joint of second digit; *U*, ulna; *R*, radius.

Fig. 30. The same bones on their inner aspect: *p*, posterior, and *i.l*, internal lateral ligament of elbow-joint; *i*, interosseous ligamentous band; *e.l**, external lateral ligament of wrist; *an*, anterior common ligament of ditto; *u.c*, strong ulno-carpal plane, deeper than the last; *t*, transverse ligament; *F.c.r*, tendon of insertion of flexor carpi radialis.

Fig. 31. $D.p.f^1$ and $D.p.f^2$, the double deep palmar fascia, with *F.c.r*, flexor carpi radialis tendon, piercing it.

Fig. 32. Reduced view of the Otary's palate: *a.p*, anterior palatine foramina.

PLATE LXXIII.

Fig. 33. Belly view of the body and hind limbs of the Sea-lion, from the neck to the ankles, and the pectoral limbs to the elbow-joint. On the left moiety of the animal the structures immediately beneath the panniculus carnosus are defined in natural position. On the right side a partially deeper dissection is shown, several muscles being reflected, others cut away, or their origins and insertions only left.

LETTERS APPLICABLE TO THE ANTERIOR SEGMENT.

St.h.&t. Sterno-hyoid and thyroid muscles.
C.h. Cephalo-humeral.
St.m. Sterno-mastoid.
$P.ma^1$, $P.ma^2$. Pectoralis major, first and second divisions.
St.s. Sterno-scapular.
S. Subscapularis.
La.d. Latissimus dorsi.
Sca^1. Scalenus anticus.
Sct. Supracostal.
It, *It.* Intercostals.
R.ab. Rectus abdominis, anterior digitations.

tr, trachea; *ca*, common carotid artery of right side; *pn*, pneumogastric nerve; *j.v*, jugular vein; *ax*, axillary plexus of nerves and vessels.

LETTERS APPLICABLE TO THE POSTERIOR SEGMENT.

E.o, *E.o**. External oblique.
I.o. Portion of internal oblique.
Tr. Partial view of transversalis.
R.ab. Rectus abdominis, hind portion (outline continued by dotted line).
Sa.&R.f. Sartorius and rectus femoris.
Pe. Pectineus.
Il. Iliacus.
Ad.l. Adductor longus.
Ad.m[1], *Ad.m*[2]. Adductor magnus, first and second divisions.
Gr. Gracilis.
Sm. Semimembranosus.
St. Semitendinosus.
La. Levator ani.
T.p. Transversus perinæi.
B.c. Bulbus cavernosus.

e.c, external cutaneous nerve; *e.p*, external popliteal, and *i.p*, internal popliteal nerve; *c*, spermatic cord; *te*, testicle; *is.f*, ischio-rectal fossa; *, ischio-rectal fascia; *a*, anus; *p*, penis, cut across; *p.t*, posterior tibial artery and nerve; *gl*, lymphatic gland.

Fig. 34. Dissection of the rump, it being looked at from above downwards. The superficial muscles of the gluteal region and lower leg as far as the ankle are preserved in place on the right side; a deeper series and tail-muscles are displayed on the left.

RIGHT SIDE.

Sa. Sartorius.
R.f. Rectus femoris.
V.e. Vastus externus.
G.md. Gluteus medius.
G.mx[1]. Gluteus maximus (free portion).
B.f[1]. Biceps femoris.
B.f[2]. Biceps femoris (second part).
Ga. and *So.* Gastrocnemius and soleus.
Ab.o.m[5]. Abductor ossis metacarpi quinti.
Ab.m.d. Abductor minimi digiti.

LEFT SIDE.

Spd. Termination spinalis dorsi.
L.c.e. Levator caudæ externus.
L.c.i. Levator caudæ internus, its tendons dragged out (*L.c.i**).
S.p. Sacro-peroneus.
G.mx[2]. Gluteus maximus (second layer), and *G.mx*[1]. Insertion of first portion.
*So.So**. Soleus. *Ga.* Gastrocnemius.
Sm. Semimembranosus.
L.a. Levator ani.

Fig. 35. Sketch of side view of pelvis and leg to below knee-joint, exposing deepest fleshy area, and also relative attachments of portions of superficial muscles.

E.sp. Erector spinæ indicated.
L.c.i. Levator caudæ internus.
Sa. Sartorius (its origin).
R.f. Rectus femoris (its origin).
G.mi. Gluteus minimus (entire).
Py. Pyriformis (entire).
G.s. Gemellus superior.
G.i. Gemellus inferior.
O.i. Obturator internus (in part, insertion).
O.e. Obturator externus (origin).
Q.f. Quadratus femoris.
G.mx[1] and *G.mx*[2]. Origins of glutei maximi.
Sp. Sacro-peronæus.
Sm. Semimembranosus (origin).
L.a. Levator ani (origin).
Ad.m. Adductor magnus (origin).
Ad.l[1] and *Ad.l*[2]. Adductores longi (origin).
Ad.b. Adductores breves (bellies, &c.).
Gr. Gracilis (cut short).
t. Trochanter, *P*, patella, and *l.p*, ligamentum patellæ.

Fig. 36. A hind segment of the body and posterior limbs, the right only as far as the ankle. The superficial layer of the loin-muscles and outline of those of the groin &c. shown on the right; and on the left a deeper dissection of the lumbar region, adductors of thigh, leg, and plantar muscles and tendons are demonstrated. The right moiety of the pelvis is dragged out to show the infracaudal muscles. Lettering applies as in figs. 33, 34, and 35; but in addition there are:—*D*, diaphragm, its spinal attachment, and the dotted line indicates its costal circuit; *Q.l*, quadratus lumborum; *Ps*, *Ps**, psoas; *Il*, iliacus; *P.* & *Ic*, Pubo- and ilio-coccygeus; *S.c*, sacro-coccygeus, tendons separated; *V.i*, vastus internus; $Ad.b^1$ & $Ad.b^2$, adductor brevis (first and second portions); $Ad.l^1$ & $Ad.l^2$, adductor longus (its two parts); *T.p*, tibialis posticus; *F.l.h*, *F.l.h**, Flexor longus hallucis; *F.l.d*, Flexor longus digitorum; *Pla*, plantaris; *Ab.m.d*, abductor minimi digiti; *F.b.m.d*, flexor brevis minimi digiti; *F.b.d*, flexor brevis digitorum; *s*, left symphysis pubis, *in situ*; *c.gl*, coccygeal gland?; *e.c*, external cutaneous nerve.

