

Dalgleish, and pointed out its resemblance to that of the Geese (*Anser*). The egg was one of a clutch of four taken in October, 1873, by Mr. E. Gibson (as described, 'Ibis,' 1880, p. 166) near Cape San Antonio, Buenos Ayres.

The following papers were read :—

1. Contributions to the Anatomy of Picarian Birds.—Part I.
On some Points in the Structure of the Hornbills. By
FRANK E. BEDDARD, M.A., F.R.S.E., &c.

[Received October 5, 1889.]

Under the above heading I propose to offer to the Society a series of notes upon the structure of Picarian birds which may form a parallel series to the valuable communications upon Passerine birds by Prof. Garrod and Mr. Forbes published in the 'Proceedings' of this Society.

The anatomy of the soft parts of the Hornbills has not been much studied, excepting as regards those points which were made use of by Garrod in his scheme of Bird-Classification; further details are, however, to be found in Gadow's work upon Birds¹, and in Max Fürbringer's recently published monograph upon the shoulder-girdle and muscles of Birds².

Visceral Anatomy.

The *liver*-lobes present some differences in different Hornbills.

Commencing with *Bucorvus abyssinicus*, in which the right lobe is larger than the left, the series terminates with *Buceros coronatus*, in which the left lobe is larger than the right. The following table shows the relations of the liver-lobes in such Hornbills as have been examined³.

<i>Bucorvus abyssinicus.</i>	R > L.
<i>Aceros nipalensis.</i>	R > L.
<i>Buceros bicornis.</i>	R > L.
<i>Sphagolobus atratus.</i>	R > L.
<i>Bycanistes subcylindricus.</i>	R > L.
<i>Buceros plicatus.</i>	R = L.
<i>Buceros rhinoceros.</i>	R = L.
<i>Buceros coronatus.</i>	R < L.

I have noticed a peculiarity in several species of Hornbills which is not found in all other birds. In all birds the two lobes of the liver are completely separated from each other by the umbilical ligament, which bears the umbilical vein (this appeared to be particularly large and well developed in all Hornbills which have

¹ Bronn's 'Klassen und Ordnungen des Thierreichs,' Bd. vi.

² 'Untersuchungen zur Morphologie und Systematik der Vögel.'

³ The greater part of these observations are to be found in MS. notes of Garrod and Forbes.

been dissected by me); and in addition one liver-lobe—the right—is commonly separated from the abdomen by a thin membranous septum. In Hornbills both lobes of the liver are thus shut off; I have figured this condition in *Bucorvus abyssinicus*¹; it is exactly the same in one or two other species which I have subsequently studied. This condition is, so far as my experience goes, rare in birds; since, however, I propose later to bring forward some facts relative to the arrangement of the viscera and the partition of the coelom in birds, I only dwell upon this character now as tending to separate the Bucerotidæ from most of their allies.

Syrinx.

Aceros nipalensis.—The last rings of the trachea are fused together to form a solid box, at the sides of which, however, the individual rings are recognizable. In front the last three rings are thus fused, but behind two additional rings fuse with the others to form a wide and deep bony plate. The tracheal rings lying in front of these five show the dovetailing arrangement which is so often found in the tracheal rings. The pessulus is well developed and bony, but owing to the complete fusion of the tracheal rings both posteriorly and anteriorly it is impossible to say from which rings it is developed.

The intrinsic muscles of the syrinx are attached near to the boundary-line between the last and the penultimate tracheal rings.

The bronchial semirings are cartilaginous, and there is a considerable interval between the first of these and the last tracheal ring.

Bucorvus abyssinicus.—The syrinx of this Hornbill (fig. 1, p. 589) differs in many particulars from the last. The tracheal rings are not ossified, and there is no box formed by their fusion. Only posteriorly are the penultimate ring and the two in front of this fused just at the origin of the pessulus; anteriorly the pessulus is fused with the antepenultimate tracheal ring, which forms with it a three-way piece; the last two tracheal rings do not meet in front. The slender syringeal muscles are attached to the anterior margin of the last tracheal ring.

The peculiar shaped tracheal rings are hardly recognizable until about the 14th from the end.

Buceros rhinoceros (fig. 2, p. 589) has a syrinx which is not very different from that of *Aceros*. The same rings are fused to form an ossified box; but the fusion between the several rings is hardly so extensive as in *Aceros*; furthermore the syringeal muscles are attached to the posterior border of the last tracheal ring.

