

**Pterylosis of the Wing and Tail in the Noisy Scrub-Bird,
Atrichornis clamosus, and
Superb Lyrebird, *Menura novaehollandiae*
(Passeriformes: Atrichornithidae and Menuridae)**

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ABSTRACT. The wing and tail pterylosis of *Atrichornis clamosus* and *Menura novaehollandiae* were studied. On comparing the wing pterylosis, a great difference was found in the number of the remiges and coverts, especially those in the forearm. In comparison with *Ploceus nigerrimus* (Morlion, 1971), chosen as a representative passerine, we saw that in wing pterylosis *Atrichornis* is much nearer to the Passeres than is *Menura*.

In the tail pterylosis, a great difference also exists between the two species investigated: not only in the aspect of the feathers, but also in the number of rectrices, greater upper and under tail coverts and in the presence or absence of the first pair of upper and under tail coverts. In contrast to the wing pterylosis, however, the tail pterylosis of *Atrichornis* is markedly different from *Ploceus nigerrimus*.

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KEYWORDS: comparative morphology, pterylosis, Atrichornithidae, Menuridae, Aves.

The wing and tail pterylosis of *Atrichornis clamosus* and *Menura novaehollandiae* were investigated using the clipping method (Morlion, 1971). Because the tips of the remiges and rectrices of the *Menura* specimen were worn, only the measurements of the wing and tail feathers of *Atrichornis* could be taken.

A. Alar tract

Figs 1-9, Table 1

1. Primaries. In *Atrichornis*, ten well developed primaries are present. All of the remiges overlap laterally in the same way: the distal (outer) vane of each remex overlaps the proximal vane of the next distal feather. The diameter of the calamus gradually decreases outwards; the last two primaries have a markedly smaller rachis. Neighbouring downy feathers are absent on both sides of the wing. On the dorsal side, the first four primaries are accompanied by two proximal filoplumes (6 mm long), the fifth and sixth primaries have only one proximal filoplume, and the rest have none. On the ventral side, no filoplumes are found near

the primaries.

Menura possesses eleven primaries: ten are well developed and the eleventh is weaker. In this feature, *Menura* differs from most Passeres and resembles many non-passerines. Other passerines known to have eleven primaries include *Corvus* (Morlion & Vanparijs, 1979). From the innerside to the tip of the hand, the calamus diameter of the primaries gradually decreases. All of the remiges overlap laterally as in *Atrichornis*. On the dorsal side of the wing near the base of each of the primaries, three downy feathers are found, one or two of them lying in the skin fold between the primaries. Filoplumes are absent. On the ventral side of the wing, Prim. I up to Prim. III, inclusive, have on their proximal side a downy feather inserted on the skin fold and under the corresponding upper greater primary covert. Prim. IV up to Prim. IX, inclusive, have a proximal downy feather over their calamus. Prim. X has no proximal, but four distal downy feathers.

2. Secondaries. In *Atrichornis* there are nine secondaries, as in most Passeres. They show the same overlapping as the primaries and lie parallel with each

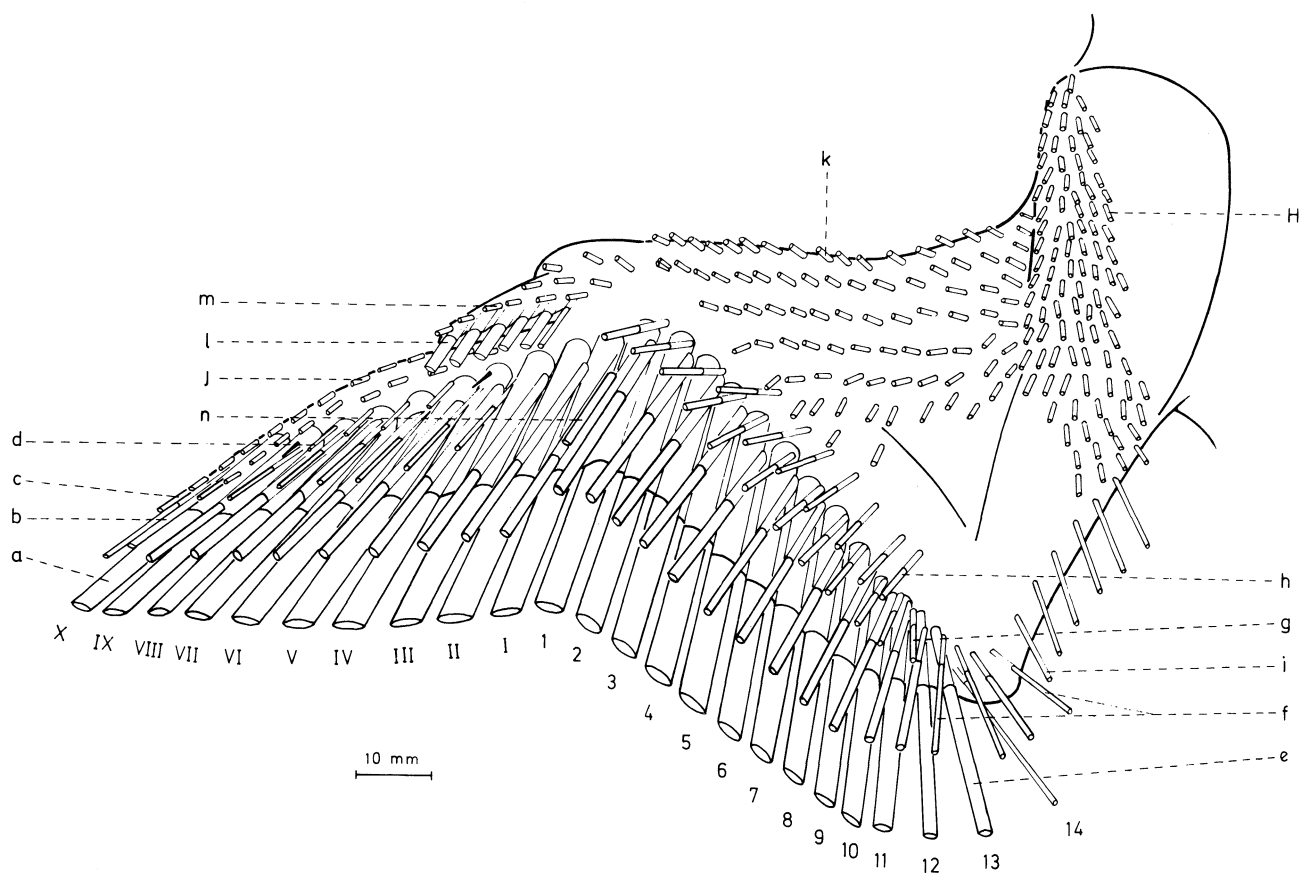


Fig. 1. Pterylosis of the wing of *Menura novaehollandiae*: dorsal view.

- | | |
|------------------------------------|-----------------------------------|
| a. primaries (numbered I-X) | h. upper lesser secondary coverts |
| b. upper greater primary coverts | i. tertiary coverts |
| c. upper middle primary coverts | j. upper carpometacarpal coverts |
| d. upper lesser primary coverts | k. upper marginal coverts |
| e. secondaries (numbered 1-14) | l. alula quills |
| f. upper greater secondary coverts | m. alula coverts |
| g. upper middle secondary coverts | n. carpal covert |
| H. pteryla humeralis | |

other. The calamus diameter decreases from the distal part of the forearm, inward. On the dorsal side of the wing, neither downy feathers nor filoplumes accompany the secondaries. On the ventral side of the wing, only the first two secondaries have a proximal filoplume, both of which originate from a distinct papilla. Near the other secondaries, downy feathers and filoplumes are completely missing.

In *Menura*, the secondaries are fourteen in number, much more numerous than in most Passeres, which usually have nine. Sibley (1974) reported only ten secondaries in *Menura*. From Sec. 11 to Sec. 14, a marked decrease in calamus diameter occurs. The fourteenth secondary is rather thin and it does not insert on the border of the underarm, but lies slightly dorsal to the others. The wing is eutaxic. The proximal secondaries spread open, fan-like. On the dorsal side of the wing, three downy feathers insert between each of the first six secondaries and their corresponding upper greater secondary coverts; between the seventh to the

tenth secondaries and their coverts, two downy feathers are found; between the eleventh secondary and its covert only one is found; and the remaining secondaries have no downy feathers at all. A few irregularly spaced filoplumes can be found mediodorsal to the secondaries. On the ventral side of the wing, some secondaries have one or two very short, 3 mm long, filoplumes. The downy feathers found proximal to Sec. 9 through Sec. 13 could represent vestigial under greater secondary coverts.