Fig. 37. Deep muscles, lower and inner side, of left leg and sole. There remains only the bones from condyle of femur to the tarsus, the latter twisted to a line with the *i.l* (internal lateral ligament of knee-joint): *o.c*, os calcis; *L* to L^6, first to sixth lumbricales, as described; *I* to *V* respectively indicate the digits; other letters as in preceding figures.

Fig. 38. Plantar surface of sole of left hind foot, to just beyond the distal ends of the metacarpals: *t*, tibial malleolus; *o.c*, os calcis; *a*, astragalus; *D.p.f*, deep plantar fascia; *Ab.o.m.*5, abductor ossis metacarpi quinti; *Ab.m.d*, abductor minimi digiti; *F.b.m.d*, flexor brevis minimi digiti, 1 & 2, its tendons of origin; $S.i^1$ and $S.i^2$, fleshy horns or bellies of the superficial interosseous muscular layer: the crescentic dotted line gives its real limits; it is thinnest in the middle, and here partially removed, to display the deep interossei; 1, single hallucial deep interosseous muscle; 2, 3, 4, 5, pairs of interossei of corresponding digits; *Ga* and *So*, Insertions of gastrocnemius and soleus.

Fig. 39. A different and deeper view of plantar surface and ligaments of sole of left hind foot. The lower extremities of the fibula (*F*) and tibia (*T*) are set at about a right angle to the foot, and seen somewhat from behind and within. *i.l*, internal lateral ligament; $c.s^2$, inferior calcaneo-scaphoid or deep plantar ligament; $a.c^2$, $a.c^3$, $a.c^4$, respective divisions of the astragalo-calcaneal ligaments; $c.c^1$, $c.c^2$, $c.c^3$, calcaneo-cuboid ligamentous slips; *t*, transverse intermetatarsal ligaments; *T.p*, tibialis posticus muscle; *Ad.h*, adductor hallucis? *Fb.h*, flexor brevis hallucis?; *P.l*, tendon of peronæus longus; *I* to *V*, digits.

Fig. 40. Ligaments of the left ankle-joint and foot, outside and on the dorsal aspect: i^1, superior, and i^2, inferior interosseous band between the tibia (*T*) and fibula (*F*); *i.t.p*, inferior tibio-peroneal; $e.l^1$ and $e.l^2$, first and second divisions

of the external lateral ligament of the ankle-joint; *a*, anterior ligament; *acc*, accessory portion of same; $c.c^1$, calcaneo-cuboid, first portion; $c.s^1$, calcaneo-scaphoid; *e.c.t*, external calcaneo-talar ligament; $s.cb^1$, superior scaphoido-cuboid ligament; $sc^{2\,\&\,3}$, scaphoido-cuneiform and intercuneiform ligaments; $c.m^4$ and $c.m^5$, cubo-metatarsal; and $c.m^{1,2,3}$, cuneo-metatarsal ligaments.

Fig. 41. The lower tibio-fibular articulation and ankle-joint, from behind; the tibialis posticus (*T.p*) insertion remains: *T*, tibia, and *F*, portion of the fibula; *i.t.p*, inferior tibio-peroneal ligament; *i.l*, internal lateral ligament of the ankle-joint; $e.l^2$ and $e.l^3$, second and third portions of the external lateral; *p*, extra or posterior ligament; $a.c^3$, astragalo-calcaneal ligament, third part; *o.c*, os calcis.

Fig. 42. Occipito-atlantal ligaments, in side view, the outline indicating the hinder end of skull with attached first cervical vertebra: *p.o.a*, posterior occipito-atlantal ligament; *ac*, accessory band of the anterior occipito-atlantal ligament; *ms*, mastoidal region of skull; 1, atlas; *t*, its transverse process.

Fig. 43. Ligaments, pelvis, and hip-joint, seen from above, or dorsally; the left femur and adjoining side of the pelvis and sacrum are sketched in outline: *c*, capsular ligament of hip-joint; *is.f*, accessory portion or ischio-femoral ligament; *p.s.i*, posterior sacro-iliac ligament; *si*, sacro-ischiatic ligament; *fe*, femur; *t*, trochanter; *sa*, sacrum; *il*, ilium; *is*, ischium; *pu*, pubis.

