

THE PTERYLOSIS OF THE NESTLING *COUA RUFICEPS*

BY ANDREW J. BERGER AND WILLIAM A. LUNK

IT seems likely that differences in the pattern of the major feather tracts will be found of considerable importance in determining relationships within the order Cuculiformes. Berger (1953) recently described the pterylosis of an adult specimen of the Blue Coua (*Coua caerulea*). We are now able to describe the pterylosis of the nestling of another species, *C. ruficeps*, of this interesting genus. We are indebted to Dr. Renaud Paulian, Institut Scientifique de Madagascar at Tananarive, for his kindness in sending two sibling nestlings. These birds were taken from a nest near Ifotaka, Lower Mandrare, Madagascar.

Terminology of feather tracts follows that of Burt (1929).

Ventral tract. Marginal apteria (=submalar apteria) are present on each side of the inter-ramal tract. The *ventral cervical feather tract* is undivided anteriorly, but bifurcates about a third of the way down the neck. At the junction of neck and thorax, there is on each side a single row of feathers extending laterad to the ventral marginal coverts. Just anterior to this, another row (single at first) extends dorsad, then laterad, widening to become confluent with the anterior end of the humeral tract. (This row, being lateral in position, could not be clearly indicated in either the dorsal or the ventral view.) There is a wide lateral cervical apterium which is continuous posteriorly with the dorsally located interscapular apterium. Near the anterior end of the sternum, the ventral tract of each side bifurcates to form two *abdominal tracts*. The *inner abdominal tract* is composed of two rows of feathers throughout the sternal and anterior abdominal regions, and continues as a single row which stops short of the anus. The *outer abdominal tract*, also composed of a double row of feathers anteriorly and a single row posteriorly, does not turn inward to join the inner abdominal tract, but ends less than halfway between the posterior margin of the sternum and the anus. The lateral abdominal region is devoid of feathers. There is no anal cirlet of feathers.

Capital tract. A very small median frontal apterium is present. There are small superciliary apteria; and between them there is a continuous feather tract in the frontal, coronal, and occipital regions, but the feathers are more widely spaced in the temporal and lateral occipital regions. Well developed eye-lashes are present on both eyelids, those on the upper lids being longer. There is a limited, pigmented, bare area around the eye in the superciliary, subocular, and postocular regions; in the latter the bare area extends only a short distance posterior to the bony orbital rim. The *spinal cervical feather tract*, broadest at the base of the skull, ends abruptly at about the level of the shoulder joint. The interscapular region is devoid of feathers. The bilateral *dorsal spinal feather tracts* begin at about the level of the first dorsal vertebra. These two dorsal tracts meet at the level of the hip joint to form a *median pelvic tract*, which terminates anterior to the oil gland.

There is a single *humeral tract*, composed of closely spaced feathers, raised above the level of the surrounding skin.

Alar tract. There are 10 primaries, 10 greater primary coverts, and 5 middle primary coverts. There are five alula quills. The carpal remex and its covert are present. The fifth secondary is present, *i.e.*, the wing is eutaxic (=quintocubital). According to the