3. Upper greater primary coverts. *Atrichornis* has ten upper greater primary coverts. They insert distally to and near the insertion of their corresponding primary. They form a very small acute angle with their remiges; only the last ones are nearly parallel with the primaries. The coverts overlap in the same way as the primaries. The barbs of the vane converge medially and there is a very weak hyporachis consisting of just a few filaments. No downy feathers or filoplumes are found, except for the ninth and tenth upper greater primary

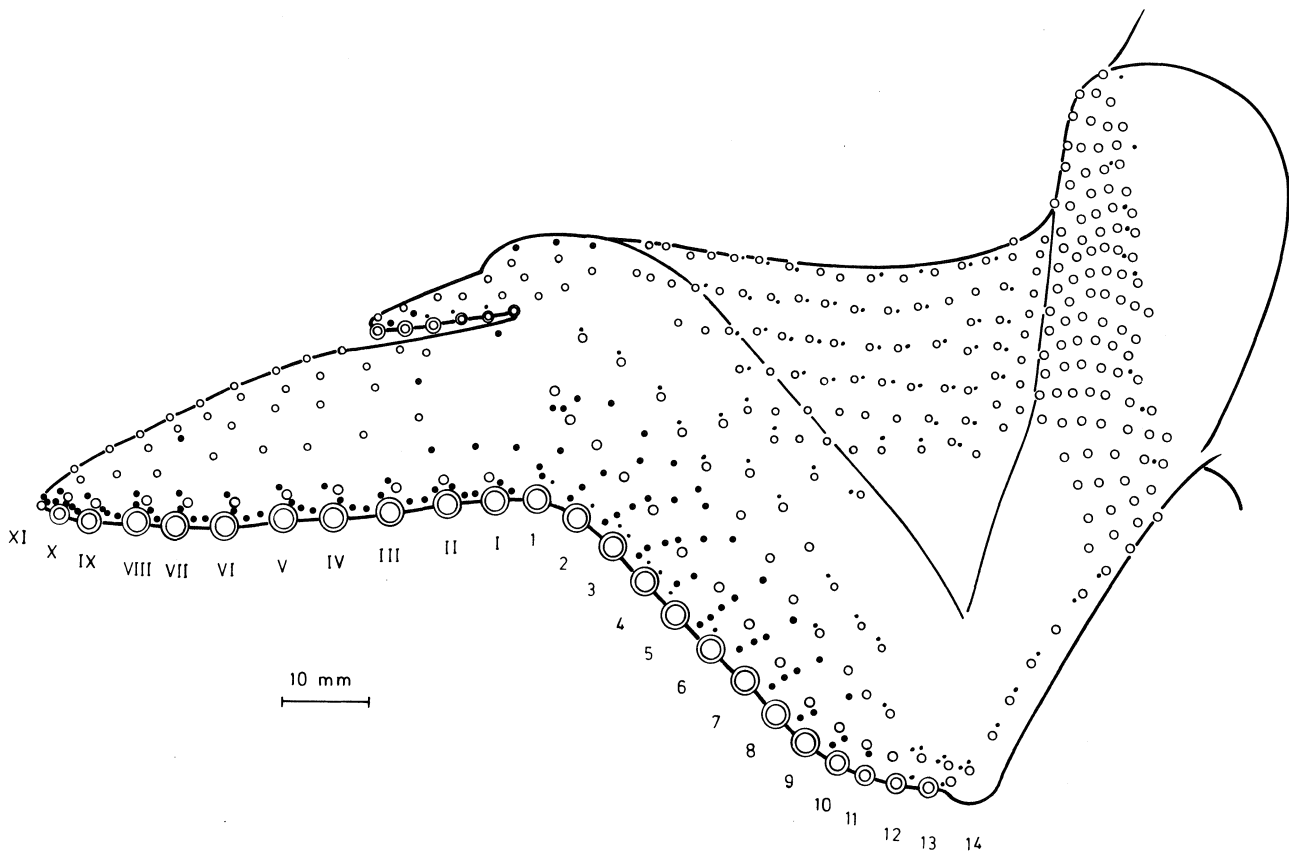


Fig. 2. Pterylosis of the wing of *Menura novaehollandiae*: dorsal view.

⊙ remex
○ covert

● downy feather
● filoplume

coverts which possess one distal filoplume each.

Menura has ten well developed upper greater primary coverts. They insert over the distal half of the calamus of the corresponding primary. Prim. XI has no upper greater primary covert. The calami of these coverts lie parallel to each other and caudodistally to the calamus of the corresponding primary, making a small acute angle with the latter. They have the same overlap as the primaries. With the exception of the first two, each greater primary covert possesses a distal downy feather. These coverts do not have a hyporachis but the two sides of the vane converge medially on the calamus.

4. Upper greater secondary coverts. In *Atrichornis* the number of upper greater secondary coverts outnumbers the number of secondaries by one. Each of these ten coverts inserts distally to its corresponding secondary and forms a distinct acute angle with it. This angle is very small for the eighth upper greater secondary covert, while the ninth covert runs nearly parallel to its secondary. Here too, the barbs converge medially and a very weak hyporachis is found. No downy feathers are present but each covert possesses a distal filoplume (up to 12 mm long).

There are sixteen upper greater secondary coverts in *Menura*. All of the secondaries possess a greater secondary covert inserted halfway up their calamus and

on the distal half. Only the fourteenth inserts just dorsally of its corresponding secondary. The two 'additional' upper greater secondary coverts (without a corresponding secondary) have a stronger rachis and different orientation, easily distinguishable from the tertiary coverts. All these coverts show a caudodistal orientation. Only the last three exhibit a more caudoproximal direction. These coverts lack a hyporachis. Most of them are accompanied by a distal downy feather and the last three possess two distal filoplumes each.

5. Upper middle primary coverts. In *Atrichornis*, seven pennaceous and one downy upper middle primary coverts are found. Coverts associated with the ninth and tenth primaries are missing and the eighth is downy. The upper middle coverts insert distally to the upper greater primary coverts and lie parallel to them. These little feathers are too small to overlap each other. Some of them lack pigment. They have a very weak hyporachis. Neither downy feathers nor filoplumes are found in their surroundings.

Eight upper middle primary coverts are present in *Menura*. Near Prim. I up to Prim. III, inclusive, they are lacking, but a downy feather inserts at the lower third of the calamus. The eight following upper greater primary coverts each have an upper middle covert. The

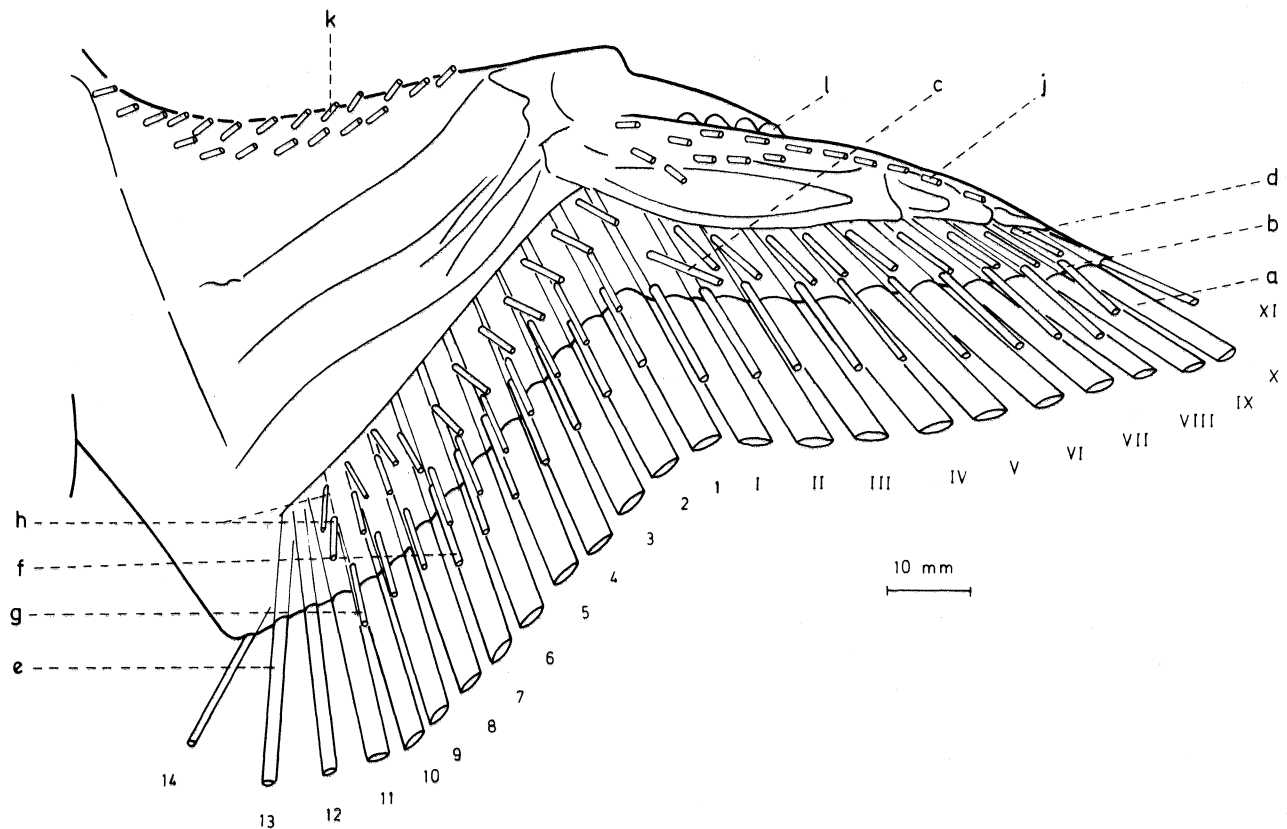


Fig. 3. Pterylosis of the wing of *Menura novaehollandiae*: ventral view.