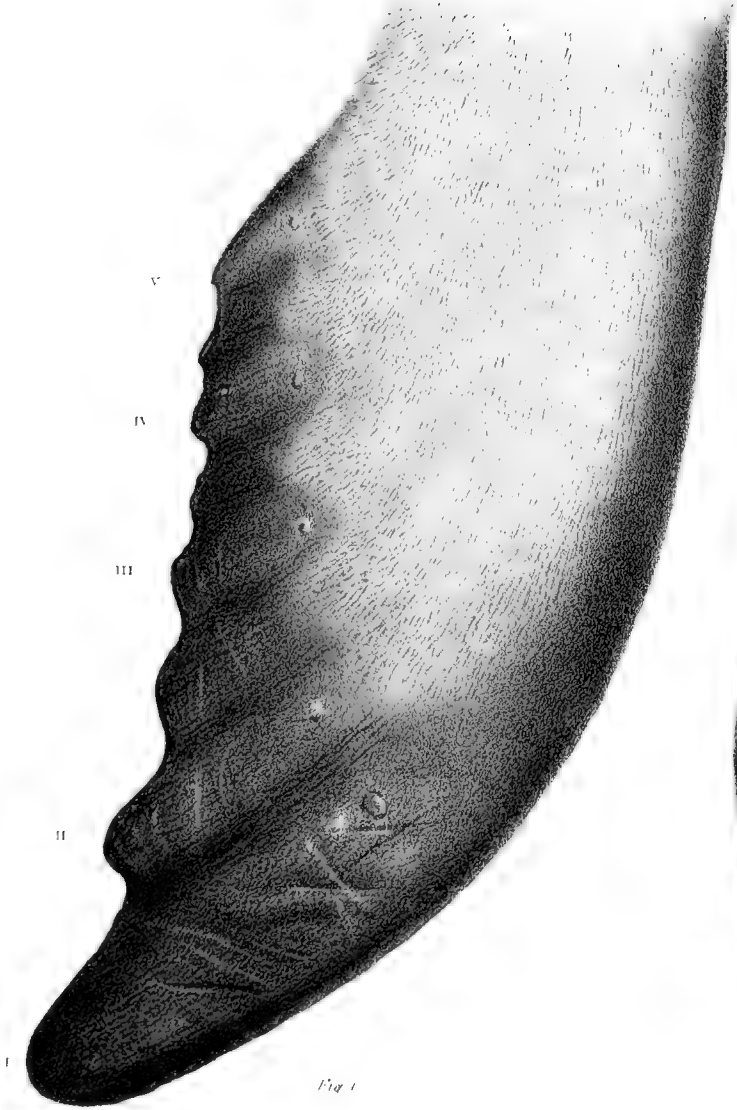


Fig. 1

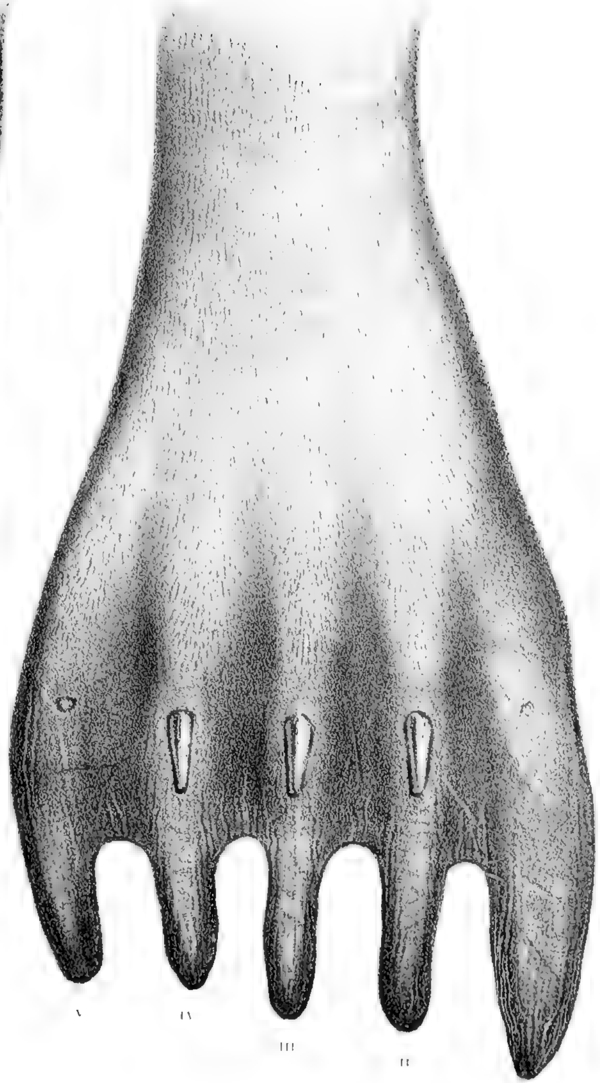
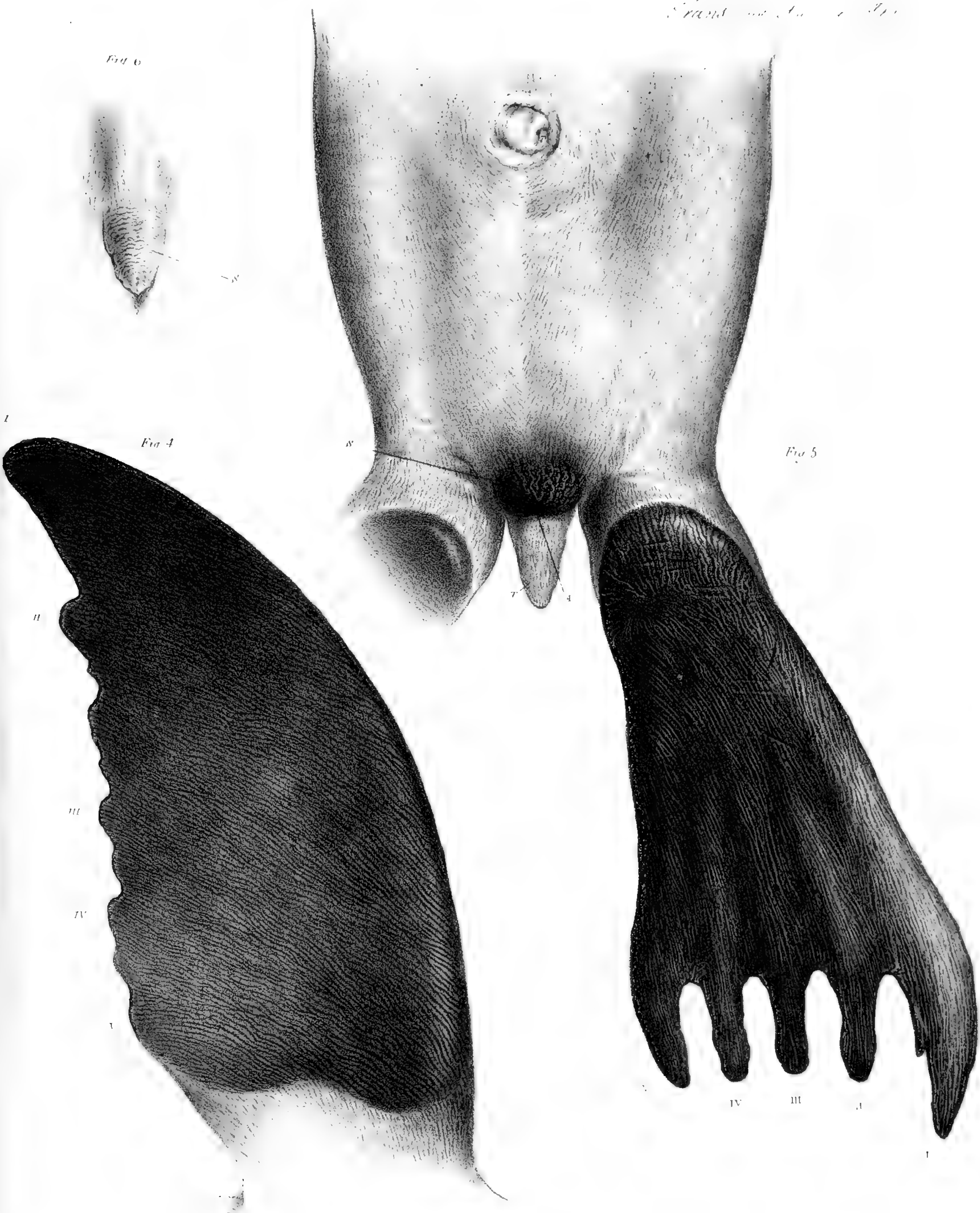