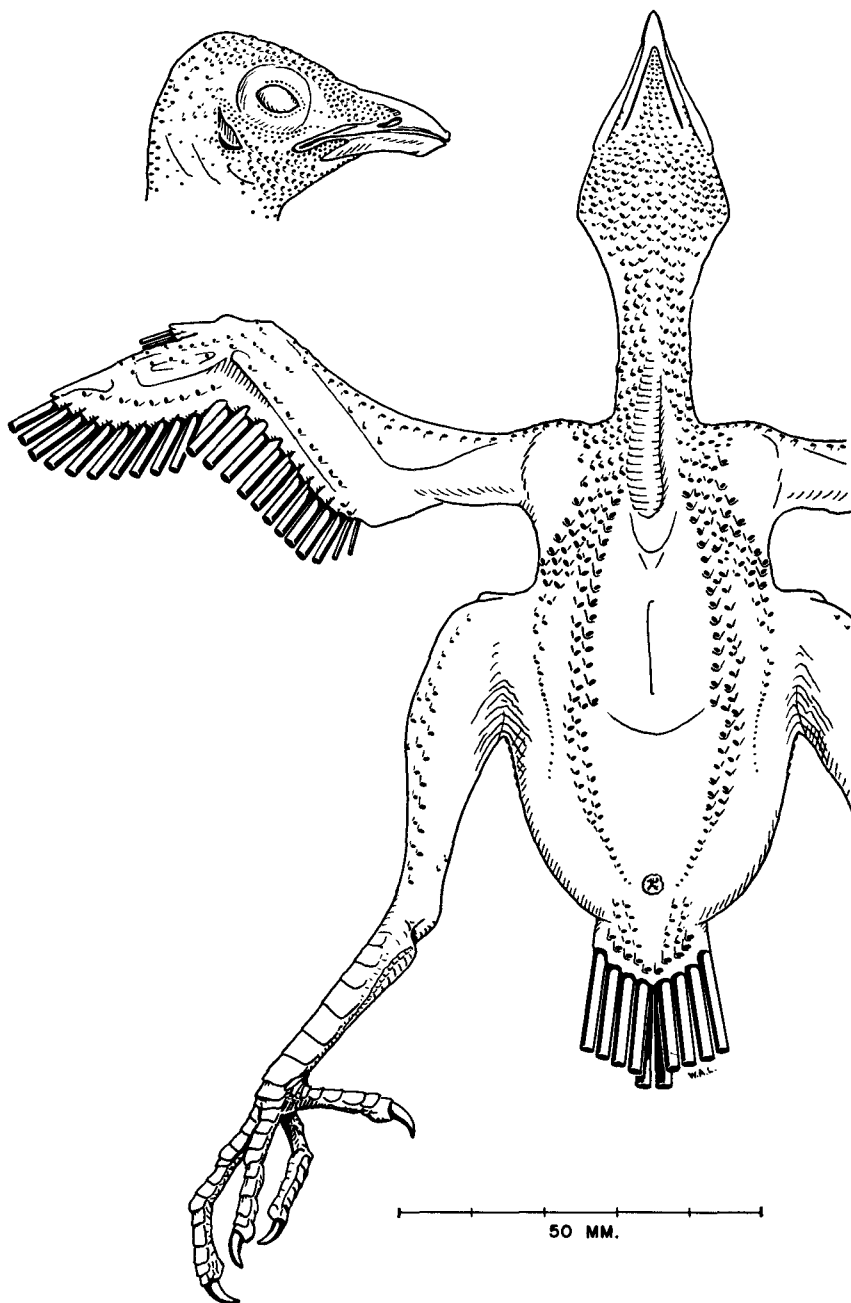


FIG. 1. Ventral view of nestling *Coua ruficeps* showing feather tracts.