- | | |
|------------------------------------|-----------------------------------|
| a. primaries (I-XI) | g. under middle secondary coverts |
| b. under greater primary coverts | h. under lesser secondary coverts |
| c. under middle primary coverts | j. under carpometacarpal coverts |
| d. under lesser primary coverts | k. under marginal coverts |
| e. secondaries (1-14) | l. alula quills |
| f. under greater secondary coverts | |

insertion of these latter coverts is somewhat different from that usually found in the Passeres. In *Menura* they insert over the proximal half of the corresponding primary calamus and lie proximally and parallel to the corresponding upper greater primary covert. They have a slightly caudo-proximal orientation, forming a small acute angle with the primaries. They lack both a hyporachis and accompanying downy feathers or filoplumes.

6. Upper middle secondary coverts. In *Atrichornis* the first of the eight upper middle secondary coverts is downy, the other seven are little quills. They insert near the end of the calamus of the corresponding secondary, and distally to this secondary and its upper greater secondary covert. The first upper middle secondary coverts form a small acute angle with the upper greater secondary coverts, the last ones lie parallel to them. The last two have a notably smaller rachis. A very weak filamentous hyporachis is found in the middle of the converging barbs. No downy feathers or filoplumes are found in their surroundings.

There are twelve upper middle secondary coverts in *Menura*. Sec. 13 and Sec. 14 have none. These coverts

insert on the distal side of the calamus of the corresponding secondary and the upper greater secondary covert. Initially they are caudodistally oriented but the last one is caudally directed. They lack a hyporachis. Most of them are accompanied by a distal filoplume. Between the insertions of each set of corresponding greater and middle secondary coverts, one or two downy feathers are found.

7. Upper lesser primary coverts. The upper lesser primary coverts are completely missing in *Atrichornis*. In *Menura*, one proximally incomplete row of four well developed and two downy (the most proximal and the most distal) upper lesser primary coverts is present. Distally these coverts are continuous, by way of that distal downy feather with the upper carpometacarpal coverts. The upper lesser primary coverts lack a hyporachis. As far as it is known, these feathers are completely missing in all other Passeres.

8. Upper lesser secondary coverts. In *Atrichornis*, the upper lesser secondary coverts consist of an incomplete row of seven downy feathers. One incomplete row of seven well developed upper lesser secondary coverts is found in *Menura*. They lack a hyporachis. A distal

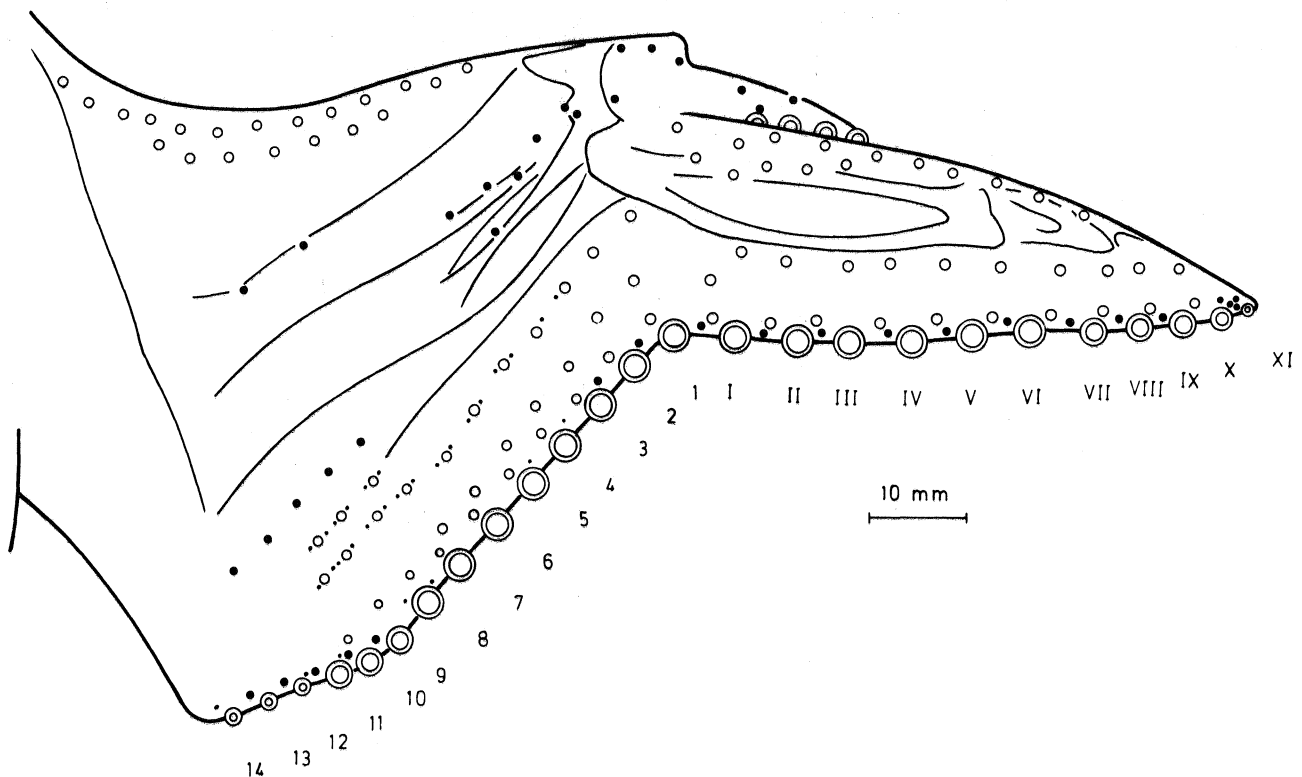


Fig. 4. Pterylosis of the wing of *Menura novaehollandiae*: ventral view.

⊙ remex
○ covert

● downy feather
● filoplume

filoplume is found near all but one of them.

9. Tertiary coverts. In *Atrichornis* there is a double row of tertiary coverts, inserted and oriented parallel to the caudal border of the upper arm. The upper row consists of four feathers with a distinct downy hyporachis and an accompanying distal filoplume. The four feathers of the lower row have the same kind of hyporachis but lack filoplumes.

There is a single row of six tertiary coverts in *Menura*. They are accompanied by a distal or a proximal filoplume. A hyporachis is lacking. Proximally they are continuous with the humeral coverts; distally they touch the upper greater secondary coverts.

10. Upper carpometacarpal coverts. A double row of upper carpometacarpal coverts inserts at the foremost border of the hand in both species. The most peripheral row inserts on the hand border. The feathers are oriented parallel to that border. In *Atrichornis*, these coverts are preceded by one or two downy feathers and all the coverts have a weak filamentous hyporachis. They lack a hyporachis in *Menura novaehollandiae*. No downy feathers or filoplumes are found in their surroundings.

11. Upper marginal coverts. The upper marginal coverts are not very numerous in *Atrichornis*. They form a lozenge pattern on the propatagium. The little pennaceous feathers of the most cranial row alternate with downy feathers. Otherwise no other downy feathers

are found among them. Most coverts are anterodistally oriented; only the more caudally inserted quills are posterodistally directed. The marginal coverts have a weak hyporachis and have a distal filoplume.

The upper marginal coverts are very numerous in *Menura*. Their insertions form a lozenge pattern on the propatagium. Horizontal and oblique rows can be distinguished. Most coverts have a filoplume in their immediate vicinity. Proximally, the marginal coverts are continuous with the humeral coverts but can be distinguished by a different orientation. Distally a small apterium separates them from the alula coverts. Most marginal coverts are anterodistally oriented; only the feathers of the lowest row are posterodistally directed. A hyporachis is absent.

12. Under greater primary coverts. In *Atrichornis* there are ten pennaceous and one downy under greater primary coverts. They insert very near the insertions of the primaries and just proximal to them. Distally to the first two is a filoplume originating from a distinct papilla. Downy feathers are completely absent in their vicinity. The first under greater primary covert has a stronger rachis than the others. All of them possess a distinct but weak hyporachis.