Fig. 2

Fig. 3



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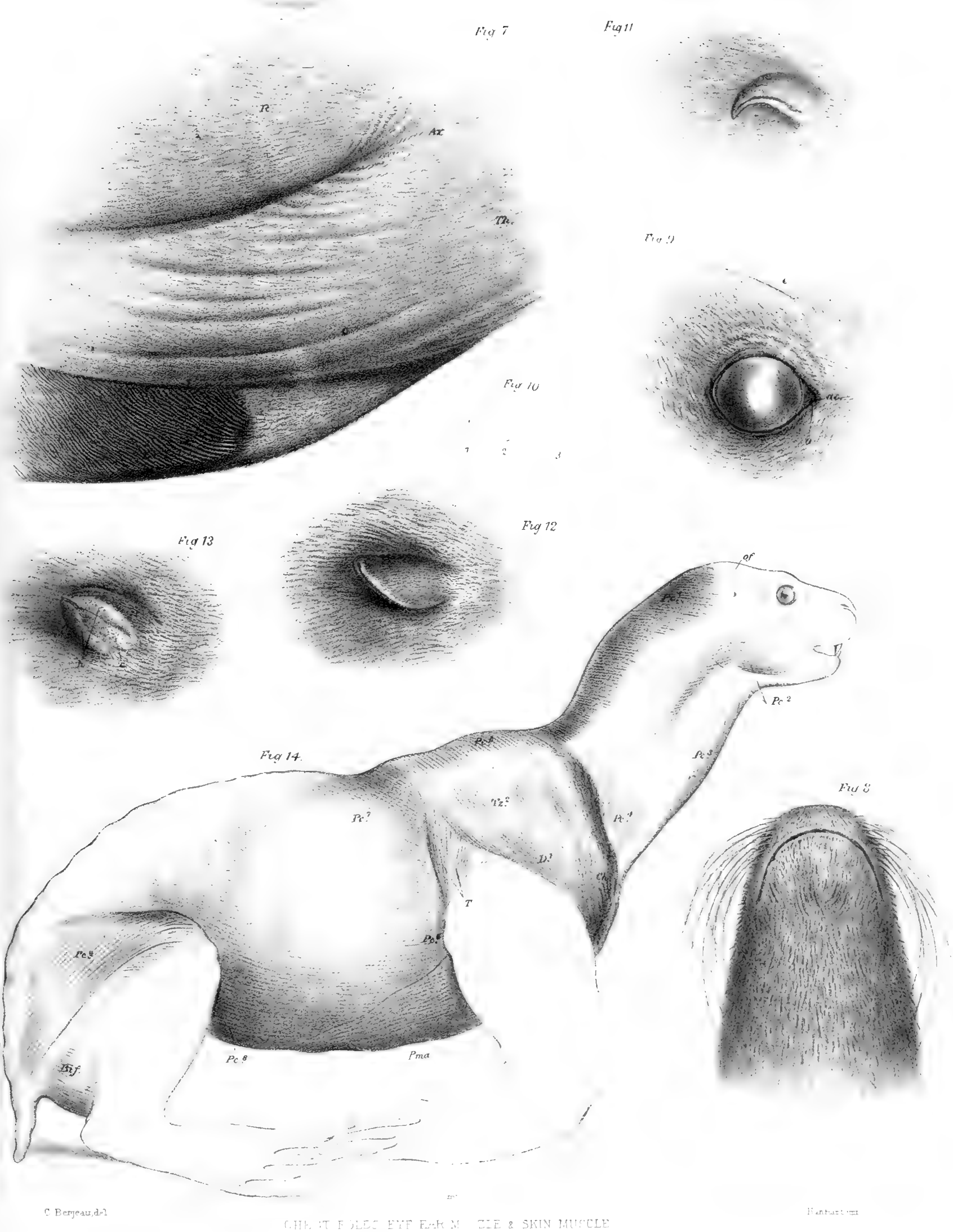
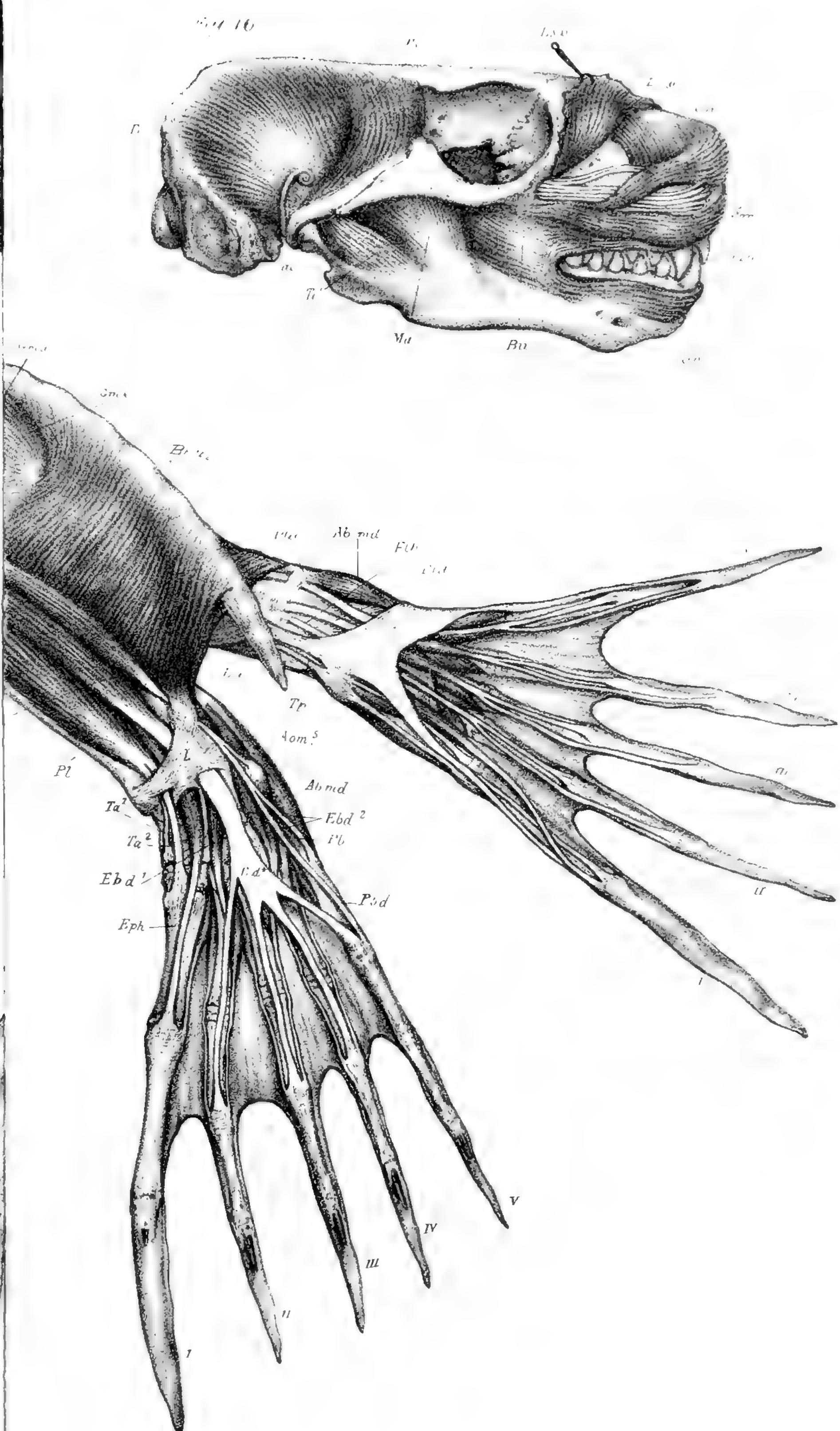


