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INTRODUCTION

THE PURPOSES OF THE PRESENT PAPER are to describe in detail the natal plumages and neossoptile pteryloses of North American birds of the Order Passeriformes; to determine the taxonomic value, if any, of passerine neossoptile pterylosis; and to indicate the variations that could be investigated for adaptive significance.

Birds are perhaps best known by their plumages, and the various plumages of most North American birds have been quite fully described. However, the natal plumages of passerine birds, composed of scant wisps of down present at or soon after hatching, have been largely neglected. That neglect is surprising, because study of natal plumages would seem to hold considerable promise in a solution of problems of taxonomy and adaptive evolution—promise in taxonomy, as embryonic material supposedly best reveals relationships, and promise in adaptive evolution, as the early stages of development supposedly are the most sensitive to environmental variables. Further, the natal plumages are nicely amenable to quantitative analysis.

Nestlings of the avian Order Passeriformes are said to be altricial at hatching, as opposed to precocial (active or nidifugous). The altricial nestlings are said to be naked (psilopaedic, or gymnopaedic) as opposed to downy (ptilopaedic). Actually, however, very few passerine species are entirely naked at birth, but are covered with infantile down, or natal plumage. "These [down] tufts ['neossoptiles or neoptiles'; Dwight, 1902, p. 250] precede, and are afterwards carried on, the tips of only a few, definitely distributed, contour-feathers" (Ingram, 1920, p. 859). As "the 'Neossoptile' is only a more or less differentiated distal part of the first 'Teleoptile' [definitive feather]" (Jones, 1907, p. 3), it may be assumed that the natal-down distribution is superimposed on the contour-feather tracts or pterylae. The pre-pennae, as the natal down of passerines may be called, occupy exceedingly limited areas of the presumptive contour-feather pterylae, usually only uniserial rows wherever found.

Pterylosis can be defined as the arrangement of feathers in definite areas of growth (pterylae). Pterylology is the study of pterylosis. Pterylography, the term under which Nitzsch's original work in this field was introduced to the English language (1867), is the study or description of the pterylae of birds. Pterylology should not be confused with ptilology, the study of ptilosis, which is plumage irrespective of pterylosis. The study of infantile-down pterylosis should not be confused with microptilology, a term proposed by May (1945, p. 308) for the study of feather structure not visible to the unaided eye.

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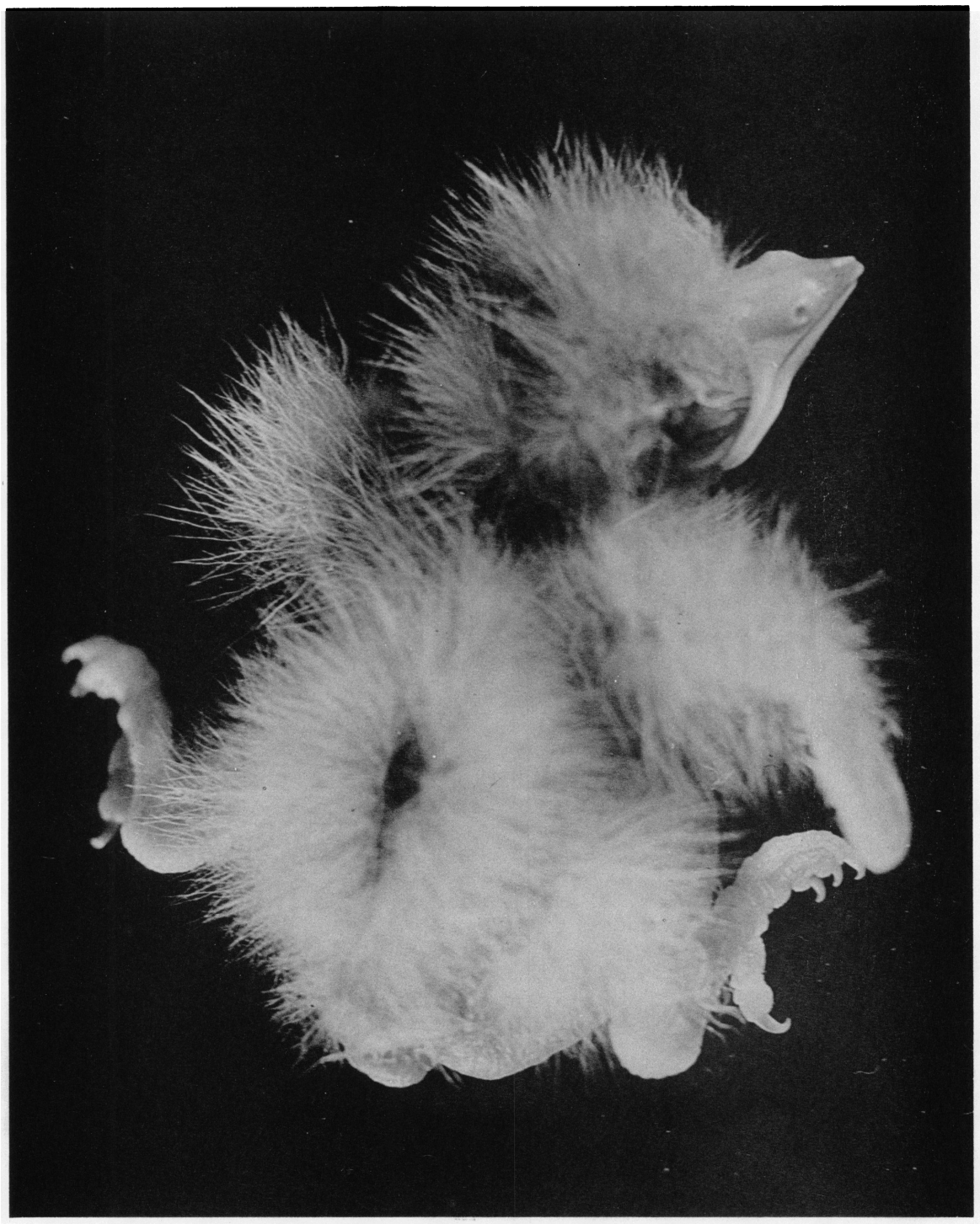
THE TELEOPTILE PTERYLOGRAPHY