In *Menura* too, ten under greater primary coverts insert near the base, and lie on the proximal side, of the calamus of the corresponding primary. The proximal coverts lie parallel to the primaries; more distally, they

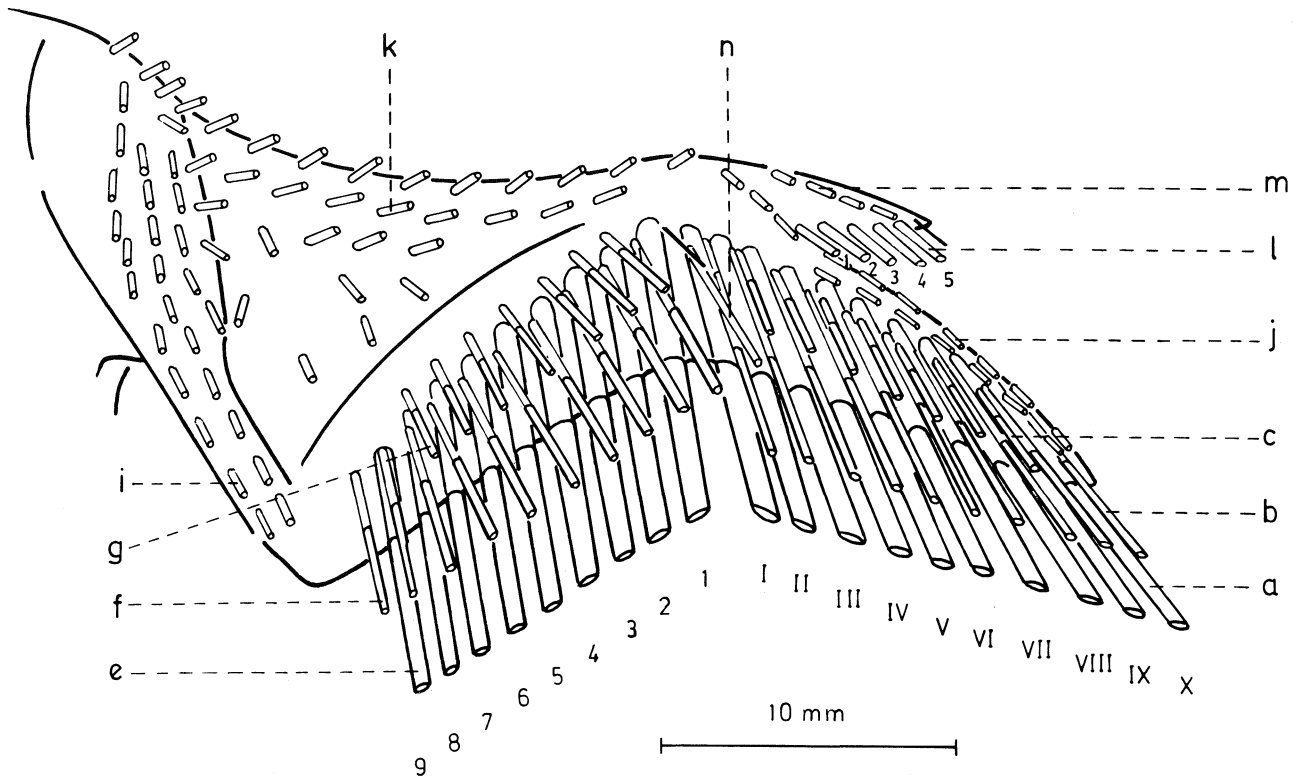


Fig. 5. Pterylosis of the wing of *Atrichornis clamosus*: dorsal view.

- | | |
|------------------------------------|----------------------------------|
| a. primaries (I-X) | i. tertiary coverts |
| b. upper greater primary coverts | j. upper carpometacarpal coverts |
| c. upper middle primary coverts | k. upper marginal coverts |
| e. secondaries (1-9) | l. alula quills (1-5) |
| f. upper greater secondary coverts | m. alula coverts |
| g. upper middle secondary coverts | n. carpal covert |
| H. pteryla humeralis | |

exhibit a slightly oblique course, forming a small acute angle with them. All these coverts are well developed and do not have a hyporachis. Externally, their calamus is not visible. A weak, downy feather inserts at the place of the eleventh under greater primary covert. These coverts are not accompanied by either downy feathers or filoplumes.

13. Under greater secondary coverts. The under greater secondary coverts are completely absent in *Atrichornis*. In *Menura*, there are seven pennaceous under greater secondary coverts, inserted proximally to their corresponding secondaries and oriented parallel to them. The first four coverts are plain quills and the following three are less developed and somewhat downy quills. Near the eighth secondary, no proximal covert is found but, proximal to the ninth and up to the thirteenth, a downy or even very weak downy feather is present. Perhaps these can be considered as vestigial under greater secondary coverts. No filoplumes or other downy feathers are found in the surroundings of these feathers. In the Passeres the under greater secondary coverts are usually absent and, if present, they are small and rudimentary downy feathers.

14. Under middle primary coverts. In *Atrichornis*, the first under middle primary covert is the only one present. It inserts proximally to the first primary and the first under greater secondary covert, and lies parallel to them. It has a distinct filamentous hyporachis.

The first under middle primary covert is also the only one present in *Menura*. It has an obvious oblique orientation, is posterodistally directed, and forms an acute angle with the first primary. Its insertion lies halfway down the calamus of this primary. There are no accompanying filoplumes or downy feathers.

15. Under middle secondary coverts. There are eight pennaceous under middle secondary coverts and a ninth downy one in *Atrichornis*. The first two lie on the proximal side of the calamus of the corresponding secondary; the others undergo a slight proximal shift so that they are not situated on, but lie next to the calamus at its proximal side. Their course is parallel to that of the corresponding secondary. Proximal to each quill, a papilla is found and, near the sixth, seventh and eighth under middle secondary covert, a filoplume is inserted in the papilla. No downy feathers are present in the vicinity. Some weak filaments constitute a

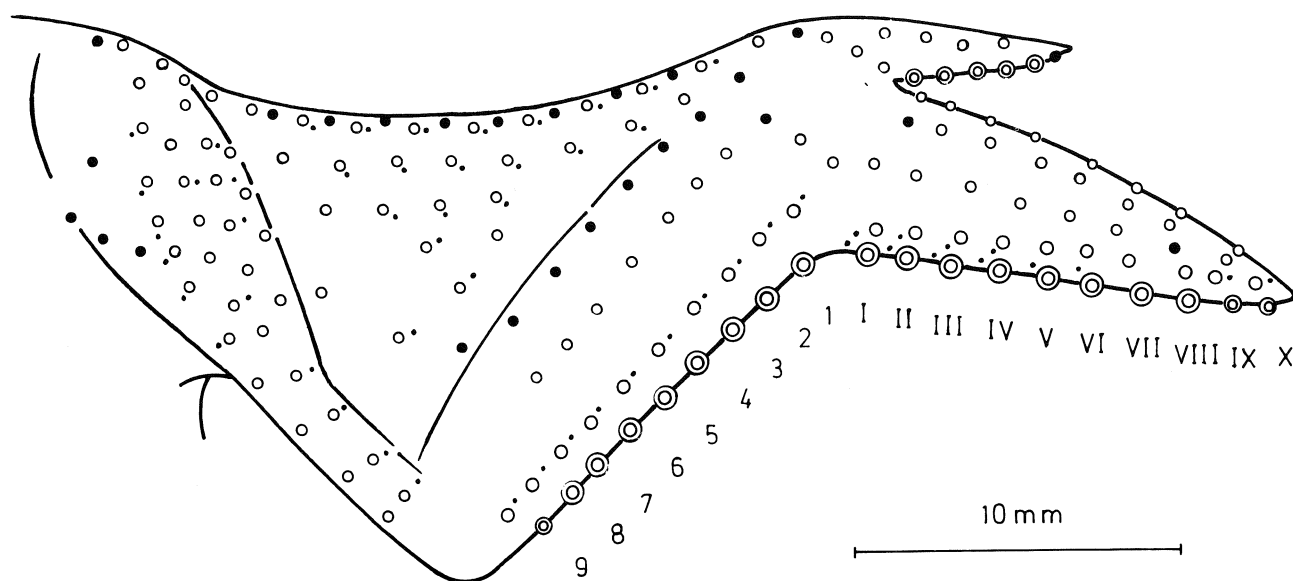


Fig. 6. Pterylosis of the wing of *Atrichornis clamosus*: dorsal view.

⊙ remex
○ covert

● downy feather
• filoplume

hyporachis.

In *Menura* the ten under middle secondary coverts insert proximally to their corresponding secondaries and lie parallel to them. Only the most proximal coverts show a slight change in orientation. No downy feathers or filoplumes are found near them. All the under greater and middle coverts are reversed: their concave, morphologically ventral side lies at the outside, and not inwards, as for the other coverts.

16. Under lesser primary coverts. In *Atrichornis* ten pennaceous, followed by one downy, under lesser primary coverts are found. They insert proximally to the corresponding primary and under greater primary covert, and form a small acute angle with them. They are weak, somewhat downy little quills; some of them lack pigmentation. They have a very weak, downy hyporachis. No downy feathers or filoplumes are found near them.

