

With the Author's Compliment



Royal Society of Tasmania.

Points in the Morphology and Anatomy
of Certain Megapodes.

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INTRODUCTORY.

It is unnecessary, I think, to commence a series of papers on the Anatomy of the Megapodes by an apology. That such a series should seem to be necessary is, perhaps, to be wondered at, the more so when the special nature of this remarkable group of birds is considered. Some work has indeed been done, but in general it has been directed to special features to be used for taxonomic purposes. Such notes are, therefore, scattered about in numerous papers on the anatomy of birds, a good many of which, here in Tasmania, are quite unavailable to me. When we consider that even in the matter of the pterylosis of the group probably the only complete account of any member is contained in two papers—one by Garrod, on the anatomy of "*Megacephalon maleo*," the other by Pycraft, on the pterylosis of "*Megapodius pritchardi*," we get some idea of the necessity of a systematic investigation of the group.

My material consists of a number of specimens of two genera, "*Catheturus lathami*" (the "Scrub Turkey") and "*Lipoa ocellata*" (the "Mallee Fowl").

In the case of the latter I have not as much material as could be desired, but any new facts noted with the arrival of further specimens will be embodied in later papers. In addition, I have a chick (12 days hatched) of "*Megapodius eremita*," on the pterylosis of which I make some notes, but which I have not dissected.

I have to tender my sincerest thanks to Prof. W. A. Haswell, of Sydney, without whose kindly advice and assistance in obtaining literature this work could not have been undertaken.

The specimens were all obtained through the assistance of the fund of the John Coutts Scholarship, of Sydney University, of which for one year I was the holder. A single exception is the young specimen of "*Megapodius eremita*," obtained through the help of F. Young, Esq., of the s.s. "*Upolu*," who brought it from the Solomon Islands, preserved in diluted gin. I am deeply indebted to him for the opportunity of examining this valuable specimen.

PART I.—PTERYLOSIS.

The feather arrangement of the group seems, singularly enough, to have been almost neglected, the only papers available to me on the subject being those of Nitzsch (Proc. Ray Soc., 1867), containing a brief account of the pterylosis of "*Megapodius rubripes*"; Garrod (Proc. Zool. Soc., 1878, pp. 629-631) on the anatomy of "*Megacephalon maleo*," and Pycraft (Wiley's Zool. Res., Pt. IV., 1900, pp. 483-491) being "*A Contribution towards our Knowledge of the Pterylography of the 'Megapodii'*".

In his remarks on the pterylosis of "*Megapodius rubripes*," Nitzsch stated that it was typically gallinaceous in character, and that the oil gland was tufted. Garrod, however, found that in "*Megacephalon maleo*" the oil gland was nude, and that the rest of the feather arrangement differed in some respects from the typical galline character. Pycraft deals in an extended manner with the pterylography of "*Megapodius pritchardi*" and of a nestling of "*Megapodius eremita*." In his paper he raises a number of points of interest. Unfortunately, this paper has only recently come into my hands, and since the plumage of my 12 days' old chick of "*M. eremita*" is worthy of detailed study in connection with several points emphasised by Pycraft, I have decided to withhold all remarks upon it till later.

In "*Catheturus lathami*" the head is almost bare, the feathers of this region being scanty, reduced, and bristle-like. In the supra-orbital region, however, and anterior to this region, the feathers are slightly longer, being about half an inch in length. The anterior part of the neck is occupied by the large "wattle," which is sparsely covered by a number of bristle-like feathers, which, on the posterior side, take more the character of contour feathers.

"*Lipoa*" differs greatly from "*Catheturus*" in this region. The head is comparatively thickly covered with well developed feathers, which are raised above into a distinct crest. Anterior to the eyes, and extending backwards below and behind them to surround the auditory

aperture, is a paired white space, bare except for a few bristles (absent in "Catheturus"), which surround this aperture in a double row.

In the posterior neck region, in "Catheturus," the lateral neck spaces are broad and well defined. The ventral tract begins in this region, and as it passes backwards divides into two strongly-marked pectoral bands, which diverge some distance in front of the sternum, and are carried down on each side towards the thigh, just anterior to which (about the mid length of the sternum) they suddenly cease. The rest of the ventral tract is wholly separated from the pectoral bands by well-marked spaces. This other part commences just anterior to the manubrium sterni, and immediately divides, the two tracts running backwards and only meeting just anterior to the anus. The two tracts diverge greatly in the abdominal region before meeting.

The arrangement in "Lipoa" is almost exactly similar to the above, there being the two strong pectoral tracts which are separated from the ventral tract proper, the latter becoming divided into two tracts, which meet in this case some distance anterior to the anus, forming a diffused tract on the abdomen.