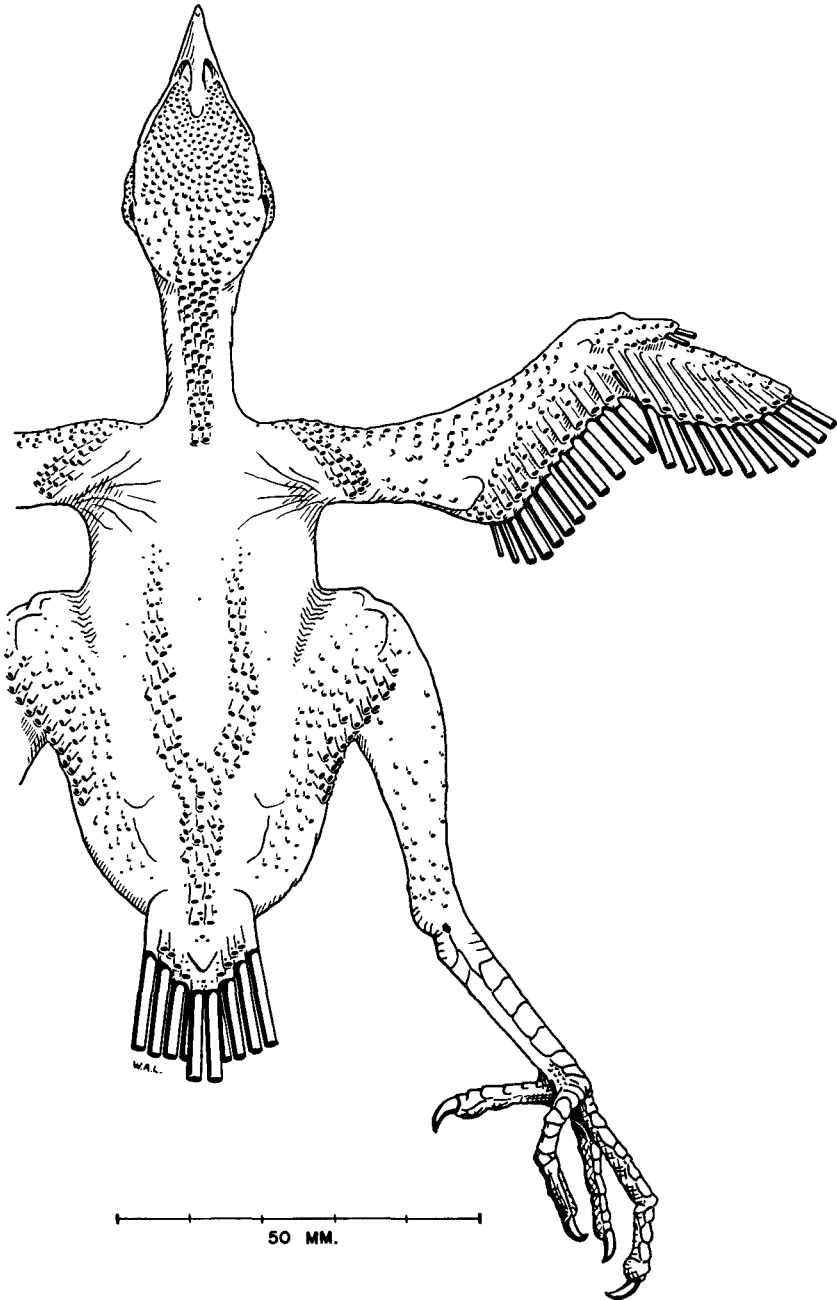


FIG. 2. Dorsal view of nestling *Coua ruficeps* showing feather tracts.

criteria we used, there are 12 secondaries, with 13 greater, 13 middle, and 15 lesser coverts. There is a distinct gap at the elbow between the secondary coverts and the tertials. (See discussion below.)

Caudal tract. There are 10 rectrices; the central pair (No. 1) is raised above the level of the others, and the second pair nearly meets beneath them. There are 8 upper and 10 lower tail coverts. The oil gland is nude. Three small feathers arising anterior to the gland send their shafts posteriorly over it.

The *femoral tract* consists of widely spaced feathers covering the outer aspect of the thigh and is bordered posteriorly by two well defined rows of very closely spaced feathers which extend onto the posteroproximal aspect of the crus.

The *crural tract* is best developed on the anterior aspect of the distal two-thirds of the crus, where it appears as a well defined, essentially double row. Laterally and posteriorly there are widely spaced feathers; the medial aspect of the crus is devoid of feathers.

DISCUSSION

Little is known about the development of nestling plumage in cuckoos. Oberholser presented a photograph of two young *Centropus senegalensis* but made only a few general comments on the color of the plumage because many of the feathers were still sheathed and the wings and tail were "very imperfectly developed" (1899:27). Shelford (1900) described and illustrated the pterylosis of the embryo and nestling of *Centropus sinensis*. Herrick (1910: 198, 204-205) presented some data on feathers of the nestling Black-billed Cuckoo (*Coccyzus erythrophthalmus*). Hartley (*in* Beebe *et al.*, 1917:309) illustrated the feather tracts in both the embryo and adult of the Smooth-billed Ani (*Crotophaga ani*).

To what extent the pattern of tracts described here for the nestling *Coua ruficeps* represents also the adult condition is not known. Nor is the feather pattern known for the nestling of any other species of this genus.

It seems probable, however, that new feathers continue to appear throughout the growth-period of the bird. Hartley's illustrations (*loc. cit.*) indicate that although the major feather tracts are visible in the embryo, additional tracts develop after hatching. In his report on the pterylosis of embryos of *Centropus sinensis*, Shelford (1900:654) spoke of the conspicuous covering of "long, white, thread-like structures" which he called "trichoptiles"; and that "dissection and microscopical examination show these threads to be enormous prolongations of the horny sheaths which envelop the developing feathers, a narrow lumen extends from the base to the tip of each, whilst the base of each lumen, again, is occupied by a feather-papilla, situated below the skin." Although Shelford found that "the arrangement of the trichoptiles is," in part, "prophetic of the adult pterylosis" (1900:666), he further stated: "The horny sheath of *all* the definitive feathers are not produced to form trichoptiles; whilst, on the other hand, certain areas occupied in the young nestling and embryo by trichoptiles are in later stages devoid of feathers" (1900:654).

In his fringillid studies, Sutton (1937) found whole new rows of feathers still coming in, particularly ventrally, after much of the juvenal plumage was complete.