There are ten under lesser primary coverts in *Menura*. Each primary, except the first, has on the proximal side of its calamus an under lesser primary covert. The covert near the eleventh primary is less developed and somewhat downy. The coverts' rami converge medially, but a true hyporachis is lacking. Downy feathers and filoplumes are not present.

17. Under lesser secondary coverts. In *Atrichornis* there are three pennaceous and four downy under lesser secondary coverts. These little coverts are much weaker than those of the other series in the same bird. They insert proximally to their corresponding secondary and under middle secondary covert, and are slightly posterodistally oriented. Some of them lack pigmentation.

There are two rows of under lesser secondary coverts

in *Menura*. The first row has eleven feathers; only near the last three secondaries are they missing. Most of the coverts have a filoplume on both sides. The second incomplete row has only three coverts, lying above the proximal end of the other row. A third, distally incomplete row of downy feathers is also present.

18. Under carpometacarpal coverts. In *Atrichornis*, the under carpometacarpal coverts consist of a single row of six little quills. They insert parallel to the border of the hand but are not oriented parallel to it. They have a weak, downy hyporachis. Downy feathers or filoplumes are not present in this area.

In *Menura* the under carpometacarpal coverts consist proximally of a double, but distally of a single, row of feathers, inserted and oriented parallel to the border of the hand. These coverts lack a hyporachis. Neither downy feathers nor filoplumes are found nearby.

19. Under marginal coverts. In *Atrichornis*, only one row of nine under marginal coverts is present. They insert very near to the anterior border of the propatagium, and the row of their insertion lies parallel to it, but the feathers are anterodistally directed. Each covert has a posterodistal filoplume and the most proximal one even has a supplementary little quill posterodistal to it. These coverts have a very weak hyporachis. A few downy feathers are sparsely distributed over the undersurface of the propatagium.

A double row of feathers situated at the anterior border of the propatagium forms the under marginal coverts in *Menura*. They insert parallel to the propatagium border, but are not oriented parallel to it. Some of them have a distal filoplume.

20. Under tertiary coverts. In *Atrichornis* three downy under tertiary feathers are present. *Menura* has

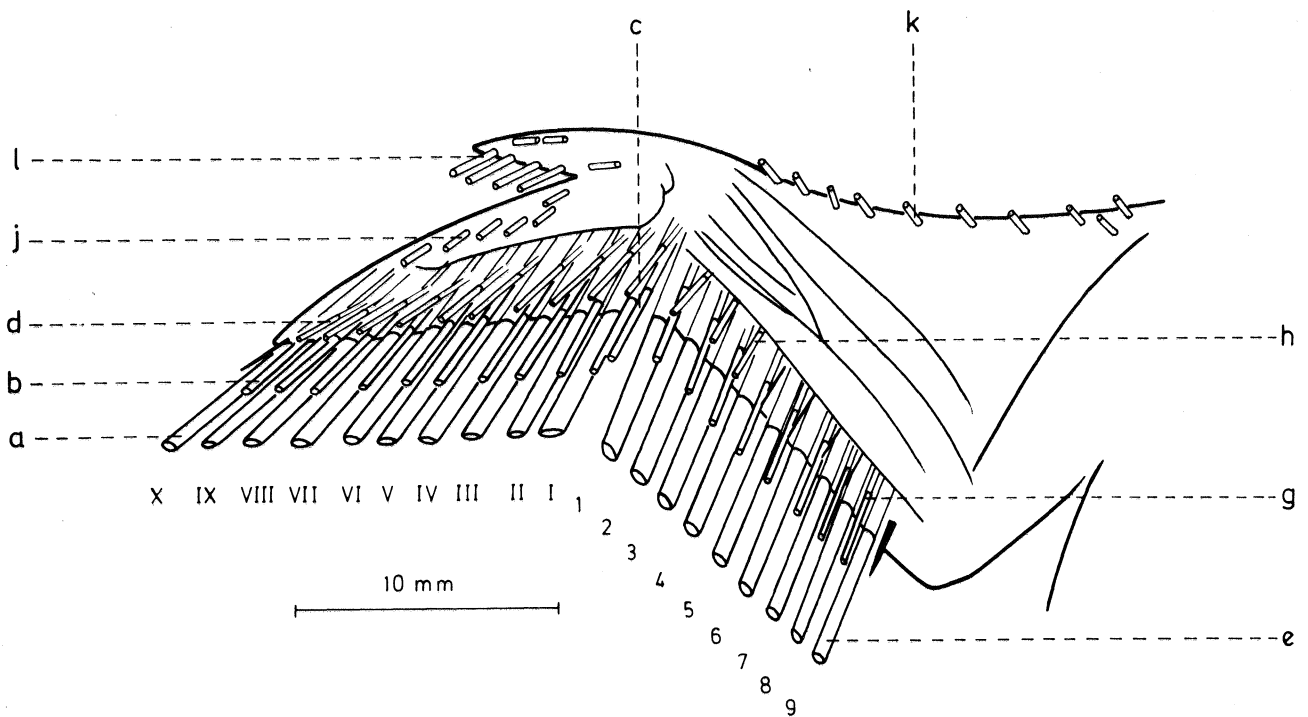


Fig. 7. Pterylosis of the wing of *Atrichornis clamosus*: ventral view.

- | | |
|----------------------------------|-----------------------------------|
| a. primaries (I-X) | g. under middle secondary coverts |
| b. under greater primary coverts | h. under lesser secondary coverts |
| c. under middle primary covert | j. under carpometacarpal coverts |
| d. under lesser primary coverts | k. under marginal coverts |
| e. secondaries (1-9) | l. alula quills |

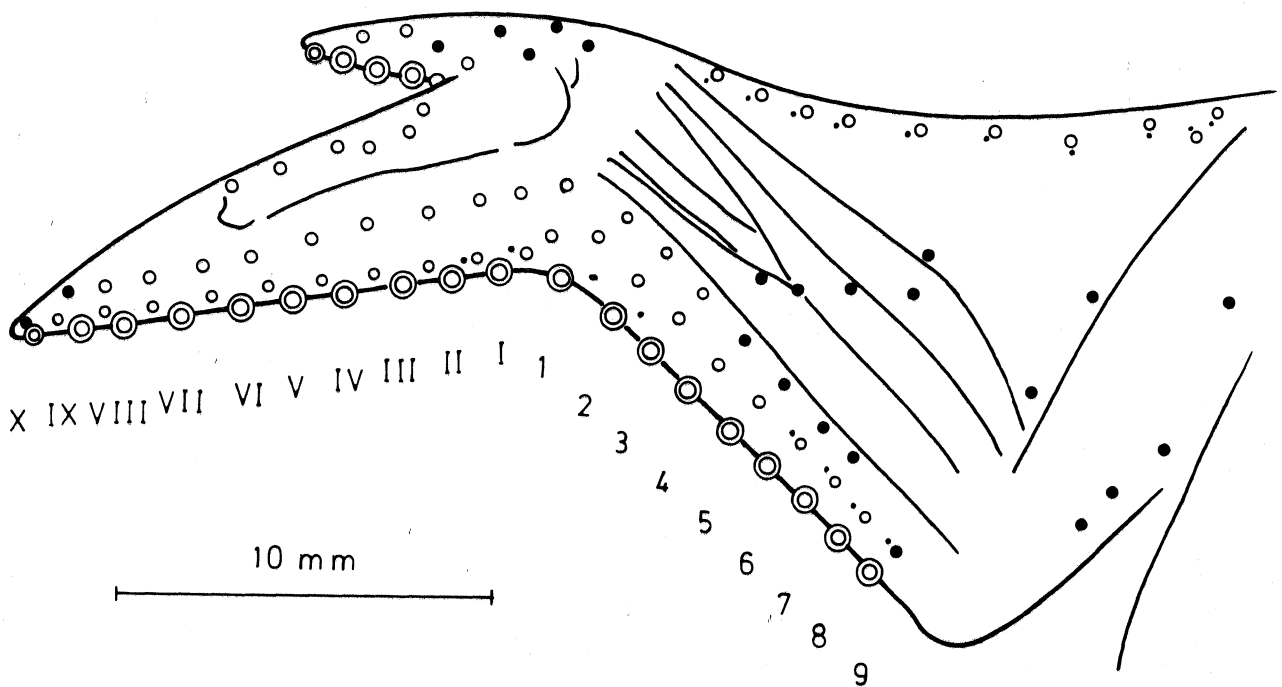


Fig. 8. Pterylosis of the wing of *Atrichornis clamosus*: ventral view.