The dorsal tract in "Catheturus" is bounded laterally on the neck region by the two large neck spaces. It is continued caudad as far as a point lying shortly behind the shoulder joint, where it abruptly ends in fairly long and strong feathers. When the tract begins again, it becomes diffused over the entire pelvic region as a broad area, so wide as to be fused with the femoral tracts on either side. The oil gland is nude.

In "Lipoa," the arrangement of the dorsal tract is similar. There is a large space, as in "Catheturus," connecting the lateral spaces of the trunk. The oil gland here again is nude.

The humeral and femoral tracts are well developed in each of the two genera, the latter being fused with the posterior expanded portion of the dorsal tract.

The distribution of the feathers on the wings agrees in both of the specimens examined. The number of remiges is:—Metacarpals, 10; cubitals, 15. In each the

first cubital is equally well developed with the rest, though not quite so long. The cubitals are graduated, the eighth being the longest. Both genera are quin-cubital, markedly differing in this respect from "M. pritchardi" and "M. eremita."

The dorsal major tectrices of the primaries are well developed, but not so long as the cubitals, these latter being graduated, the first (in "Catheturus") being in length $5\frac{1}{4}$ inches, the seventh (the longest) measuring $6\frac{1}{2}$ inches.

The dorsal tectrices mediae of the secondaries are fairly large, and are graduated, there being no sudden differences in length between adjacent feathers. Those of the primaries are feeble, and on the manus they are almost deficient.

The dorsal tectrices minores do not call for special mention.

On the ventral side the tectrices majores are well developed, the tectrices mediae are absent, and the minores are scattered and feeble.

The rectrices number 16 in each of the two genera.

In a number of specimens of "Catheturus" there is present in the mid-ventral apertium a patch of specially thickened skin. It is roughly rhomboidal in shape, with its long axis (about two inches) extending along the carina sterni posteriorly. Its short axis measures about $\frac{3}{4}$ in., and the skin covering it, though specially thickened, is not at all scaly.

REMARKS.

All the genera of the Megapodidae so far described resemble the typical gallinae in a number of points in their feather arrangement, but most especially in the fact that the two parts of the ventral tract unite before reaching the anus. They, however, agree with one another, and differ from the typical gallinae in the possession of the interrupted ventral tract, the presence of the large dorsal interscapular space and the fusion of the

lumbar with the dorsal tract. It seems possible that the Megapodidae are capable of being divided into two groups. The first of these have the oil gland tufted, and are aquincubital. This group would probably be found to include all the species belonging to the genus "Megapodius," but at any rate includes "M. eremita" and "M. pritchardi." The second group would include those genera with a nude oil gland and quincubital wing, comprising the genera "Catheturus," "Lipoa," and probably "Megacephalon," although we have no evidence yet, in the case of this genus, as to the wing being diastataxial or otherwise.

PART II.—MYOLOGY OF THE HIND LIMB.

Myologically, I have as yet examined only two genera of the Megapodidae — "Catheturus" and "Lipoa." These two genera agree almost exactly in the arrangement and distribution of the muscles, such differences as are noticeable being in the main due to the disparity in the length of the hind limb. That of the Mallee Hen is much shorter than the Brush Turkey, being only three-quarters the length. In both cases the enormous strength of the leg muscles is very noticeable, particularly as regards the muscles of the thigh. The size of these muscles is much greater than in Gallus. The great size of the posterior thigh muscles in these birds results in the drawing out of the post-acetabular portion of the sacral region. The acetabulum, therefore, which lies about half-way between the two ends of the pelvis in Gallus, comes to about one-third of the distance from the anterior end. The enormous thickness of the thigh muscles, anterior as well as posterior, results in the deep hollowing out of the sides of the pelvis external to the ilio-ischiatic crest.

The thigh contains the usual muscles of the Gallinaceous birds, the tensor fasciae, the semitendinosus and accessory semitendinosus, the femoro-caudal and its accessory, and the ambiens. Certain points, some of which may be characteristic, are worthy of note in connection with these muscles. The gluteal muscles are well developed, and are four in number—primus (tensor fasciae), medius, minimus, and quartus—the latter being a short, chunky little muscle having its origin at the posterior outer margin of the ilium for a short distance, and passing backwards, slightly downwards and outwards, to be inserted into the outer side of femur just below the trochanter and slightly below and anterior to the insertion of the gluteus medius.