In *Sphagolobus atratus* there is very little fusion between any of the last tracheal rings; the last three rings, which alone show any signs of ossification, are fused for a very short space anteriorly; posteriorly there is no fusion at all, and the pessulus can be plainly

¹ "Notes on the Visceral Anatomy of Birds.—I. On the so-called Omentum." P. Z. S. 1885, p. 842, woodcut, fig. 2, L.

seen to be connected with the antepenultimate ring. Although the last tracheal rings are not fused, they are very closely applied together and no membranous interspaces are left.

Fig. 1.

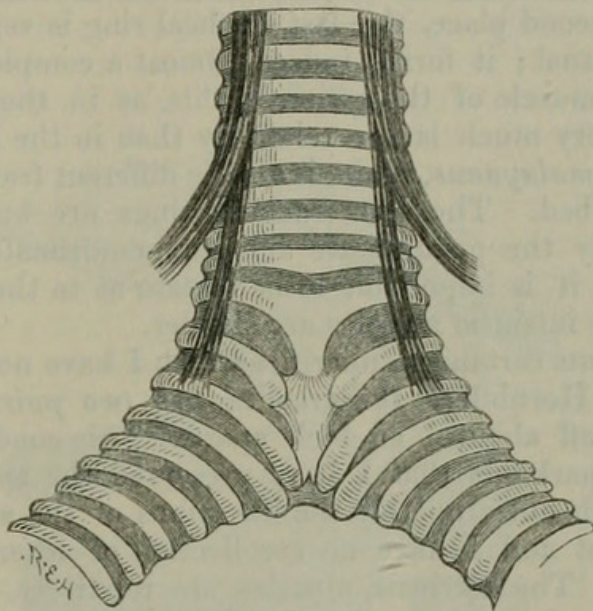
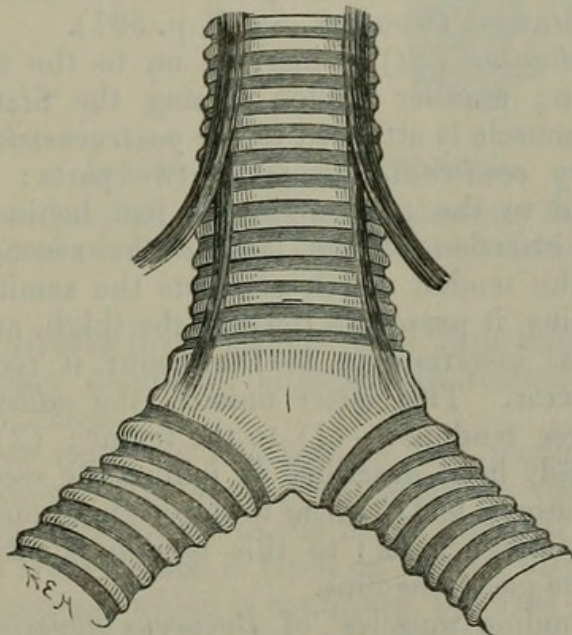
Syrinx of *Bucorvus abyssinicus*. Front view.

Fig. 2.

Syrinx of *Buceros rhinoceros*. Front view.

Ceratogymna elata, which is, like the last, a comparatively small species, has a very similar syrinx; indeed I can find no differences sufficiently tangible to be described.

Buceros lunatus and *B. bicornis*, which are both large species, hardly present any differences from *B. rhinoceros*.

Bycanistes subcylindricus has a syrinx which, although of about the same size as that of *Ceratogymna elata*, shows certain differences which are worth putting on record. In the first place, the syrinx is much compressed from side to side at the level of the last tracheal ring; in the second place, the last tracheal ring is very much more arched than usual; it forms indeed almost a complete semicircle. The intrinsic muscle of the syrinx in this, as in the other smaller Hornbills, is very much larger relatively than in the larger species.

Anthraceros malayanus, again, is a little different from all the types hitherto described. The last tracheal rings are but little fused posteriorly, only the penultimate and antepenultimate rings are so fused, so that it is impossible to be certain as to the origin of the pessulus. The intrinsic muscles are slender.

Toccus presents certain peculiarities which I have not yet observed in any other Hornbills; the trachea has *two pairs* of extrinsic muscles given off about $\frac{1}{2}$ an inch apart. This condition seems to me to be so remarkable that I have preserved the specimen which shows it, though unfortunately the insertions of the anterior pair of muscles are lost and I have no recollection of where the point of insertion was. The intrinsic muscles are relatively small. There appears to be no fusion between any of the tracheal rings.

Myology.