There is no question that some marked change would be noted as the nestling matured. This is evidenced in the lack of symmetrical or regular alignment of feathers in the tracts, and in the great disparity in size between the "normal feathers," the much enlarged blood quills, and the minute, hairlike projections barely visible above the skin. The latter tend to be scattered, for the most part, along the periphery, and beyond the ends, of tracts. Whether they represent additional feathers that would later be as prominent as any of the others or whether they would remain rudimentary is as yet impossible to say. Some of the differences mentioned below would by inference be correlated with age, while others would represent specific characters. However, the following differences between the nestling of *ruficeps* and the adult of *caerulea* may be mentioned.

The feathers of the sterno-axillary region form a narrower and more compact tract in *ruficeps* than in *caerulea*. The inner abdominal tract extends to the anus in *caerulea*, but terminates lateral to that opening in *ruficeps*. An anal circlet of feathers is present in *caerulea*; it is lacking in *ruficeps*. In *caerulea* the outer abdominal tract turns inward to join the inner abdominal tract; in *ruficeps* the outer abdominal tract does not turn inward, and ends less than halfway between the posterior sternal margin and the anus.

In *caerulea*, the scapular region is covered by four widely separated rows of four feathers each and is connected with the spinal cervical tract by a single feather. In *ruficeps* the spinal cervical tract ends abruptly farther forward, at the level of the shoulder joint, and there is a long interscapular apterium between this tract and the two dorsal spinal tracts. In *caerulea* there is a single row of feathers down the midline in the median dorsal apterium; this character is not found in the nestling of *ruficeps*.

There is a single humeral tract in *ruficeps*; in *caerulea* there is an inner and an outer humeral tract. *Coua caerulea* has 10 secondaries; *ruficeps* 12. There is also a difference in the number of secondary coverts. In *caerulea* the secondary coverts seem to be continuous with the *distal* tertials at the elbow (see below); in *ruficeps* there is a wide diastema between the secondary coverts and the tertials.

The crowding and irregularity of feathers in the *ruficeps* nestling increase the difficulty of interpretation of certain differences between it and *caerulea*: e.g., note the apparent shifting of relative positions in the region of the carpal remex and its covert. In *caerulea* the carpal remex and its covert are inserted into the dorsal surface of the basal sheath of the first primary. In *ruficeps*, however, these feathers are inserted into the skin proximal to the first primary,

i.e., in the narrow diastema between the primaries and secondaries. Degen (1894:xxvi) believed that primitively the carpal remex had its attachment on the proximal phalanx of digit III. He believed further that a shifting of feathers from the manus to the ulna resulted from the ankylosis of certain carpal and metacarpal bones, and that the mechanical disadvantage of a flight feather located at the wrist joint resulted in the reduction in size of the carpal remex. Whether or not one accepts Degen's interpretation, the intercarpal location of the carpal remex and covert in the *ruficeps* nestling probably represents only a developmental position. It seems likely that continued ontogenetic differential growth, with an increase in size of the primary quills and a decrease in relative extent of the diastema, would "pull" the carpal remex and covert onto the surface of the basal sheath of the first primary. In this event, these feathers in the adult *ruficeps* would have similar relations to those found in the adult of *caerulea*.

Certain differences pointed out above center around the elbow region. Counts of greater, middle, and lesser secondary coverts, even the counts of secondaries themselves, and the separation or non-separation of secondaries and tertials, all seem to hinge on the correct interpretation of the small and crowded feathers near the elbow. To one who has not dissected the region in detail, or to one not thoroughly familiar with the accepted criteria of the various rows and tracts, the whole set of distinctions seems somewhat subjective. It is undeniable that to the reader who gives the drawings close study, the general pattern of feathers on the elbow and lower humeral region in the two species will look closely similar (compare with illustrations in Berger, 1953).

The secondaries (=cubitals) are by definition those flight feathers which "are seated on the fore-arm" (Coues, 1903:119). Though this seems to be a simple and clear-cut definition, it is not an easy matter to determine, in all cases, where the secondaries end and the tertials begin. There has been, in fact, considerable discussion on this matter. Wray (1887:344) stated that "the term 'tertials' or 'tertiaries' has been abandoned, 'cubitals' always including them when present, because there is no way of absolutely distinguishing any definite number of remiges as belonging to this special category." Pycraft (1889:134) felt that the feathers in question should be called "inner secondaries." Degen (1894:xxi) preferred the term "parapteron," which earlier had been used by Nitzsch. Newton (1896:780) also stated that tertials "have no separate existence," but Coues (1903:119) said that the tertiaryes "are properly the remiges which grow upon the arm, *humerus*. But such feathers are not very evident in most birds, and the two or three innermost secondaries, growing upon the very elbow, and commonly different from the rest in form or color, pass under the name of 'tertiaries.'" Coues further remarked

that the tertiaries "often afford good characters for description, in peculiarities of their size, shape, or color." A.A. Allen (1930:214) also said that the "innermost of the secondary group of feathers born on the 'elbow' are often elongated and spoken of as *tertiaries* or *tertials*." (For a further discussion of this problem the reader is referred to the paper by Sundevall, 1886, pp. 403-404.)