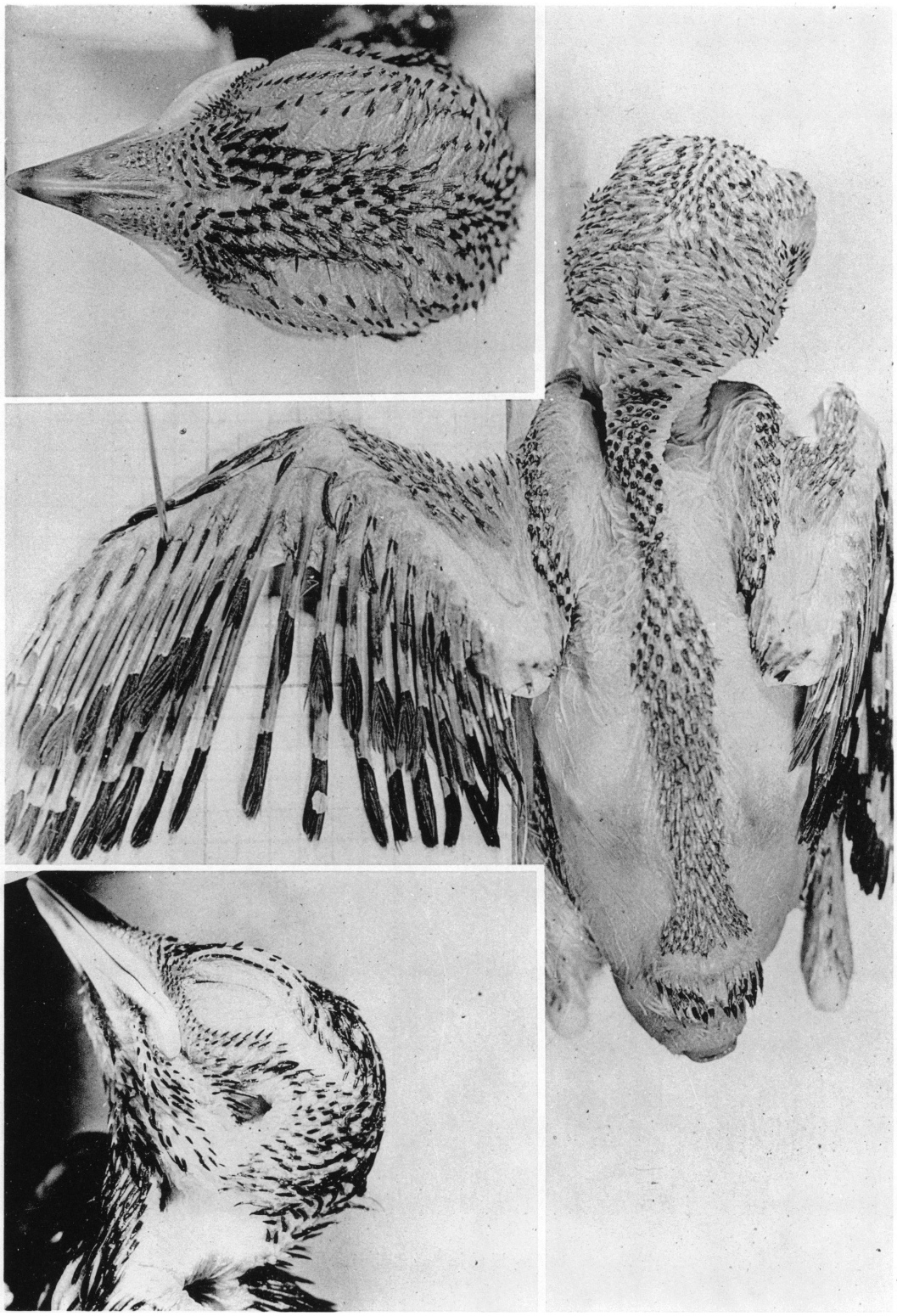
A description of passerine contour-feather pterylae is basic to a consideration of neossoptile pterylology in its nomenclatural and distributional relationships. The following description of *Hylocichla mustelina* will serve as a working example. (See pl. 7.)

Regions of the Capital Tract

The frontal region is densely covered with small feathers in apparent rows that originate at the sides of the upper mandible and extend mediad and dorsad to the exposed culmen and frontal apterium. The feathers in the anterior rows are directed forward, but in the more posterior rows become deflected progressively mediad and posteriomediad. The coronal region inherits from the frontal region six indistinct, posteriorly directed rows of feathers closely set in the interorbital groove which gradually lose their linear arrangement so that a closely imbricated distribution obtains. Approaching the occipital region the feathers flare backward and laterad. Laterally the posterior coronal regions border the temporal apteria by ventrally directed feathers. The occipital region consists of a junction of the posteriorly radiating, sparsely feathered fan of the coronal region and the anteriorly radiating, sparsely feathered fan of the cervical region of the spinal tract. The mutually conflicting feather directions of these two fans at the occiput are resolved into laterad and ventrad rows that cover broad areas postauricularly (postauricular regions) which almost reach the lateral tangs of the submalar region of the ventral tract and form the dorsal borders of the postauricular apteria. Each superciliary region has two distinct rows of feathers that originate at the frontal region and course over the ocular regions to the posterior coronal regions. The feathers of the medial rows are laterally directed; the lateral row is more posteriorly directed. Each loral region is confluent with the frontal and ocular regions; the tiny feathers are imbricated. There is a single row of rictal bristles. Each ocular region includes one medial row of small, posteriolaterally directed feathers that originate at the lores and extend over the upper eyelid, paralleling and ultimately joining the superciliary rows posteriorly; another very brief row immediately below this junction; two rows of minute feathers on the inner margins of both upper and lower eyelids; several small feathers scattered on the lower eyelid; and three rows of feathers below the eye (infra-ocular region) that arise at the lores and are inserted along the base of the lower eyelid, curving over the auricular region and forming the ventral border of the temporal apterium. These feathers point dorsad and oppose the feathers of the postauricular region. The most ventral of these three rows departs briefly from the other two at a point about midway below the eye and fuses with the dorsal part of the auricular ring. Each malar region is composed of a few irregular rows of feathers that begin in the V formed by the junction of the mandibular tomium and ramus. These extend backward to the commissural point where another row originates; the whole continues backward to a point below the ear where it joins ventrally the lateral tangs of the inter-ramal region of the ventral tract. The most dorsal row, which originated at the commissural point, curves upward to join the auricular region, thus isolating a rictal apterium from the anterior extension of the postauricular apterium. The feathers of the malar region point ventroposteriorly except in the anterior part where a vertical rotation of the feathers on their bases results in a forward orientation. Each auricular region consists of a uniserial ringlet of posteriodorsally directed feathers that surround the external auditory meatus, together with a group of feathers anterior



Kingbird in natal down



Teleoptile pterylosis of *Hylocichla mustelina*

to the meatus which is confluent with one row of feathers of the ocular region and one of the malar region.