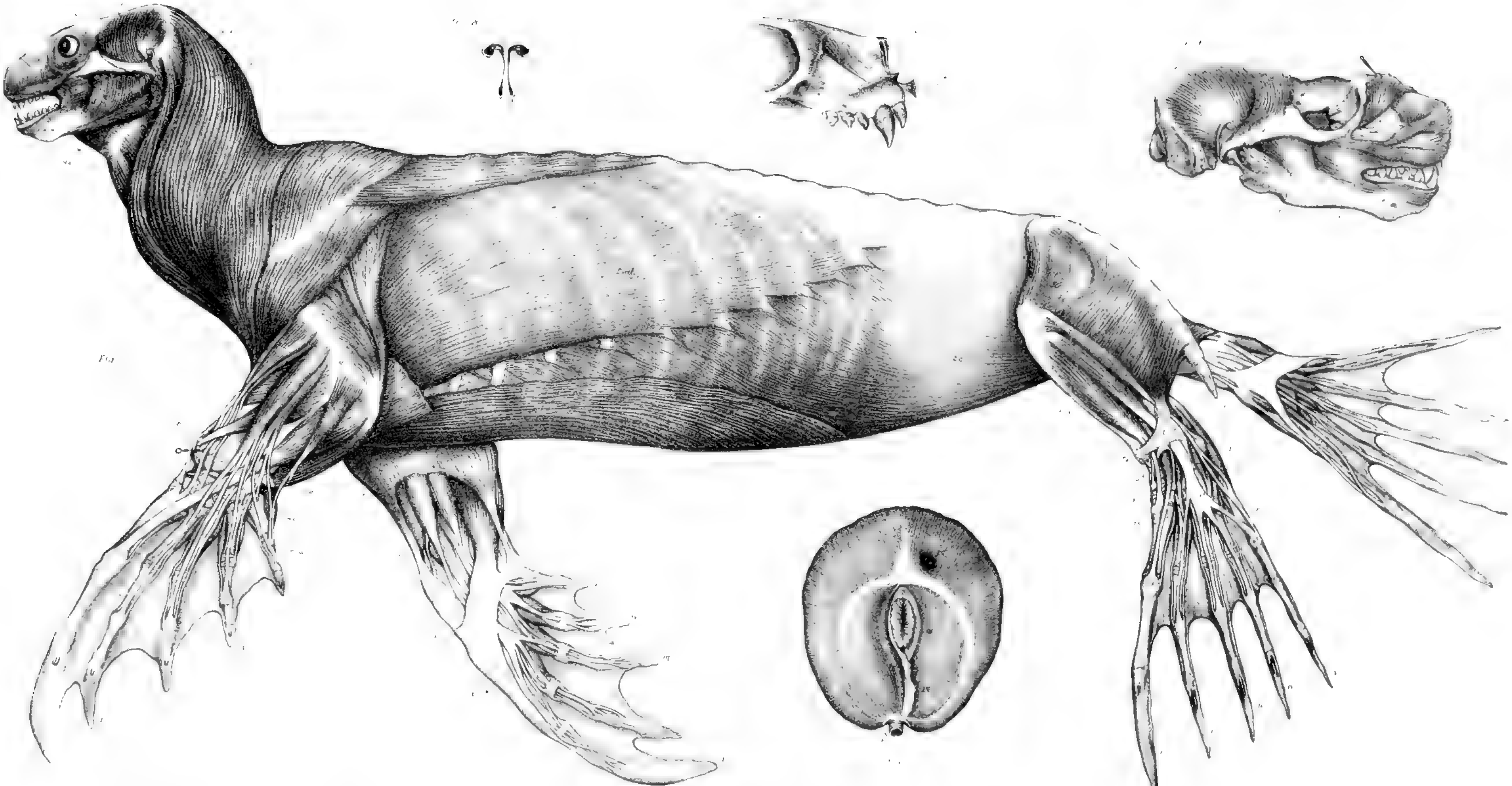
C. Bergeau, del.

Hanhart imp.

CHEST FOLDS, EYE, EAR, MUZZLE & SKIN MUSCLE



M & N Hanhart imp



J. Murie del.

MUSCLES HEAD, BODY LIMBS and DIAPHRAGM

M & N Hanhart imp.