The arrangement of the semitendinosus and adductor in *Aceros nipalensis*, which is somewhat complex, will be understood from the accompanying drawing (woodcut, fig. 3, p. 591).

The *semitendinosus* (*St*) is inserted on to the tibia by a long thin flat tendon; another tendon joining the first just where it passes into the muscle is attached to the *gastrocnemius*.

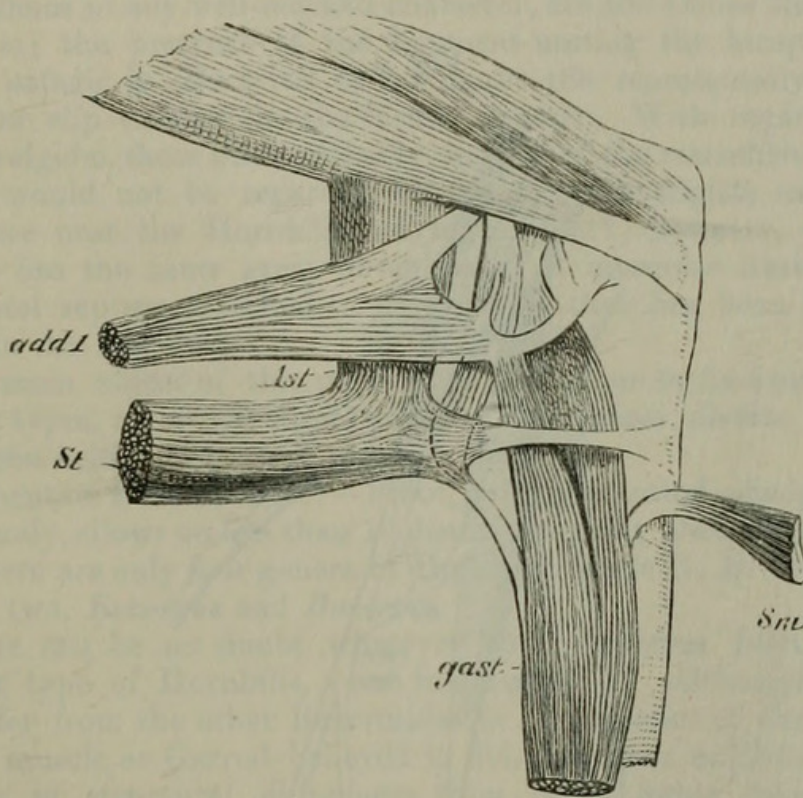
The *accessory semitendinosus* is in two parts: the larger half (*Ast*) is attached to the semitendinosus just behind the origin of the tendon of insertion of the latter; the second half appears to arise from the tendon which connects the semitendinosus with the gastrocnemius, it passes up towards the thigh, and just in front of its (tendinous) insertion on to the femur it receives a tendon from the adductor. This latter muscle (the *adductor longus*) is inserted by three tendons:—(1) to the femur; (2) a small tendon which has already been described as joining the second half of the accessory tendinosus; and (3) near to the origin of one of the internal heads of the gastrocnemius; to this tendon is also attached the inner head of the gastrocnemius.

The corresponding muscles¹ of *Bucorvus abyssinicus* are rather simpler than in *Aceros nipalensis*. The *adductor longus* is only inserted at two places: first by a fleshy insertion along a considerable length of the lower border of the femur; second by a tendon in

¹ Gadow figures most of these muscles in Bronn's 'Thierreichs,' Aves, Bd. vi. Abth. iv. Taf. xxiii. b. fig. 1.

common with the innermost head of the gastrocnemius. The *semitendinosus* is attached by a thin tendon to the tibia as in *Aceros* and by a short tendon, also as in that species, to the gastrocnemius. The *accessory semitendinosus* arises chiefly from this latter tendon, but there is no division between this part of the muscle and that which takes its origin from the fleshy part of the semitendinosus.

Fig. 3.

Leg-muscles of *Aceros nipalensis*.

add, Adductor longus; *Ast*, accessory semitendinosus; *St*, semitendinosus; *gast*, gastrocnemius; *Sm*, semimembranosus.

In *Buceros atratus* there is again some little difference from both the types already described, although the resemblances are on the whole closer to *Aceros*.

The *adductor longus* is attached by two tendinous heads; the upper one of these, as in *Aceros*, is attached to the lower border of the femur; this corresponds to the fleshy insertion of the muscle in *Bucorvus*; the lower tendon is fused on its way with the inner head of the gastrocnemius, which is continued upwards and reaches the femur, and then bifurcates into two tendons of insertion. The relations of the semitendinosus and of the accessory semitendinosus are as in *Aceros nipalensis*.