Regions of the Spinal Tract

The cervical region begins as a broad, sparsely feathered fan of feathers that radiate anteriorly and merge with the occipital and postauricular regions of the capital tract. Passing backward, the cervical region gradually narrows to a width of about five closely set feathers which progressively rotate on their bases vertically, changing the feather orientation from craniad to dorsad. The interscapular region is a continuation of the narrow cervical region that passes along the median line between the wings. The posteriorly pointing feathers are imbricated (as throughout the tract) and thus, depending on the angle of perception, appear in oblique or herringbone rows which are more apparent than real. Before its fusion with the dorsal region at a point opposite the humeral patagia, the band narrows to a width of about three papillae. The middorsal region has more procumbent feathers. It broadens in the nestling to about twice the width of the interscapular region to form the so-called dorsal saddle; the broadening and posterior tapering are comparatively slight at this age. (In adults the saddle widens to more than 12 papillae and is broadly fusiform in shape.) The nestling shows all the loci of the more lateral saddle feathers of the adult in the form of minute pits. No other contour feathers are so conspicuously retarded. The pelvic region continues caudad from the dorsal region as a slightly wider band than the cervical region and tapers somewhat until just before the uropygial gland where the tract again broadens in width and is truncated abruptly at the anterior margin of the gland.

Regions of the Caudal Tract

The rectrices are six in number on each side. There are five upper rectrix coverts, each above a rectrix, on each side. The first (inner) pair of rectrices is without upper coverts and is itself situated in a line with the upper coverts of the other rectrices. The greater under rectrix coverts number seven on each side below the rectrices and immediately anterior to them. The seventh is reduced in size, and the first is strongest and is inserted with an under covert of its own. There is a patch of about 10 lesser under rectrix coverts (post-ventral region) on each side, arranged in three rows of three or four feathers each, all of which point posteriomedially. The anal circlet has three concentric lines of feathers that surround the cloaca; the outer circle is incomplete and indistinct.

Regions of the Ventral Tract

The entire inter-ramal region is densely imbricated with small feathers directed posteriorly and posteriolaterally. A tang projects acutely posteriolaterally on each side and fuses with the malar region of the capital tract under each ear. The cervical region is a narrow band about eight papillae in width which passes posteriorly along the ventral median line of the neck to a point about midway, where a bifurcation results in two slightly narrowing bands that extend posteriolaterally. At the pectoral girdle each cervical fork is continuous with a sternal region on each side. Each sternal region continues posteriorly to a point posteriomedially. Where the cervical region joins the sternal region, the humeral tract arises laterally and courses up and backward over the humerus. Also at this point a uniserial row of feathers arises which runs parallel to the humeral tract to the proximal origin of the patagium and meets the marginal coverts of the arm of the alar tract. The axillar region (of the ventral tract) is differentiated from the sternal region to which it is closely spliced as a lateral lobe, not separated at its extremity, and reaches the flexed knee. Its feathers are directed towards the flank. Each abdominal region courses as a narrow band from the sternal region to a point lateral and anterior to the anal circlet of the caudal tract. It is quadriserial for half of its length, then triserial, and finally uniserial.

Regions of the Alar Tract

The primaries are ostensibly 10 in number; the tenth is rather weaker than the others. There is a vestigial eleventh primary at the dorsal base of the tenth. The 10 greater upper primary coverts are inserted distally at the bases of their respective greater upper

primary coverts. Number 1 is wanting, as is also number 10. (The lesser upper primary coverts are probably more properly called the posteriormost row of the marginal coverts of the hand. They point towards the middle upper primary coverts but seem to have no definite positional relationship to them.) There are nine secondaries; the ninth (most proximal) is rather weaker than the others. The greater upper secondary coverts are inserted proximally at the base of their respective secondaries, but each immediately crosses its secondary to assume a distal relationship. They are 10 in number; the tenth has no corresponding secondary. Proximal to the greater upper secondary coverts on the humeral-ulnar joint there are two or three feathers of the tertiaries of the humeral tract which apparently belong to this series. The middle upper secondary coverts are inserted distally and at the bases of their respective greater upper secondary coverts. They are nine in number. Number 1 is wanting, and number 10, which is very small, may be one of the feathers of the lesser upper secondary coverts. The lesser upper secondary coverts, irregularly present, are inserted at the bases of their respective middle upper secondary coverts. The greater carpal remex covert, for which there is no corresponding carpal remex, is situated between the first greater upper primary covert and the first greater upper secondary covert. It has a middle carpal remex covert. There are pairs of insignificant feathers about the bases of each secondary. The alula has three quills. There are several alula coverts. The marginal coverts of the hand cover the edge of the alula distally to the tenth primary and include the lesser upper primary coverts dorsally and the carpometacarpal coverts ventrally. The marginal coverts of the arm densely imbricate most of the dorsal and anterior part of the patagium with laterally directed feathers. At the proximal origin of the patagium the uniserial row of feathers from the ventral tract meets the marginal coverts at right angles to their insertion. Ventrally the patagium is very sparsely feathered. The axillars (of the alar tract) consist of several posteriorly directed feathers inserted linearly under the proximal part of the radius and ulna and irregularly under the humerus. The 10 greater under primary coverts are inserted proximally and ventrally at the bases of their respective primaries. The 10 lesser under primary coverts are inserted proximally and at some distance anterior to the bases of their respective greater under primary coverts which they cross distally. The eight greater under secondary coverts are inserted distally and obliquely at the base of their respective secondaries. The eight lesser under secondary coverts are inserted distally at the bases of their respective greater under secondary coverts. There is an under carpal remex covert between the primary and secondary covert series.