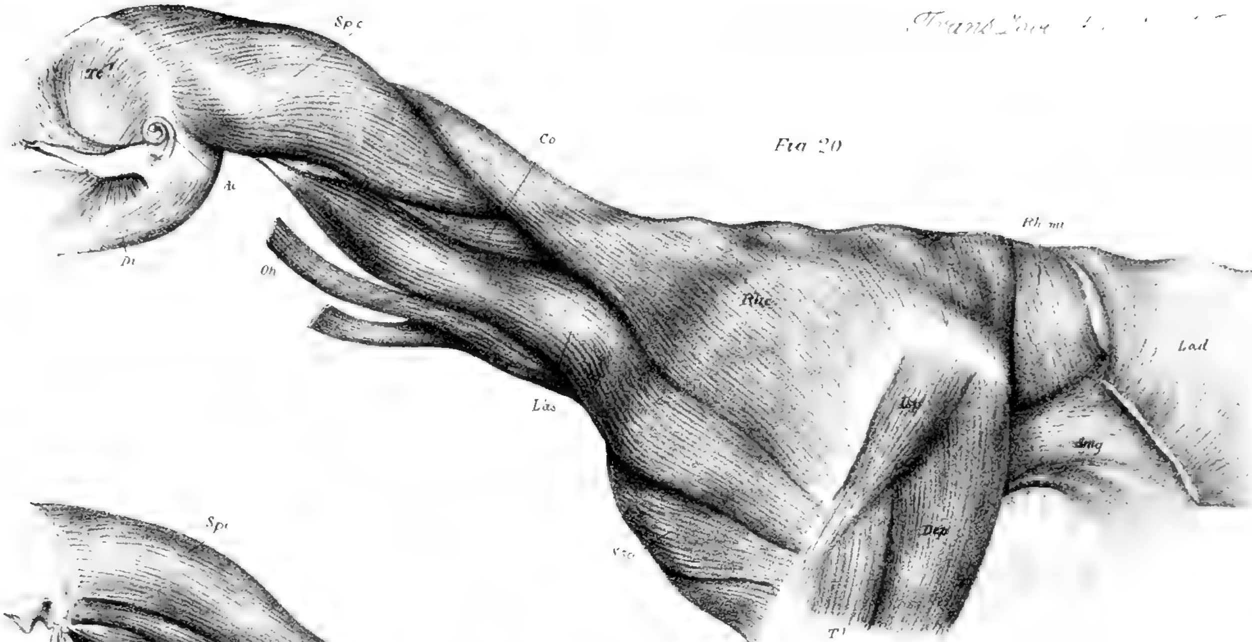


Fig. 20

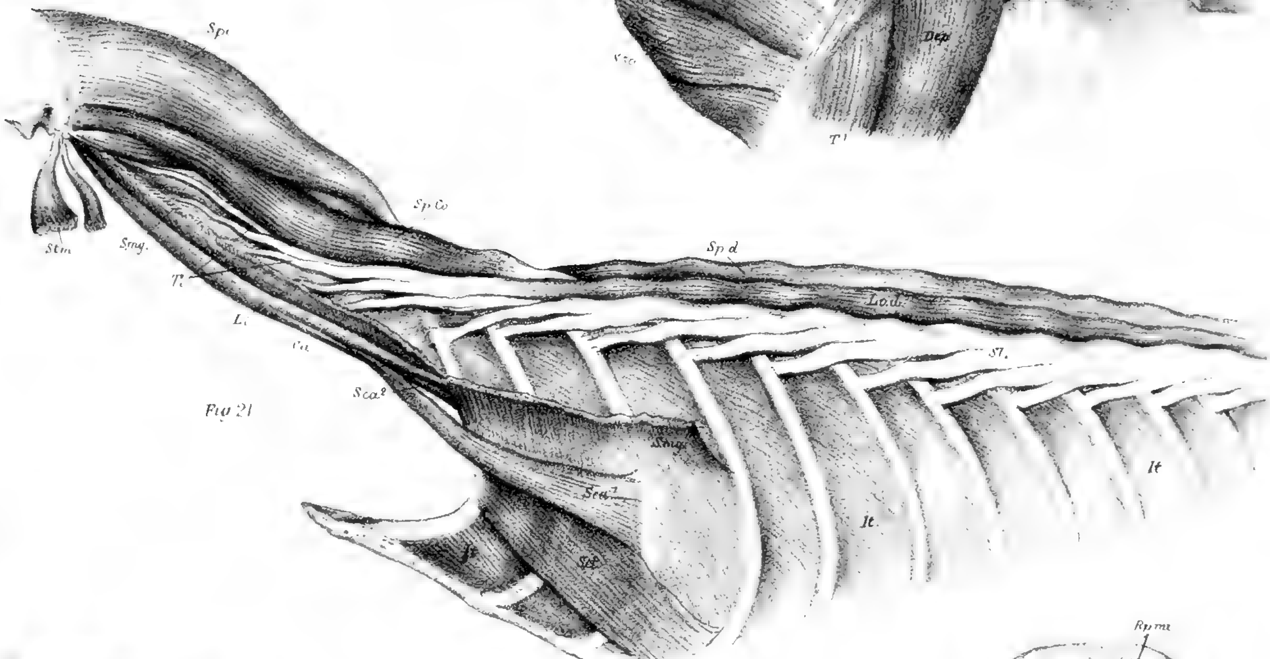


Fig. 21