The semitendinosus and its accessory are surprisingly well developed, the latter being nearly as long as broad (one and a half by one and a quarter inches). The arrangement of the femoro-caudal muscle is interesting in these genera. According to Garrod (P.Z.S., 1873, pp. 626-644) in most birds "it arises from the (anterior)

transverse processes of the two last coccygeal vertebrae, and is inserted into the *linea aspera* of the femur at about one-third of its length from the trochanter." In my specimens I have found the insertion exactly as stated by Garrod, but when the muscle is traced out towards the tail the arrangement is found to differ remarkably from that laid down by him. The muscle on each side is found to spread out into a thin aponeurotic sheet, the two uniting and covering the lower side of the muscles of that region. The shape of this muscle, remarkably enough, varies in the two genera. In the Brush Turkey it is long and ribbon-like, while in "Lipoa" it is much expanded and thin, so that its centre part comes to be leaflike. This latter condition in "Lipoa" may, however, be due to the pressure of overlying muscles in preservation. The accessory head, however, agrees in both genera in being large and fan-shaped, rising along a fairly extensive line posterior to the ischiatic foramen, covering in this position the lower half of the hollow, which lies external to the ilio-ischiatic crest. Centrally this muscle is thinned, consisting only of an aponeurosis, through which can be seen the tendon of *M. obturator externus*.

The arrangement of the *semimembranosus* is interesting in these birds. In "Gallus" this muscle rises from the outer edge of the ischium, but its origin does not extend so far back as to completely cover the ischio-pubic foramen. In "Cathetus" and "Lipoa," however, this foramen is completely covered, so that with the lengthening of the origin the muscle comes to be fan-shaped. In company with the *semitendinosus*, it forms the posterior contour of the thigh.

M. ambiens has much the usual insertion, bending round the knee over the patella, to become merged with the head of *M. perforatus digiti iii.*, but its origin is worthy of comment. It is not, as usual in birds, a thin, spindle-shaped muscle; but owing to the fact that it arises from both the pectineal process, and some small portion of the bone behind it, it comes to be triangular.

The muscle representing the *pyramidalis*, called by Gadow the *ilio-femoralis externus*, and by Owen and Selenka, the *glutaeus externus*, is also present in the

Megapodes, as in "Gallus," but is more powerfully developed in the former. It is a well developed, triangular muscle, rising fleshy along the posterior third of the preacetabular crest and from the hollow below this, then passing directly over the head of the femur, rapidly narrows to a pointed tendon, which is inserted into the outer side of femur just below the trochanter above the insertion of *gluteus minimus*.

The obturator muscles (internal and external) show nothing of special interest except that the area of origin of the latter is triangular.

In the shank muscles, a special feature is the strong ossification in some of the tendons, so complete that often they may easily be broken in two with a sharp blow. In the presence of this ossification almost all the shank muscles are alike, but it is more particularly confined to the *peroneus longus*, the *tibialis anticus* and the *soleus*.

M. extensor digitorum communis in the Megapodes rises from the hollow between the pro and ecto-cnemial crests of the tibia, partly also from the outer side of the latter and from the upper third of the anterior face of the bone. It passes, as usual, under the bony and ligamentous bridges at the proximal end of the tarso-metatarsus. About two-thirds the distance down this latter bone it bifurcates, forming an outer and inner slip.

The latter passes to the base of the second digit, where it again divides into an outer slip (A) and an inner (B). (A) is ribbon-like, and divides into two, one of which forms the fibrous bridge of slip (B), the other the fibrous bridge at the base of digit iii.

Slip (B) divides also into two, the outer of which crosses over the inner to become inserted into the base of the second phalanx. The other division of slip (B) passes along the outer side of the second digit to be inserted into the base of the unguis phalanx. The rest of the tendon of *M. extensor digitorum communis* is distributed in the usual manner, dividing at the base of each phalanx into two, one of which is inserted into the base of each phalanx, the other continued onwards to the base of the next.

The extensor brevis digitorum of Owen is present in these birds underlying the last-named muscle. It runs along the sulcus in front of the tarso-metatarsus, and is attached to that bone for the main part of its extent. Just underneath the point where the extensor communis digitorum first bifurcates, the present muscle is converted into a tendinous expansion, which is hardly differentiated into tendons, but of which separate parts are inserted into the bases of the proximal phalanges of digits ii., iii., and iv. From the side of the body of the muscle, and about half-way down the tarso-metatarsus, a small portion takes its origin, which passes to the hallux, and is inserted into the base of the movable metatarsus of that digit.

M. abductor digiti iv. is a small muscle rising externally to the origin of m. perforatus hallucis (vide infra) at the proximal end of the tarsus. It passes down the postero-internal aspect of the bone, being attached to it for some considerable part of its extent. About two-thirds down this bone it develops a tendon, which passes externally to the joint between the foot and the metatarsus, to be inserted into the outer side of the base of the proximal phalanx of the fourth digit.