Regions of the Humeral Tract

The scapular region from its origin at the ventral tract ascends laterally over the anterior joint of the humerus as a triserial band of posteriolaterally directed feathers. As it courses along the humerus it crosses that bone to its medial side, then terminates at the humeral patagium. The tertiaries are a group of about nine feathers arranged in a series of about six on the humeral-patagial edge of the humerus and a series of about three on the humeral-ulnar joint.

The femoral tract is a small, crescent-shaped, closely imbricated patch of feathers situated midway between the abdominal region of the ventral tract and pelvic region of the spinal tract and paralleling both. The crescent is slightly concave upward.

The crural tract consists of areas of sparse feathering about the ankle, the ventral and outer edge of the flexed tibiotarsus, and the dorsal and inner edge of the tibiotarsus.

THE NEOSSOPTILE PTERYLOGRAPHY

A species heavily endowed with natal down is *Sayornis phoebe* and will best serve the purpose of describing passerine natal down regions.

Regions of the Capital Tract

The coronal region (inner supra-orbital of some authors) has an average of 14 neossoptiles, 8 mm. in length, on each of the most lateral left and right rows, which commence anterior to the eyes and extend posteriorly

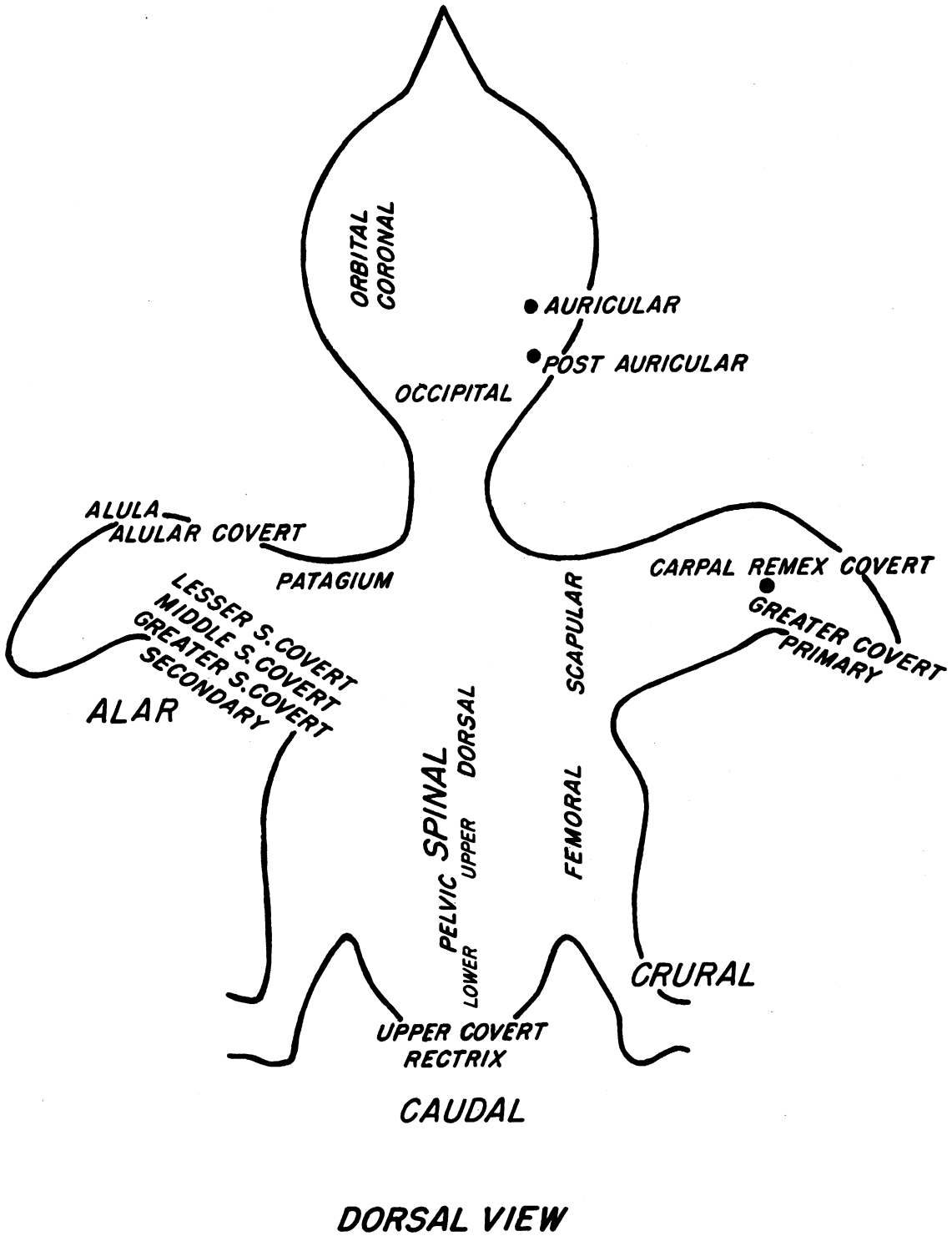


FIG. 1. Nomenclature of passerine neossoptile pterylae.

to points posterior to the eyes where the superciliary regions join the posterior coronal regions. Each superciliary region (a neossoptile pteryla described here for the first time) sometimes bears one or two neossoptiles 2 mm. in length on its anterior part. Each ocular region (outer supraorbital or orbital of some authors) has an average of 18 neossoptiles 6 mm. in length of the mediad row, which originate at the lores and extend posteriorly to its junction with the superciliary rows posterior to the eye. An apparently abnormal locus for natal down, the infra-ocular region, bore one 1-mm. neossoptile in two of 17 specimens examined. Each auricular region (a passerine neossoptile pteryla described here for the first time) has an average of 19 neossoptiles 4 mm. in length on the uniserial ringlet around the auditory meatus. Each postauricular region (a passerine neossoptile pteryla described here for the first time) has an average of two neossoptiles 4 mm. in length at its ventral apex. The occipital region has bilateral clusters averaging 10 neossoptiles 10 mm. in length at the occiput distinctly separated at the medial line. These tend towards confluence with the coronal regions.