- | | |
|----------|-----------------|
| ⊙ remex | ● downy feather |
| ○ covert | ● filoplume |

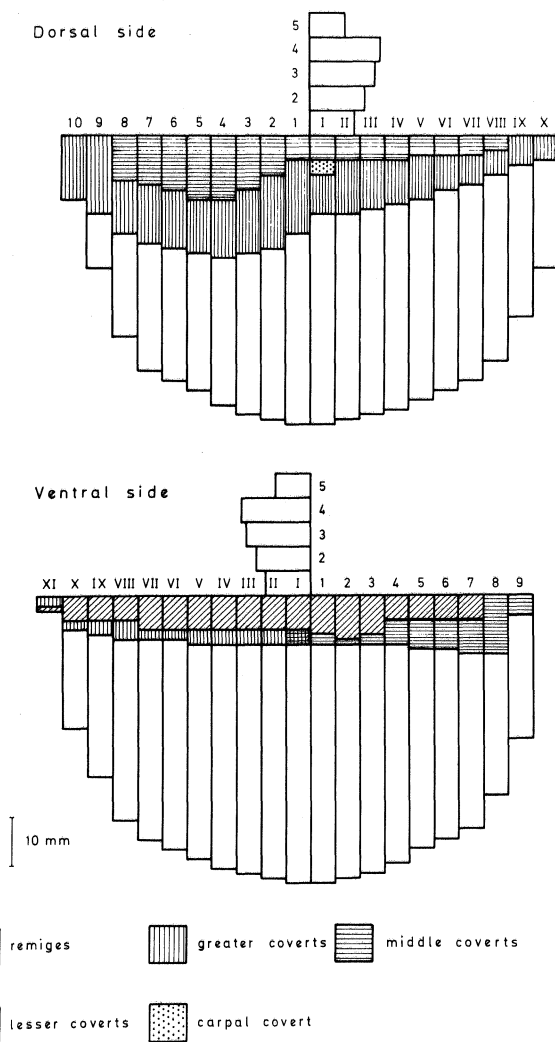


Fig. 9. *Atrichornis clamosus*: length of the principal wing feathers (the gridded area under primary I of the ventral side means both greater and middle covert presence.)

no under tertiary coverts whatsoever.

21. Alula In *Atrichornis* the alula has five well developed alula quills. The first four increase in length distally; the fifth is smaller and is followed by a sixth downy feather. Another little quill, inserted proximally to this series, appears to be another alula quill, but in structure, length and possession of a hyporachis is more similar to the alula coverts. There are seven upper alula coverts with a weak, filamentous hyporachis. On the ventral side of the alula, two or three little quills and five downy feathers are present.

In *Menura* the alula has six well developed quills. Most Passeres have three or four alula quills. Distally, the alula feathers increase in length. The most distal three have the largest rachis, the proximal three have a weaker rachis. They overlap distal-over-proximal and are accompanied by downy feathers or filoplumes. On the dorsal side of the wing, each alula quill has at least

one proximal covert. In total, there are three rows of alula coverts and a fourth row of downy feathers on the dorsal side of the wing. On the ventral side, some downy feathers are irregularly scattered all over the alula surface.

22. Carpal remex and carpal covert. No carpal remex is found in *Atrichornis*. At the proximal side of the first primary, a well developed carpal covert inserts. It is longer than the upper middle primary coverts. It is posterodistally directed and has a weak hyporachis. No downy feathers or filoplumes are near it.

The length of the remiges and wing coverts of *Atrichornis* is pictured in Fig. 9.

In *Menura* there is no carpal remex, but a well developed carpal covert lies in direct line with the upper greater secondary coverts, proximal to the calamus of the first primary. It is situated in the position of the first upper middle primary covert, but is distinctly larger and has a stronger rachis than do the upper primary middle coverts. There is no hyporachis.

B. Humeral tract

Figs 1, 2, 5 and 6

In its broadest part the pteryla humeralis in *Atrichornis* is composed of four parallel feather rows. Many humeral coverts, and especially those in the periphery, have a filoplume. A weak hyporachis is present. Downy feathers are not found in this pteryla.

In *Menura* this pteryla is formed by a band of feathers that lies obliquely across the upper arm. Transverse and longitudinal rows can be distinguished. The quills of the distal part have a stronger rachis than do those of the proximal part. Distally, this tract is continuous with the upper marginal coverts. A hyporachis is lacking. In the proximal area, some of the humeral feathers are accompanied by a filoplume.

C. Caudal tract

Figs 10-12, Table 2

a. Caudal region

1. Retrices. In *Atrichornis* there are six pairs of retrices. Unlike *Menura*, they are not greatly extended and specialised in structure. All of them, the central pair included, insert on the same oblique line. The rachis of the fifth and sixth pair of retrices is much smaller than that of the other pairs. On the dorsal side, each of the central retrices possesses three to four (7 mm long) filoplumes on the medial side. All retrices, except the fifth and sixth, have another distal filoplume. No downy feathers are found in their vicinity. On the ventral side most retrices have a dorsal or distal filoplume, and lack accompanying downy feathers.

In *Menura*, the tail of the male bird has eight pairs of retrices. These sixteen feathers are inserted in a large and highly muscularised tail, which can be raised or lowered by the bird at will. The retrices are usually carried extended behind the bird's body in the normal

fashion, but during display they are raised and held over and parallel to the back while being vibrated (Smith, 1965).

The first, or central pair of rectrices are generally referred to as the medians or 'wires'. These rectrices are very narrow and practically devoid of vane. The inner side carries very short, widely spaced barbs; the outer side has a very narrow vane which gradually increases in width from the proximal to the distal end of the feather, until it reaches 10 mm in width. Proximally, the diameter of the rachis is 3 mm but at the tip it is nearly as thin as the barbs themselves.

The next six pairs of rectrices, or filamentaries, consist of a central shaft of 4 mm diameter, which tapers toward the extremity with numerous barbs on either side. In the proximal portion these filamentaries have barbs with interlocking barbules, resulting in a continuous vanelike appearance. This vane is longest and widest in the central filamentaries, gradually decreasing in the side filamentaries.

The eighth pair of rectrices, or lyrates, have the thickest rachis. On the inner side of these quills, there is a small vane of short and stiff barbs; the inner vane gradually increases in width from the proximal end (6 mm) to the distal tip (18 mm). On the outer side, the vane is formed by fine and flexible barbs and exhibits a number of V-shaped transparent windows. This effect is produced by the absence of barbules in the V-shaped areas (Smith, 1965). All the rectrices, even the central pair, insert on the same oblique line.

On the dorsal side of the tail, each rectrix of the first pair is surrounded by five minuscule feathers (3–4 mm in length) with a distinct rachis and hyporachis. Rectrices 2 through 7 have two accompanying distal tiny feathers, and sometimes a very short filoplume. The eighth pair of rectrices is accompanied by two downy feathers. A few more small feathers are scattered in the space above the first pair of rectrices.

On the ventral side, a series of minuscule quills is present between the first rectrices. Each rectrix itself is surrounded by three tiny feathers and all the other rectrices, except the last pair, are generally accompanied by at least two minuscule feathers, the inferior one being the smallest and more downy. The eighth rectrix has one or two distal downy feathers.

2. Greater upper tail coverts. In *Atrichornis*, five pairs of greater upper tail coverts are present. Pair 1 apparently is missing, but on the left side (only) a very small and weak covert is inserted at the same level as the second greater upper tail covert. The second, third and fourth greater upper tail coverts lie over the middle of the corresponding rectrix; the fifth and sixth lie on the proximal side of their rectrix. All coverts lie parallel to their rectrices. Their barbs converge medially and a filamentous hyporachis is seen. No downy feathers or filoplumes accompany these coverts.

Eight pairs of greater upper tail coverts are present in *Menura*. Each tail covert bears the same number as its corresponding rectrix. Pair 1 is missing. Pair 2 lies

on the distal side of its rectrix; pairs 3–5 lie on the medial side. The ninth greater upper tail covert is very weak and lies close to the eighth, over the middle of the eighth rectrix. The rachis of the seventh and eighth pair of coverts is smaller than those of the other coverts. The rachis of the ninth is substantially smaller.

A very small pennaceous feather inserts medially to pair 2 of the greater upper tail coverts. The other coverts have an accompanying downy feather or, more commonly, a filoplume. On the right side between and above the seventh and eighth greater upper tail coverts, and on the left side between and above the eighth and ninth greater upper tail coverts, another small pennaceous feather is present.

3. Lesser upper tail covert. In *Atrichornis* one pair of lesser upper tail coverts is present. They insert mediodorsally to the first pair of rectrices. They possess a very weak hyporachis. No downy feathers or filoplumes are found near them. The lesser upper tail coverts are completely missing in *Menura*.

4. Greater under tail coverts. On the ventral side there are at least five pairs of greater under tail coverts in *Atrichornis*. The sixth pair was missing in this specimen, but as the ventral side of the tail was slightly damaged we may not exclude the presence of an outermost pair of coverts. The first three coverts insert on the distal side of their rectrix, the fourth and fifth on the medial side. All have a rather weak hyporachis. Only the first pair of coverts has a medial filoplume. Halfway between the insertion of the first rectrix and its greater under tail covert, another filoplume originates from an obvious papilla.

On the ventral side there are eight pairs of greater under tail coverts in *Menura*. This row runs parallel to that of the rectrices. Pair 1 is missing; pairs 2–4 are situated on the middle of their corresponding rectrix; pairs 5–7 lie on the medial side of their rectrix; pair 8 is on the distal side of the seventh rectrix; and pair 9 lies on the medial side of the eighth rectrix. Most of the coverts are accompanied by a very short filoplume. Sometimes a supplementary downy feather or minuscule pennaceous feather can be found near the medial ones.