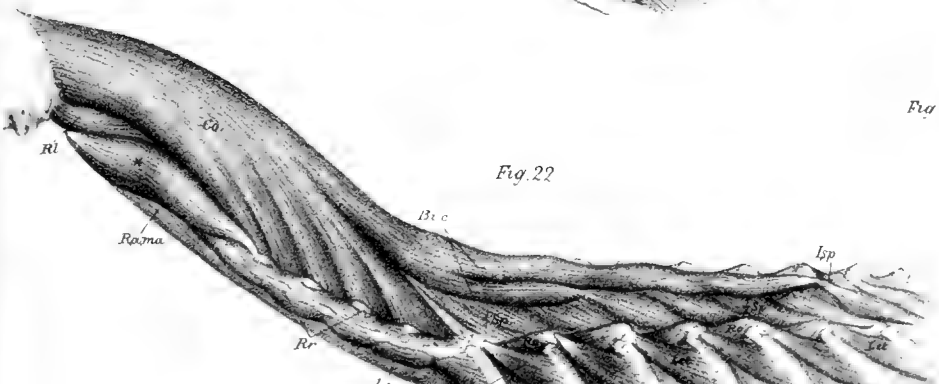


Fig. 22

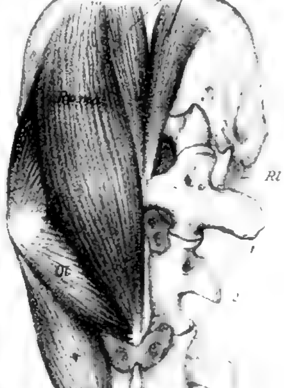
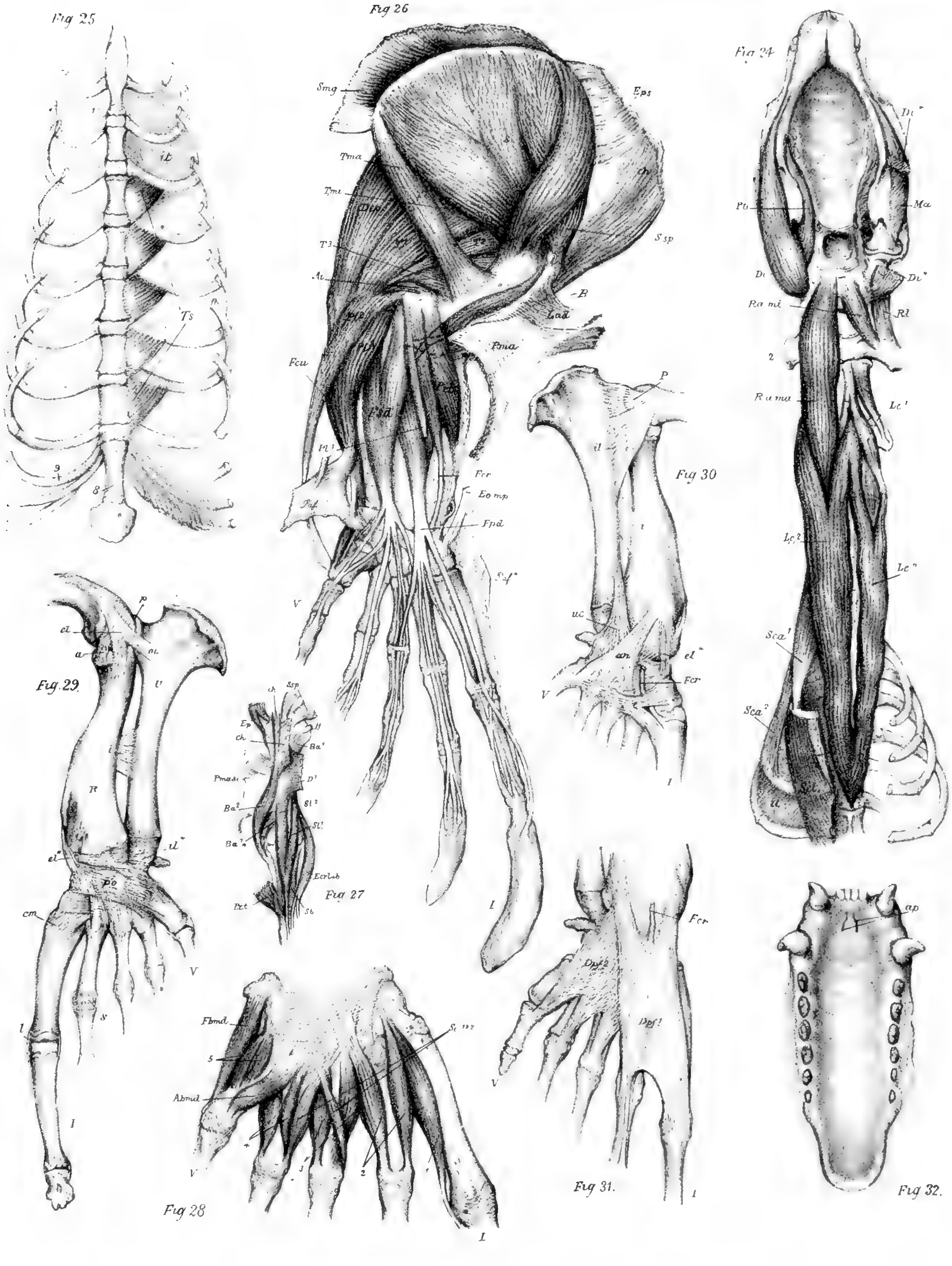