Regions of the Spinal Tract

The middorsal region has an average of 10 neossoptiles 9 mm. in length on either side immediately bordering the ephippial apterium. The pelvic region has an average of seven neossoptiles 6 mm. in length on the medial line extending posteriorly from the posterior tip of the ephippial apterium (where the pelvic region is confluent with the paired middorsal region) to the base of the uropygial gland where the two most posterior neossoptiles are offset laterally.

Each scapular region (humeral of some other authors) bears on an average 12 neossoptiles 10 mm. in length on its distal rows, which extend from a point posterior to the proximal origin of the patagium posterior to the termination of the region at the humeral patagium. The neossoptiles are biserial anteriorly and become uniserial posteriorly.

Each femoral tract has an average of 12 neossoptiles 9 mm. in length arranged biserially the entire length of the tract.

Regions of the Caudal Tract

Each of the 12 rectrices bears a neossoptile 1 mm. in length characteristically crooked towards the apex of the uropygium. Four upper rectrix coverts on each side are tipped with neossoptiles 2 mm. in length.

Regions of the Ventral Tract

Each axillar region of the ventral tract has an average of two neossoptiles 6 mm. in length at its apex. Each abdominal region has a uniserial row of 14 neossoptiles 6 mm. in length, which extend to its posterior terminus from the sternal-axillar cleft. A somewhat abnormal locus for natal down, the ventral cervical region bore one 1-mm. neossoptile in four of 17 specimens examined.

Each crural tract has an average of 10 neossoptiles 4 mm. in length distributed over the lower flexed crus in three rows; a dorsal row of four, an external row of three, and a ventral row of three.

Regions of the Alar Tract

Counts are unilateral. The primaries and secondaries (ulnar of some authors) bear insignificant microscopic wisps of natal down. The greater upper primary coverts average eight neossoptiles 3 mm. in length. The greater upper secondary coverts average 10 neossoptiles 10 mm. in length. The greater carpal remex covert is 5 mm. in length. The middle upper secondary coverts average nine neossoptiles 6 mm. in length. The alula has two neossoptiles 2 mm. in length.

NATURE OF NATAL PLUMAGE

Neossoptile or neoptile (piloplumes; Keeler, 1890, p. 174) is a general term that denotes infantile down. It is used regardless to which feather generation the down structures may belong—protoptile or mesoptile. The consensus seems to be (Ticehurst, 1908, p. 186; Bonhote, 1921, p. 348) that passerine neossoptiles belong to the mesoptile generation. They are succeeded by teleoptiles, a general term for the successive generations of definitive feathers. Palmer (1899, p. 424), however, used the word "mesoptile" for nestling (juvenile, not down) plumages. The possibility that natal down belongs to a different neossoptile generation exists, if Ingram's observations are correct, as quoted by

Witherby (1925, p. 69): ". . . white down has been noticed to appear between the feathers on the wings and in the apteria on several parts of the body [in *Lanius senator*]." Otis W. Allen (MS), examining the microptilology of down from *Agelaius phoeniceus* and *Quiscalus quiscula*, found that a "few of the barbs were branched at about three-fourths of the distance from the calamus into two branches, each with its own series of branches. Further study into this condition . . . might prove significant in determining whether the nestling downs in passerines is of protoptiles or mesoptiles."

Jones's essential description (1907) of the neossoptile shows that it ". . . is only a more or less differentiated distal part of the first teleoptile." Each down tuft and sometimes several tufts together resume a twisted appearance when wet. This may be due to an inherent spiral phylotaxy of the barbules or a consequence of the revolving movements of the embryo within the shell during development.

Thus the natal plumage in passerines is only a transitory phase of the juvenile plumage.

TAXONOMY

The pterylosis of natal plumage seems to be of considerable taxonomic value by virtue of its definite pattern and possible palingenetic nature. Ticehurst (1908, pp. 186, 188), the Heinroths (1926, pp. 91, 111, 129), Boulton (1927, p. 387), Forbush (1929, p. 298), Linsdale (1936, p. 114), and O. W. Allen (MS) have suggested its possible use in taxonomy but draw no real conclusions.

VARIATION

Individual variation in the distribution and color of neossoptiles may be either real or artificial. Dunlop (1911, p. 76) noted variations: ". . . newly-hatched birds of the same species show considerable individual variation in the distribution of the down, tracts being present on one nestling and absent on another." Boulton (1927, p. 411) is diametrically opposed: "The distribution of neossoptiles is constant but the number of individual downs is subject to a certain amount of variation." Saunders (MS) was impressed by the lack of variability: "In the HermitThrush I found notes on different dates from birds in both Adirondack, and Allegany State Park, New York all agree." Ivor (1944, pp. 95, 96) noted a slight variation in the length of down between the nestlings of two pairs of rose-breasted grosbeaks, "but otherwise they seemed alike."

The color of the down may vary with subspecies geographically, though there is little evidence recorded. Harrisson and Buchan (1936, p. 19) credit the *hirtensis* subspecies of *Troglodytes troglodytes* with down slightly lighter in color than that of other subspecies. These authors further attribute different distributions to the neossoptiles of the two subspecies. (See Discussion.) When the references in the literature that describe down color of *Eremophila alpestris* are compared, it is found that there are as many different descriptions of coloration (though minor) as there are describers. This may or may not be due to subspecific variations. One danger of taking color data from preserved specimens is shown by Ingram (1920, p. 879), "Greys are very liable to become brownish with exposure or with age." Saunders (1920, p. 312) writes that the "white" color of the down of *Turdus migratorius* becomes gray as the nestling becomes older "due to exposure to light and air, or what is more probable . . dirt and dust of nest-life." Howell (1942, p. 569), in discussing the same species, claims, however, "The color of the down is constant throughout the period that it remains attached to the developing bird." Richard and Jean Graber (1951, p. 81) record a progressive darkening of the neossoptiles during three days of nest life in *Parula americana*.

Many apparent variations in pterylosis are only artifical and are due simply to abrasive loss of natal plumage. Otis W. Allen (MS) writes: "It is possible that in most cases the ventral down is soon lost by abrasion. This may account for many species being described as lacking down in this tract." The least variation would theoretically be found on the capital tract. Ingram (1920, p. 860) writes, ". . . those [neossoptiles] on the head, owing presumably to the fact that they cannot be reached when the bird is preening its plumage, are generally retained the longest."