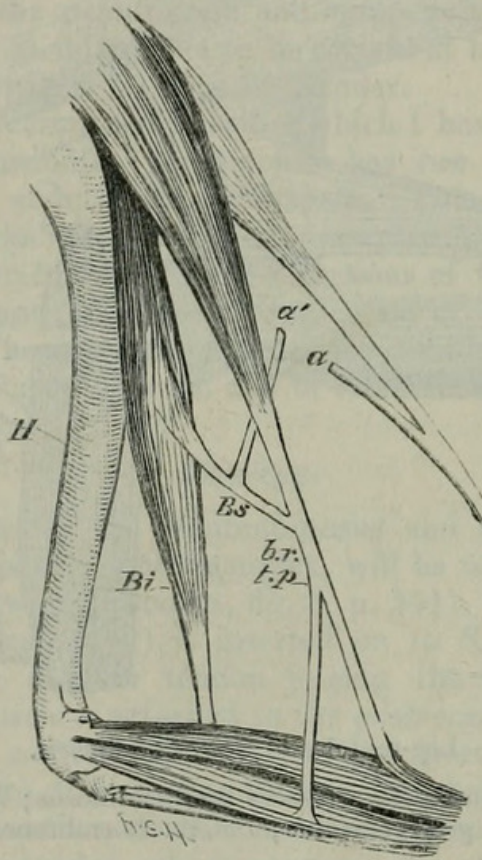
In *Toccus* these muscles are much the same as in *Buceros*.

In *Ceratogymna elata* I find a closer resemblance to *Aceros* than to any other of the genera mentioned in this paper, but there is an

agreement with *Bucorvus* in the *fleshy* insertion of the *adductor longus* on to the lower border of the femur. The *accessory semiten-dinosus* is distinctly double as in *Aceros* and is attached by a short tendon to the adductor, though the direction of this tendon is somewhat different to what is found in *Aceros*.

The *patagial muscles* of *Bucorvus* (fig. 4) are particularly interesting; as in other Hornbills, the tendon of each just at its commencement is reinforced by a tendinous slip derived from the *pectoralis primus*; in *Bucorvus* there is in addition a tendinous slip from the biceps.

Fig. 4.



Patagial muscles of *Bucorvus abyssinicus*.

H, Humerus; *Bi*, Biceps; *t.p.*, *b.r.*, tendon of *tensor patagii brevis*; *a'*, tendinous slip to *pectoralis primus*; *Bs*, junction of this with a tendinous slip to *biceps*; *a*, tendinous slip which unites tendon of *tensor patagii longus* with *pectoralis*.

The fact that this slip is attached *not* to the *tensor longus* but to the *tensor brevis* does not in my opinion invalidate its homology with the so-called "biceps slip" of other birds. *Bucorvus* is moreover not the only "Anomalognathous" bird with a biceps slip; these structures I have found in *Colius* as a well-developed fleshy muscle united to the tendon of the *tensor longus*; but its description by Prof. Fürbringer¹ has anticipated the novelty of the present remarks.

¹ Untersuchungen zur Morph. u. System. der Vögel, &c. vol. i. p. 529.

Bucorvus possesses a femoral caudal muscle, which was stated by Garrod to be absent¹, but is described and figured by Gadow².

In *Aceros* the head of the anconeus is single; it is double in *Bucorvus* and *Buceros*.

I do not attempt in the present paper to discuss in detail the affinities of the Hornbills to other Picarian birds, as material hardly exists at present for comparison. The only birds to which they might be supposed to be allied, and to which they show a particular resemblance in any well-marked character, are the Colies and Caprimulgidæ; the presence of the ligament uniting the biceps to the tensor patagii in *Bucorvus* is no doubt the representative of the muscular slip existing in the former groups. With regard to the Caprimulgidæ, these birds probably, in spite of the resemblance noted above, would not be regarded by many ornithologists as coming anywhere near the Hornbills. I may remark, however, that *Podargus* has the same great development of muscular fibres in the horizontal septum attached to the gizzard that has been recorded above in the Hornbills.

The main object of this paper is to endeavour to fix some of the generic types, about the limits of which the most diverse opinions have been held.

To mention a few of these:—Elliot, in his illustrated monograph³ of the Family, allows no less than 19 distinct genera; Dubois⁴ considers that there are only four genera of Hornbills, while G. R. Gray⁵ only admits two, *Bucorvus* and *Buceros*.