In the two specimens of *ruficeps*, all of the feathers borne on the elbow are attached either directly to the ulna or to the skin covering the olecranon process of that bone; consequently, they belong to the cubital series. It is not now possible to recheck this point on *caerulea*, but in determining the number of secondaries in that species, Berger dissected the wing so that the feathers could be traced to their bony attachments or to their position on the skin covering the ulna (the innermost secondaries are not actually attached to the bone). His statement (1953:13) that "the three rows of coverts are continuous with the tertials at the elbow," must be interpreted as meaning that in the adult *caerulea* there are small feathers located proximal to the cubital series and that they are inserted into the skin covering the distal part of the humerus and not into the skin covering the olecranon process of the ulna. The fact that the two series of feathers are in continuity increases the difficulty of deciding where one series stops and the other begins.

Probably because of this arrangement of feathers, the number of secondaries has not been used much as a diagnostic character; Ridgway (1916), for example, does not use this character. In some cuckoos, at least, the innermost two or three secondaries are progressively smaller and this fact plus the crowding of the coverts at the elbow region, makes an accurate count difficult if not impossible.

Those feathers which grow on the posterior aspect of the middle portion of the arm (=humerus) may be referred to as the tertiaries or as the parapteron. In plumage descriptions care must be taken to indicate whether a description pertains to this tract or to those sometimes elongated feathers, growing in the elbow region, which are attached to the skin overlying either the distal end of the humerus or the olecranon process of the ulna.

LITERATURE CITED

- ALLEN, A. A.
1930 The book of bird life. D. van Nostrand Co., New York, 426 pp.
- BEEBE, W., G. I. HARTLEY, AND P. C. HOWES
1917 Tropical wild life in British Guiana. N. Y. Zool. Soc., 504 pp.
- BERGER, A. J.
1953 The pterylosis of *Coua caerulea*. *Wilson Bull.*, 65:12-17.
- BURT, W. H.
1929 Pterylography of certain North American woodpeckers. *Univ. Calif. Publ. Zool.*, 30:427-442.

- COUES, E.
1903 Key to North American birds. 5th ed., 2 vols., Dana Estes and Co., Boston.
- DEGEN, E.
1894 On some of the main features in the evolution of the bird's wing. *Bull. Brit. Ornith. Club*, 2:vii-xxxiii.
- HERRICK, F. H.
1910 Life and behavior of the cuckoo. *Jour. Exp. Zool.*, 9:169-233.
- NEWTON, A.
1896 A dictionary of birds. Adam and Charles Black, London, 1088 pp.
- OBERHOLSER, H. C.
1899 A list of the birds collected by Mr. R. P. Currie in Liberia. *Proc. U.S. Natl. Mus.*, 22:25-37, pl. 7.
- PYCRAFT, W. P.
1889 A contribution to the pterylography of birds' wings. *Trans. Leicester Lit. and Phil. Soc.*, 2:123-144.
- RIDGWAY, R.
1916 The birds of North and Middle America. *Bull. U. S. Natl. Mus.* No. 50, part 7.
- SHELFORD, R.
1900 On the pterylosis of the embryos and nestlings of *Centropus sinensis*. *Ibis*, 1900:654-667.
- SUNDEVALL, C. J.
1886 On the wings of birds. *Ibis*, 1886:389-457.
- SUTTON, G. M.
1937 The juvenal plumage and postjuvenal molt of the Chipping Sparrow. *Occ. Pap. Univ. Mich. Mus. Zool.*, No. 355:1-5.
- WRAY, R. S.
1887 On some points in the morphology of the wings of birds. *Proc. Zool. Soc. London*, 1887:343-357.

DEPARTMENT OF ANATOMY, UNIVERSITY OF MICHIGAN MEDICAL SCHOOL, AND
MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, ANN ARBOR, AUGUST 20,
1953