Variation of a genetical kind is noted by

O. P. Wetherbee (personal communication): "Down is heavier on 'mealy' ('buff' or 'frosted') caged canary-birds than on 'yellow' ('jonque' or 'hard feathered') canary-birds." This is of particular interest because Darwin 1900, p. 176) wrote, ". . . young pigeons [not passerine, of course] of all breeds which when mature become white, yellow, silver (*i.e.*, extremely pale blue), or dun-coloured, are born almost naked; whereas pigeons of other colours are born well-clothed with down."

GROWTH OF NEOSSOPTILES AFTER HATCHING

A division of opinion exists in the literature which must be resolved if descriptions of natal plumage are to have any worth in taxonomy. Is there significant growth of neossoptiles in any species after hatching? Can nestlings of some species be hatched absolutely naked, then grow neossoptiles?

Nitzsch (1867, p. 75) claimed certain neossoptiles "make their appearance somewhat later on . . . parts of the spinal tract, the lumbar tracts, the apices of the arm-remiges, and perhaps also those of the rectrices." Saunders (1926, p. 483) noted the new appearance of down on the caudal tract of *Junco hyemalis* at three days. Friedmann (1929, p. 52), in describing *Molothrus rufo-axillaris*, states, "Neossoptiles appeared in the femoral tract on the second day and . . . measured 8 mm. in length." Again in *Molothrus bonariensis* Friedmann (*op. cit.*, p. 124) wrote: "By the end of the second day, the neossoptiles have grown considerably where they were present from the time of hatching . . . a few neossoptiles [*sic*] have sprouted at the lower end of the shanks, indicating for the first time the crural tracts." Erickson (1938, pp. 294–295) notes a growth of the down on the rectrices of *Chamaea fasciata* of from 1 mm. on the third day to 3 mm. on the fifth. According to Saunders (MS), "In the Corvidae . . . down grows out soon after hatching."

There is seemingly better evidence to support the stand that neossoptiles are entirely prenatal in development. Dwight (1900, p. 98) maintains that "among the Passeres, . . . the down growth is present (at least part of it) before the chick hatches." Jones (1907, p. 13) contributed evidence from his experimental work on down: "It is well known that the first few days after hatching of altricial birds are the most critical days of their lives. During this critical period there appears to be no growth of the down. An American robin which hatched on the fourteenth day of incubation possessed the usual down upon the head and back. These downs made no further growth. It was not until the fourth day after hatching that the skin gave evidence of the beginning of the definitive feathers. On the eighth day after hatching the skin surface was exposed to the drying influences of the air before renewed activity in the feather germ began. During this interval of four days the so-called 'quill' was formed at the proximal end of the down by the rapid drying of the imperfectly formed barb-vane ridges." Riddle (1908, p. 175) concludes, "It seems probable that all plumulaceous [downy] structures are produced at a relatively slow rate of growth; and also probable that during their growth they have not enjoyed optimum nutritive conditions." Boulton's work (1927, p. 399) on *Troglodytes aedon* shows: "The first feathers of a young Wren, the neossoptiles, are present when it is hatched. They appear to have attained their full size before the bird emerges from the egg. As they are attached to the tips of the forthcoming contour feathers (Jones, 1907), it is obvious that they may lengthen only as much as the distance from the tip of the feather to the surface of the skin." Fautin (1941, p. 216) writes, "The neossoptiles do not seem to grow after the time of hatching but apparently are fully developed at the time the young birds [*X. xanthocephalus*] emerge from the egg." Howell (1942, p. 569) has written of *Turdus migratorius:* "The down seems to be fully mature when the young hatch. On a number of young the down was clipped close to the skin just following hatching and at no time did it increase in length."

Certain species grow teleoptile down (which should not be confused with neossoptile down) at an early age. For *Hirundo rustica*, O. and M. Heinroth (1926, p. 68) state, "*Wenn die eigentlichen Federn sprossen, erscheinen auch zugleich auf den Federrainen Daunen, die den Vögeln ein eigentümlich wolliges Aussehen geben und das bleibende Untergefieder darstellen.*" Also for *Corvus*

corax they wrote (*op. cit.*, p. 253): "*An der ursprünglich nackten Stellen erschienen zum Teil Daunen, zwischen denen dann Federn hervorsprossten, auf deren Spitzen die Erstlingsdaunen, also diejenigen, die die Tiere mit aus dem Ei gebracht hatten, sassen. Hierin verhielten sich die Raben demnach so wie Schwalben . . . und andre, die ein sogenanntes zweites Dauenkleid haben, das später unter den Federn liegt, und das man wohl zweckmässig als Pelzdaunenkleid bezeichnet.*"

Friedmann (1929, p. 122) may have the explanation for the fact that so many young have been described as entirely bare. Concerning *Molothrus bonariensis* he writes, "At first the bird seemed absolutely devoid of down anywhere, but after the amniotic moisture had dried off I could see that there were some grayish neossoptiles on the head." The amniotic fluid dries "within about three hours, except for a suggestion of stickiness on the head," in *Spizella arborea* (Baumgartner, 1938, p. 70). It dries in "a few hours" on the Goldfinch (Walkinshaw, 1939a, p. 3): in "ten hours" on the Horned Lark (Du Bois, 1936, p. 53). In *Tangavis aeneus*, Friedmann (1929, p. 334) records that on the second day "no new neossoptiles appear and the old ones apparently do not increase in length." Otis W. Allen (MS) asserts that in *Agelaius phoeniceus*, "The down does not increase in length after hatching." Finally, Skutch (*in* Bent, 1950, p. 327) shows the caution that must be exercised in one's observing nestlings for down: "At first glimpse they [*Vireo flavoviridis*] appear to be quite naked; but careful scrutiny in a favorable light reveals a few scattered tufts of very short fine down." Experience with the literature teaches that the expression "naked young" (unless carefully qualified) may or may not mean without neossoptiles. The evidence seems to indicate that the down has completed its development before the time of hatching.