There can be no doubt whatever that *Bucorvus* forms a very distinct type of Hornbills, even in its habits. Although it does not differ from the other Bucerotidæ in the absence of the femoro-caudal muscle as Garrod believed it did, *Bucorvus* exhibits a larger number of structural differences from other forms than any of these do from each other. The peculiarities of the carotid arteries⁶, the structure of the syrinx (see p. 588), and the presence of a tendinous "biceps slip" mark out *Bucorvus* as far removed from other Bucerotidæ. With regard to the other Hornbills it is not so easy to mark out a number of distinct genera.

The form of the syrinx in *Bycanistes* is peculiar, and, as far as my observations go, restricted to this genus; but unfortunately I am not in a position to add any other differential characters. It will be remembered, however, that the species which constitute the genus *Bycanistes* are African and do not extend into the Oriental Region; there is thus some further support given to the view that

¹ *Loc. cit.*

² *Loc. cit.*

³ A Monograph of the Bucerotidæ. London, 1877–82.

⁴ "Revue critique des Oiseaux de la Famille des Bucerotides," Bull. Mus. d'Hist. nat. de Belgique, t. iii. (1884–5), p. 187.

⁵ Hand-list, p. 127.

⁶ "On a peculiarity in the Carotid Arteries, and other points in the Anatomy of the Ground Hornbill (*Bucorvus abyssinicus*)," P. Z. S. 1876, p. 60, and Coll. Papers, p. 316. W. Ottery, "A Description of the Vessels of the Neck and Head in the Ground Hornbill," P. Z. S. 1879, p. 461.

this group of Hornbills may be regarded as a distinct generic type—*Bycanistes*. I am also inclined to think that *Toccus* is a distinct genus; it may be that the African forms are really distinct from the Asiatic; but this is a matter that requires further study.

Col. Tickell¹ has separated *Aceros* and those Hornbills such as *Toccus* which are without casques from the other Indian Hornbills, and has remarked that the two genera, which he terms *Aceros* and *Buceros* respectively, have a different mode of flight.

Aceros, however, in my opinion should not be generically separated from *Buceros*, the anatomical differences between the two genera being so extremely slight.

Ceratogymna and *Sphagolobus* have a syrinx which differs in the non-fusion of the last tracheal rings from the syrinx of *Buceros* and particularly of *Aceros*, where the fusion between these rings is greater than I have observed in any other Hornbill. But this peculiarity, as also in the case of *Toccus* and *Bycanistes*, is correlated perhaps with the small size of the birds.

2. On the Anatomy of Burmeister's *Cariama* (*Chunga burmeisteri*). By FRANK E. BEDDARD, M.A., F.R.S.E., Prosector to the Society.

[Received October 31, 1889.]

Introductory.

The specimen which forms the subject of the present paper was acquired by the Society in 1887 and died in 1888, being the fifth example² which the Society has obtained.

The bird itself was discovered only thirty years ago (in 1859) by Dr. Burmeister, and was first described by Dr. Hartlaub³ in the 'Proceedings' of this Society. This description is confined to the external characters, and to an interesting account, from Dr. Burmeister's notes, of the habits of the bird. It is considered by Hartlaub to present differences of subgeneric value from *Cariama cristata*. Reichenbach afterwards⁴ placed it in a separate genus, a proceeding which is approved of by Mr. Sclater⁵. A figure of the bird⁶ illustrates Mr. Sclater's note which has just been referred to.

Later Dr. Burmeister⁷ gave a somewhat fuller account of its external characters, agreeing with Reichenbach in distinguishing it generically.

Dr. Gadow has given⁸ some account of the visceral anatomy of

¹ Birds of India (MS.); this work is in the Society's Library.

² Sclater, P. Z. S. 1887, p. 319.

³ "On a new form of Grallatorial Bird nearly allied to the *Cariama* (*Dicholophus cristatus*)," P. Z. S. 1860, pp. 335-6.

⁴ Die vollständigste Naturgeschichte der Tauben, etc. p. 159.

⁵ P. Z. S. 1870, p. 666.

⁶ Loc. cit. pl. xxxvi.

⁷ Reise durch die La Plata-Staaten, Bd. ii. p. 506.

⁸ Journ. f. Ornith. Jahrg. xxiv. (1876) pp. 445-6.



Beddard, Frank E. 1889. "Contributions to the Anatomy of Picarian Birds.-Part I. On some Points in the Structure of the Hornbills." *Proceedings of the Zoological Society of London* 1889, 587-594.

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