Fig. 23

J. Murie dir.

C. Berjeau del. et lith. — M & N Hanhart imp.

SUPERFICIAL & DEEP SPINAL MUSCLES



J Murie dir

C. Berjeau del et lith

M & N Hanhart imp

DEEP FLEXORS & LIGAMENTS FORELIMB &c

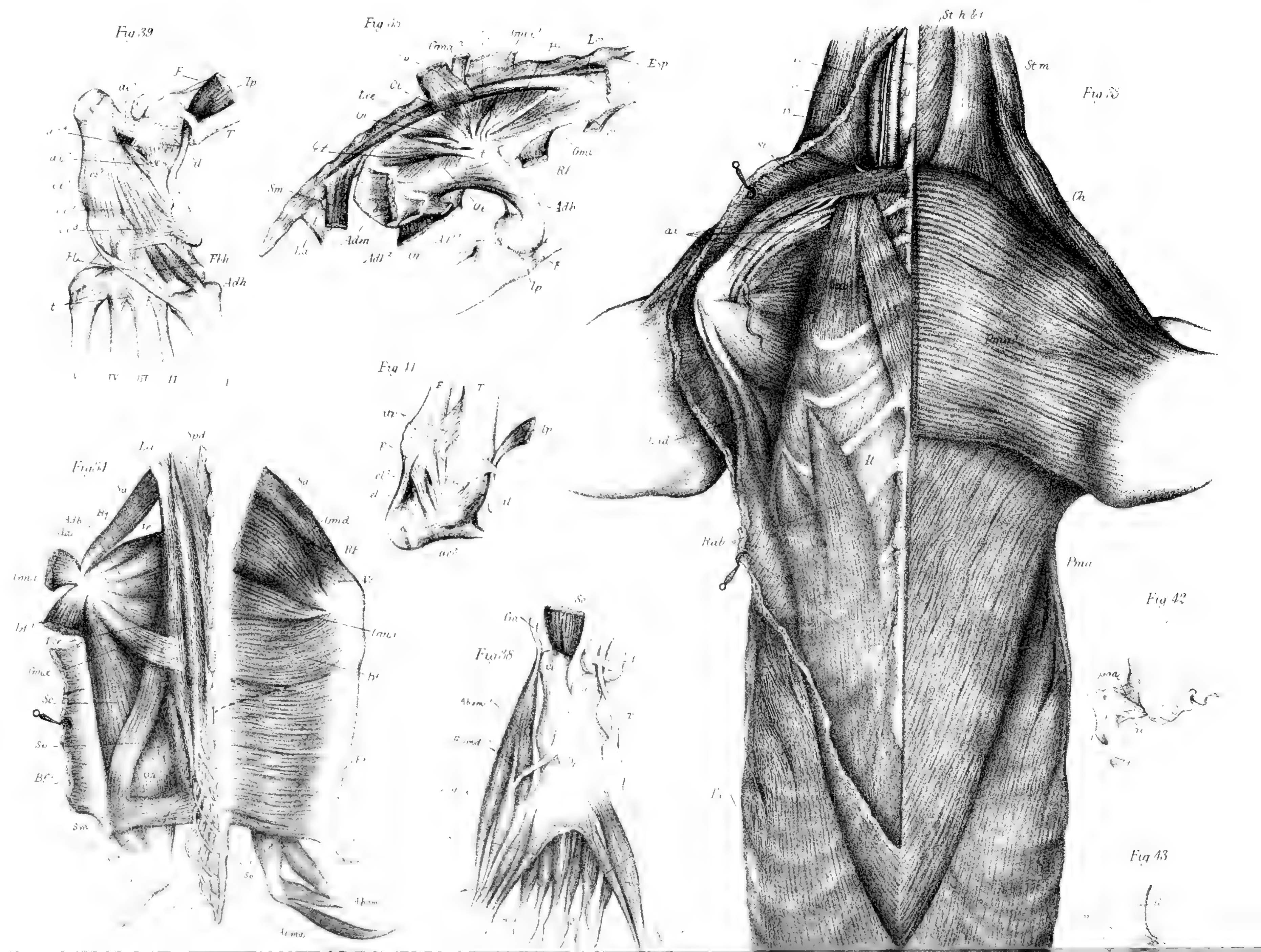


Fig 39
Fig 40
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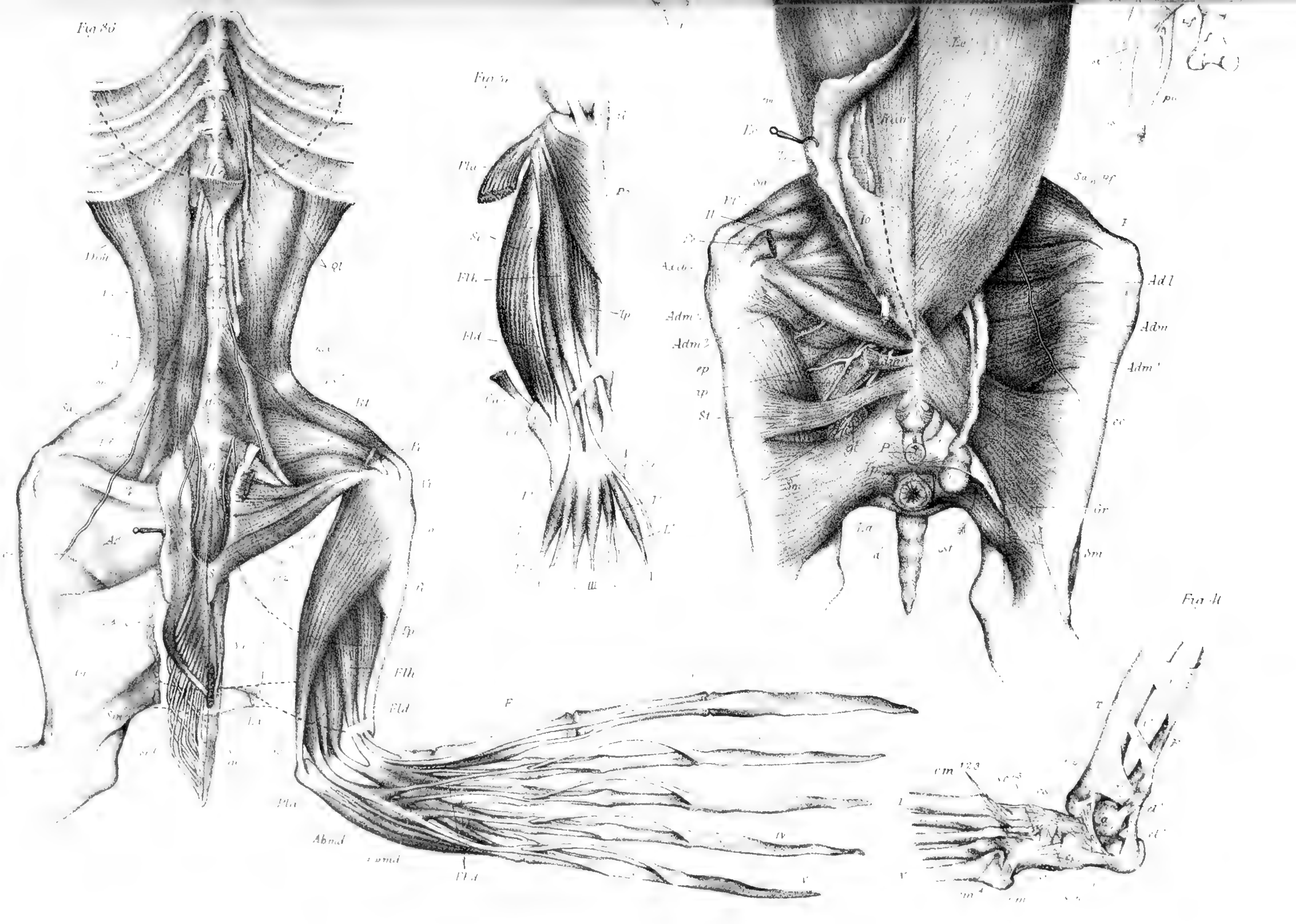

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ABDOMINO LUMBAR REGION & HIND LEGS — MUSCLES LIGAMENTS &c

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