ADAPTATION

Various adaptive advantages to the nestling passerine bird have been attributed to its natal plumage. These include concealment by color and form (Ingram, 1920, pp. 860–863; Pickwell, 1931, p. 103), protection from exposure to the sun (Linsdale, 1936, p. 117) and weather (Skutch, 1945, p. 503; Heinroth and Heinroth, 1926, pp. 153, 214), protection against insects (Harper, 1953, pp. 98, 99), and retention of body heat (Ingram, 1920, p. 860; Lawrence, 1949, p. 154). Bent (1948, p. 102) writes of the Ouzel, "This down becomes a necessary protection by the time that the young bird takes its first plunge, at an early age, into the cold water." It seems strange to me that the neossoptiles could afford much protection in this way. Down in this instance should probably refer to true down of the teleoptile generation, of which it is known the Ouzel is well endowed. Hutt and Ball (1938, p. 657), writing of teleoptile (not natal) plumage, state, ". . . increase in the number of feathers per unit of body weight with decreasing size of bird is an adaptation for retention of heat produced." This law does not seem to be applicable to natal plumages. Harper (1953, pp. 98, 99) interprets the "dense protective down" of *Zonotrichia querula* as an adaptation against black flies, "scourges of the Barren Grounds."

The complete absence of neossoptiles or the tendency for reduction of natal plumages has been considered by several writers, some seeking to learn its functional value as revealed by specific cases of its absence. Dwight (1900, p. 98), although in error concerning the universal absence of the neossoptiles on the ventral pterylae, considers "the protection of the nest [as] obviating its necessity below." Ingram (1920, p. 863) noted the frequent nakedness of cavity-nesting species. In addition he noted a "tendency for the down-tracts to disappear from all save the more exposed anterior portions of the body in species that attempt to rear a big family in a more or less confined space, . . . [in which] only their heads are exposed to view [p. 868] . . . the complete disappearance or non-development of a procryptic nestling plumage is somewhat difficult to explain," in the young of some species in which the young are reared in open nests. Further, O. and M. Heinroth (1926, p. 76), arguing against the acceptance of the Sylviidae as a homogeneous group, note that *Phylloscopus*, which has domed nests, is heavily downed, while *Sylvia*, which makes open nests, is naked. Rand (1947, p. 180) is also aware of this difficulty and criticizes Linsdale (*in* Bent, 1946, p. 141) for assigning an adaptive significance to the nakedness of

young *Pica pica*, which are born in an enclosed type of nest, as the young of *Cyanocitta cristata*, of the same family, are also hatched naked but in an open nest. Ingram (1920, p. 869) may be forcing a point in stating that the Jay's habitual "boldness" obviates the need for down.

Clark (1901, p. 372) thought "the condition of the young when hatched is rapidly modified under changed conditions." Ingram (1920, p. 869) cites the example of the Jackdaw, a hole nester, in which down persists and the eggs are still colored, which indicates a recent start of dark-place nesting. Shufeldt (1903, p. 49) chronicles very recent nest-site changes thus, ". . . in the matter of their nest building many species of North American birds have gradually, but nevertheless markedly, during the past century, changed their habits in not a few particulars." If this line of reasoning be followed, it may be assumed that *Cyanocitta cristata* lost its neossoptiles in a remote period of cavity nesting and did not regain them on acquisition (or re-acquisition) of open-nesting habits. Linsdale (1936, p. 116) observes, ". . . nestlings at early stages may be nearly naked, but they may be closely brooded by the parents and thus live in a place equivalent to a dark cavity." Ingram (1920, p. 868) considers that colonial nesting, as in some Corvidae, causes less necessity for concealment in the form of down.

METHODS AND ORGANIZATION OF DATA

NOMENCLATURE OF PTERYLAE AND REGIONS

CONSIDERING THE COMMON ORIGINS and loci of neossoptiles with teleoptiles, I decided to use the same names for the down tracts and regions as had already been conventionally given to their substrata—the contour-feather pterylae and their regions. Where it seemed impracticable to treat regions of any tract as distinct units because of confusing confluence, the tract was described as a whole. The use of the name "pelvic region" was restricted to refer only to a uniserial, medial row of neossoptiles on the lower back. If the neossoptiles on the lower back were biserial, they could not be distinguished from those of the middorsal region, which are always biserial, so that both were treated as one—the spinal tract.

DETERMINATION OF DOWN LENGTHS

Measurements were taken of the longest neossoptile of each region on each specimen. Measurements were taken by means of calipers under a 10.5-power binocular microscope. The caliper determinations were read from a metric rule to the nearest millimeter. In very young nestlings the neossoptiles were measured from their insertion in the skin; in older nestlings, from the distal limit of the "quill." Neossoptiles to be measured were damp, dry enough for the individual barb vanes to be discerned discretely, and wet enough to be manageable and free of kinks. Because measurements were taken to the nearest millimeter, the very minute feather structures often discerned (but of exasperating variability in appearance) on the rectrices and remiges could be conveniently ignored. Future workers may profitably measure these particular structures to the nearest fifth of a centimeter for more significant results.

DETERMINATION OF COLOR

Dry neossoptiles massed together on the tracts were matched in daylight with the plates in Ridgway (1912). This attribution of color was purely qualitative and may further be criticized because it did not include possible variations caused by differential abrasion of structure and fading, attributable to age, both before and after preservation, and to the mode of preservation itself. Ingram (1920) claimed that grays are liable to become brownish with exposure or with age. In my examinations no specific instances of fading due to preservation were seen, although they were often suspected in the older material, especially in skins and in specimens that had been stored in liquid preservatives obviously darkened by haemolysis and body fluids. Neossoptiles from *Turdus migratorius* had the same color characteristics [pinkish buff, as opposed to Saunders' (1920) "white" and "mouse-gray" and Howell's (1942) "pale ochraceous buff"] 10 months after preservation in formalin as in the nest. In the living bird I found that older *Passernia cyanea* had darker down than younger ones.

Wet down is invariably darker than dry down. The insertions of the down feathers were often of lighter tint than the remainder of the structure. This refinement in description was not noted in the tabulations of the species except where the tinted section was of such significance as to give an "agouti" appearance to the plumage. Likewise the extreme distal tips of the down were often a shade darker. The densest down tracts were matched when there was no conspicuous difference in the coloration between tracts. In many instances the posterior and ventral tracts were of more or less lighter tint; the more conspicuous examples were noted, i.e., *Sturnus vulgarus*. On the whole, color determinations seemed futile because of variability and the almost hopeless problem of precision in measurement.