5. Lesser under tail coverts. In *Atrichornis* only the first pair of lesser under tail coverts is present. It inserts between the first and second rectrix, bare anterodistally to the first greater under tail covert. It has a weak hyporachis. The length of the rectrices and tail coverts of *Atrichornis* is pictured in Fig. 12.

The lesser under tail coverts are missing in *Menura*.

b. Uropygial region

In *Atrichornis*, the papilla of the bilobate oil gland is bare but the body of the gland has an irregular scattering of weak, downy pennaceous feathers with a weak hyporachis.

In *Menura*, the papilla of the bilobate oil gland is devoid of feathers; even the feather tuft encircling the orifices is missing. Downy feathers and very small

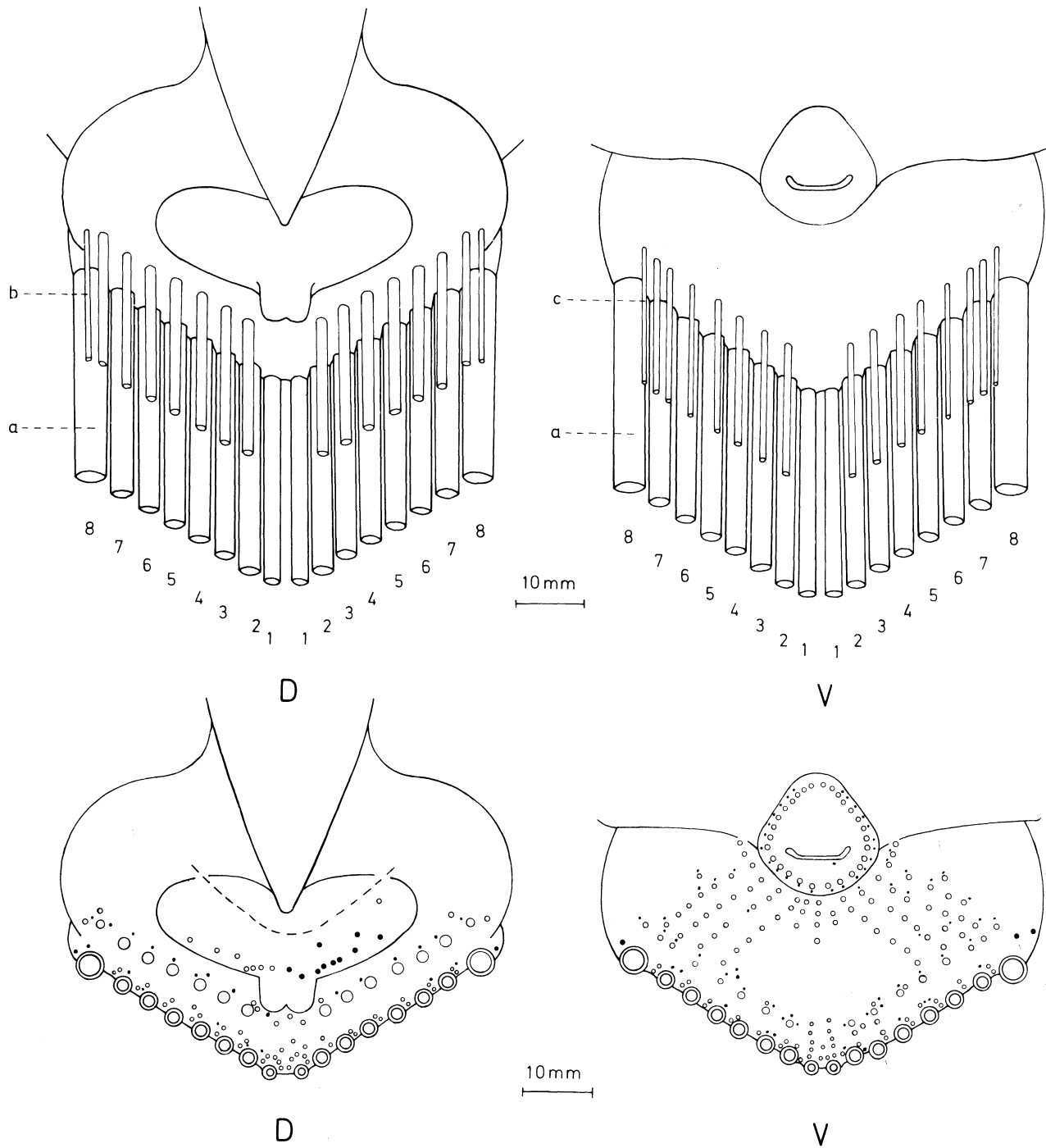


Fig. 10. *Menura novaehollandiae*: caudal tract.
 D. dorsal side
 V. ventral side
 a. rectrices
 b. greater upper tail coverts
 c. greater under tail coverts

- ⊙ rectrix
- covert
- downy feather
- filoplume

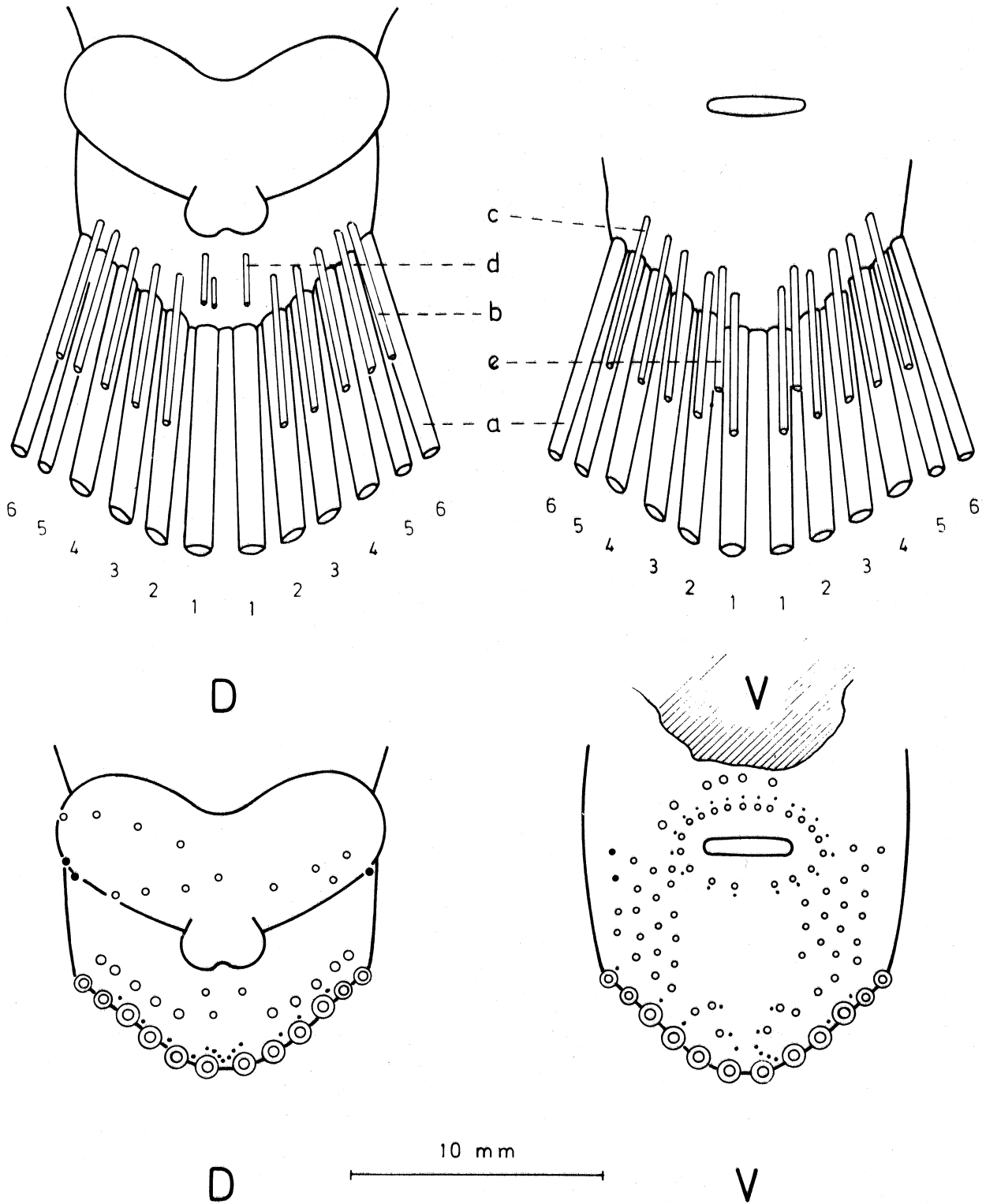


Fig. 11. *Atrichornis clamosus*: caudal tract.