There is a strong vinculum joining the deep flexor of the foot with the flexor longus hallucis, as found by Garrod to be the case in the Gallinae in general. In addition, there is another, not nearly so evident a vinculum, joining M. flexor perforatus digiti iii. to M. perforatus et perforans digiti iii.

This latter vinculum occurs just behind the joint between the metatarsus and the pes. It merely joins together the two tendons in that position.

M. perforatus hallucis is present, rising by two fleshy heads, the larger from the hollow lying on the inner side of the hypotarsus, the lesser from a similar but smaller concavity on the outer side. In this position, the tendon of the deep flexor overlies it, and passes down in a groove between the partially distinct bellies of the muscle. The lesser head develops a tendon much in advance of the larger, the two running then side by side until they fuse. The compound tendon is attached

to the base of the first phalanx of the hallux, but is perforated in this position by the tendon of M. flexor longus hallucis.

The method by which the two muscles M. flexor perforans digiti iv. and M. flexor perforatus digiti iv., are made to act on five phalanges is interesting in these birds. The arrangement in M. flexor perforans is simple. It perforates the tendon of M. flexor perforatus, and passes to the unguis phalanx, being inserted into it in two places, at the base of the terminal phalanx, and also a little in advance of this, just at the base of the nail. It gives off also small slips to the penultimate and ante-penultimate phalanges of this digit.

The perforated flexor, of course, becomes divided into two parts—an inner and an outer. The inner of these passes to be inserted into the base of the fourth phalanx, giving off also a slip to the third. The outer slip divides almost immediately into two, of which one becomes inserted into the base of the third phalanx, while the other divides again into two, one part being inserted into the base of the first phalanx, the other into the base of the second.

M. adductor digiti iv. About this muscle Gadow (Bronn's Thier-reichs, Aves, p. 204-5), says:—"Diesen Muskel, der nicht in der Literatur erwähnt ist habe ich nur bei sehr wenigen Vögeln gefunden: Bei Rhea (nicht bei den übrigen Ratiten gesehen) entspringt er als ein sehr dünner Muskel fibular neben dem M. abductor dig. ii. und ist theilweise mit dem ihn lateral begrenzenden M. abductor dig. iv. verwachsen. Seine Sehne geht durch das Spatium intertarsale externum zur Tibialseite der Basis phal. i. und adducirt die Aussenzehe neben geringer Plantarflexion. Bei Bucorvus entsprang er von distalen Ende der Tarsus: bei Rhampastus war er noch kürzer und nutzlos."

In the Megapodes, it arises from the upper part of the anterior aspect of the tarso-metatarsus, and from part of that bone as well as from the side of the extensor brevis digitorum. It is a thin spindle-shaped muscle, which develops a thin rounded tendon passing down-

wards in a canal between the metatarsals of digit iii. and iv. to be fixed on the inner side of the base of the proximal phalanx of digit iv.

M. adductor digiti ii. is present as a small muscle rising from an area of the distal end of the tarsus, and underlying all the tendons of the deep flexors. It ends in a tendon which is inserted into the infero-lateral base of the proximal phalanx of the second digit.

EXPLANATION OF FIGURES.

FIGURE 1.—“*Catheturus lathami*,” dissection of muscles of thigh.

The overlying gluteus primus has been removed except the distal portion (t.f.). The biceps and semitendinous have only their proximal and distal portions left. All the gluteus medius has been removed except its tendon.

acc. semit. accessory semitendinosus
 add. long. adductor longus
 a.f.c. accessory femoro-caudal
 bic. biceps flexor cruris
 f.c. femoro-caudal
 fem. head of femur
 gl. min. gluteus minimus
 gl. med. gluteus medius
 gl. 4 gluteus quartus
 pyr. pyramidalis
 semim. semimembranosus
 semit. semitendinosus
 t.f. tensor fasciae
 v.e. vastus externus

FIGURE 2.—“*Catheturus lathami*,” back view of the tarso-metatarsus.

h. hypotarsus
 abd. dig. iv. abductor digiti iv.
 add. dig. i. adductor digiti i.
 ten. add. dig. iv. tendon of m. adductor digiti iv.
 dig. i. cavity left after removal of metatarsal of digit i.
 dig. ii., dig. iii., dig. iv. proximal phalanges of
 digits i., ii., iii., iv.

FIGURE 3.—“*Catheturus lathami*,” front view of the tarso-metatarsus.

add. dig. iv. adductor digiti iv.
 ten. its tendon