- D. dorsal side
- V. ventral side
- a. retrices
- b. greater upper tail coverts
- d. lesser upper tail coverts
- c. greater under tail coverts
- e. lesser under tail coverts

- ⊙ rectrix
- covert
- downy feather
- filoplume

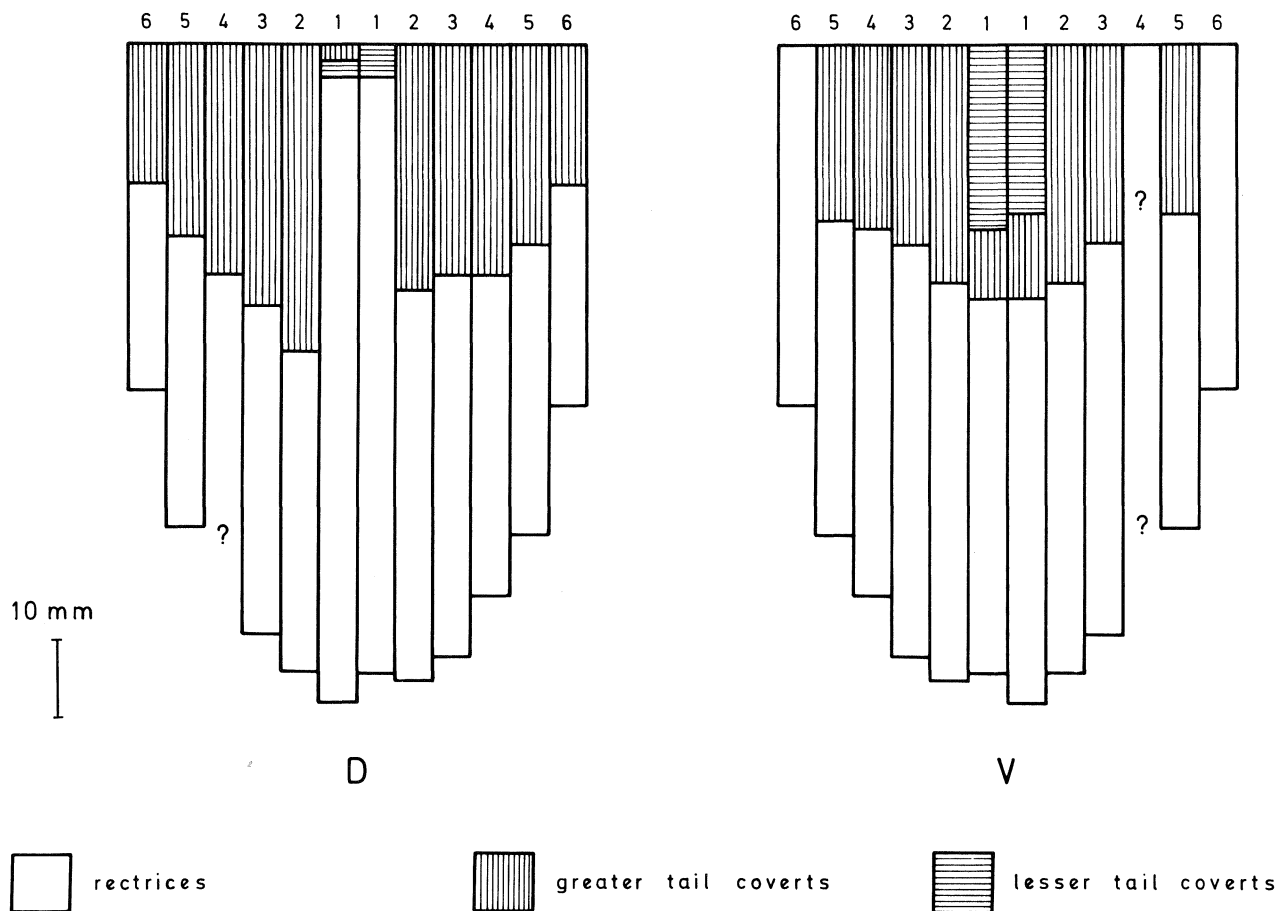


Fig. 12. *Atrichornis clamosus*: length of the principal tail feathers.

D. dorsal side

V. ventral side

pennaceous feathers are scattered along the posterior border of the gland.

c. Postpelvic region

A few downy feathers are found in the postpelvic region in *Atrichornis* but in *Menura* this region is naked.

d. Anal region

The anal region was slightly damaged in the specimen of *Atrichornis*. A caudally open circumanal ring surrounds the anus. In the cranial half of the ring the length of the feathers decreases from distal to medial; in the caudal half the feathers are all nearly the same length. They have a weak hyporachis. Their accompanying filoplumes, inserted on obvious papillae, form another, outer circle. Cranially, six other coverts form an incomplete semicircle of feathers.

In *Menura* the anal region is ringed by a complete circle of 28 small contour feathers without a hyporachis. Accompanying filoplumes insert near the coverts and form a supplementary outer circle. Only the most cranial coverts lack a filoplume. The length of the feathers increases from the middle of the cranial (5 mm) and

caudal halves (9 mm) toward the more distal margins (27 mm). Caudal to the feather circle, some downy feathers form a second feather arch (not visible in the Fig. 10).

e. Postventral region

In *Atrichornis* the postventral region consists of two separated groups of feathers. These feathers have a weak hyporachis and filoplumes are scarce.

In *Menura* the two parts of the postventral region converge medially and join each other under the anal region. These coverts lack a hyporachis and some of them, especially in the peripheral part, are accompanied by a filoplume.

CONCLUSION

On comparing the wing pterylosis of *Atrichornis clamosus* and *Menura novaehollandiae* a great difference can be seen in the number of the remiges and coverts, especially those on the forearm. Striking features are the presence of eleven primaries in *Menura* (ten in *Atrichornis*) as well as the presence of a series of primary upper lesser secondary coverts (absent in

Atrichornis). Another remarkable point is the great number of secondaries (14) and corresponding coverts present in *Menura*. In comparison with *Ploceus nigerrimus* (Morlion, 1971), chosen as a representative passerine, we see that in wing pterylosis *Atrichornis* is much nearer to the Passeres than is *Menura*. There are fewer differences in wing pterylosis between *Atrichornis* and *Ploceus* than between *Atrichornis* and *Menura*.

In the tail pterylosis a great difference also exists between the two species investigated: not only in the aspect of the feathers, but also in the numbers of rectrices, greater upper and under tail coverts, and in the presence or absence of the first pair of upper and under tail coverts. In contrast to the wing pterylosis, however, the tail pterylosis of *Atrichornis* is markedly different from *Ploceus nigerrimus* in the presence of the first pair of lesser upper tail coverts and in the possession of only five pairs of greater under tail coverts.

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Alula quills											9	11	13	14	7							
Upper lesser coverts	-	-	-	☆	☆	☆	☆	☆	☆	-	-	-	-	-	-	-	-	-	-	-	-	
Upper middle coverts	-	-	9	10	11	13	13	11	8	5	-	5	5	5	5	4	4	4	3	-	-	
Upper greater coverts	13	16	20	22	23	24	25	24	23	20	8	16	16	15	14	13	11	10	8	6	5	
Remiges	-	27	41	48	50	52	55	57	58	59	-	59	58	57	56	54	52	50	46	37	27	
Number	10	9	8	7	6	5	4	3	2	1	C	I	II	III	IV	V	VI	VII	VIII	IX	X	
Under greater coverts	-	-	-	-	-	-	-	-	-	-	-	10	10	10	10	10	9	9	9	8	7	<u>2</u>
Under middle coverts	-	<u>4</u>	12	12	11	11	10	10	10	10	-	10	-	-	-	-	-	-	-	-	-	-
Under lesser coverts	-	-	-	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	8	9	8	-	7	7	7	7	7	7	7	5	5	5	<u>3</u>

Roman numerals : primaries and primary coverts.
 Arabic numerals : secondaries and secondary coverts.
 C : carpus (carpal coverts (carpal remex)
 Underlined numbers : length of downy feathers.
 ☆ : downy feathers not measured.

Table 1. Measurements of the principal wing feathers of *Atrichornis clamosus* (in mm).

Lesser upper tail coverts	-	-	-	-	-	<u>4</u>	4	-	-	-	-	-
Greater upper tail coverts	18	25	30	34	40	<u>2</u>	?	32	30	30	26	18
Rectrices	45	63	?	77	82	<u>86</u>	82	83	80	72	64	47
Number	6	5	4	3	2	1	1	2	3	4	5	6
Greater under tail coverts	-	22	?	26	31	33	33	31	26	24	23	-
Lesser under tail coverts	-	-	-	-	-	22	24	-	-	-	-	-

Underlined number: length of a downy feather.
 ?: missing feather

Table 2. Measurements of the principal tail feathers of *Atrichornis clamosus* (in mm).



A female Noisy Scrub-bird *Atrichornis clamosus* at nest (photo G. Chapman, CSIRO Wildlife Research).