DETERMINATION OF NUMERICAL DISTRIBUTIONS

Counts were made of damp neossoptiles under a 10.5-power binocular microscope, with a dissection pin used as a pointer and preener. Complete counts were made on all specimens examined. Minima and maxima counts were recorded for both left and right sides to give a clearer indication of the variability encountered. In cases in which the

numerations are not qualified by "left" and "right," it may be assumed that either the tract in question is not paired (as in the pelvic region and, less strictly, the rectrices and their coverts), or a segregation of the data seemed to serve no purpose (as in the alar) because of frequent abrasion of one side. Average counts represent strict arithmetical means only where several good specimens were available; in other instances the average count represents a more subjective interpretation of the data. This treatment was necessary because two kinds of variables were found to be involved in the determination of the number of neossoptiles present; genetic variables and variables of abrasion. The maximum count is probably closer to the genetic norm, as loss of neossoptiles presumably by natural abrasion was found to be a common condition. Quite constant bilateral symmetry (genetic) was indicated by the least mutilated specimens.

SPECIMENS EXAMINED

Specimens were arbitrarily classified as to age according to their general feather development. The four categories of this classification are as follows:

Stage A: Early neossoptile stage, with no sign of pin feathers other than subcutaneous pigmentation

Stage B: Late neossoptile stage, with pin feathers conspicuously erupting through the skin surface

Stage C: Early teleoptile stage, with pin feathers a few millimeters long over most of the tracts

Stage D: Late teleoptile stage, with sheaths of pin feathers ruptured

As many specimens from as many different nests were examined as possible. Specimens collected personally were preserved immediately in 10 per cent formalin. With newly hatched nestlings the amniotic fluid was allowed to dry and flake off to prevent the neossoptiles from becoming encased in a brittle sheath during fixation. Each specimen was immediately labeled with identification, locality, date, and the collector's name. Specimens became the property of the American Museum of Natural History. University departments of zoology, natural history museums, and private collectors throughout the United States and Canada were requested to lend specimens of passerines in natal down. Almost unanimous response from these sources revealed a marked dearth of such material in all collections.

REFERENCES

An attempt was made to cover as many references to North American passerine natal-down plumages as possible up to 1952. This included not only bibliographic titles obviously concerned with natal down but also a search through the literature on life histories and annotated local lists, all of which were potential source material, though few were actually valuable. Literature that described any species as having "naked young," unless further qualified, was dismissed as overgeneralized. Manuscripts came to me from the following sources: Dr. S. Charles Kendeigh sent me Rudyerd Boulton's notes (made in 1926) from the files of the former Baldwin Bird Research Laboratory. Otis W. Allen's unpublished thesis written in 1940 on Red-wings and Bronzed Grackles was sent from Ohio State University. Howard Knight of Weber College sent me his manuscript (dated 1948) on the House Finch. Aretas A. Saunders sent me his journal notes as of 1951.

A perusal of the literature references made obvious the need for a standardization of the published data.

DATA

Tyrannus tyrannus

EASTERN KINGBIRD

COLOR: White but capital tract Tilleul Buff[1] or Wood Brown.

SPECIMENS EXAMINED: Three, stage A, Oxford, Massachusetts (P.G.R.); two, stage B, Cheboygan County, Michigan (U.M.M.Z.).

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 139). "The natal down that soon appears [?] on the otherwise naked nestling is 'mouse gray' " (Bent, 1942, p. 18). "Some white down covers the head, the dorsal, and the ventral tracts" (Davis, 1941, p. 164).

Tyrannus dominicensis

GRAY KINGBIRD

REFERENCE: ". . . The down varies in color from 'cream-buff' to 'cartridge buff' " (Bent, 1942, p. 37).

Tyrannus verticalis

WESTERN KINGBIRD

REFERENCES: ". . . Covered with white down" (Linsdale, 1938, p. 82). "I have not seen the natal down, which is probably gray, as in the eastern kingbird" (Bent, 1952, p. 63).

Tyrannus vociferans

CASSIN'S KINGBIRD

REFERENCES: ". . . Hatched naked, but the juvenile plumage soon appears (Bent, 1942, p. 72). This statement, probably reworded from Wheelock (1904, p. 323), should not be construed to mean that natal down is absent.

TABLE 1

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Tyrannus tyrannus*

Region	Length	Minimum Number		Average	Maximum Number	
		Left	Right		Left	Right
Ocular	6	17	18	20	22	25
Coronal	8	13	16	26	31	34
Auricular	2	0	0	?	1	4
Postauricular	4	0	0	4	10	12
Occipital	7	11	13	20	24	25
Spinal	8	41	41	43	46	46
Pelvic	6	6		5	8	
Scapular	8	17	18	20	23	24
Tertiary	2	0		?	3	
Femoral	9	21	22	24	26	25
Inter-ramal	2	0	0	0	2	0
Cervical (ventral)	3	0	0	0	0	1
Sternal	3	0	0	1	8	6
Axillar	5	1	1	3	6	6
Abdominal	4	13	13	20	25	23
Crural	4	17	17	19	21	21
Rectrix	2	12		12	12	
Upper rectrix covert	6	10		10	10	
Under rectrix covert	2	0		2	8	
Primary	2	8		10	10	
Secondary	5	3		6	9	
Greater primary covert	4	9		9	9	
Greater secondary covert	8	10		11	12	
Middle primary covert	1	0		3	5	
Middle secondary covert	8	9		10	11	
Lesser secondary covert	5	6		8	9	
Carpal remex covert	5	1		1	1	
Alula covert	2	0		3	7	
Patagial covert	2	0		6	23	

[1] Capitalized color terms are those of Ridgway (1912).

Muscivora forficata

SCISSOR-TAILED FLYCATCHER

COLOR: Tilleul Buff.

SPECIMEN EXAMINED: One, stage A, Lipscomb, Texas (U.S.N.M.).

TABLE 2

MEASUREMENTS (IN MILLIMETERS) AND NUMBER OF NEOSSOPTILES OF *Muscivora forficata*

Region	Length	Number
Ocular	5	23
Coronal	6	19
Occipital	6	29
Spinal (unilateral)	8	32
Pelvic	5	4
Scapular	7	17
Femoral	7	22
Axillar	2	5
Abdominal	4	17
Crural	4	7
Rectrix	1	12
Upper rectrix covert	3	8
Primary	1	10
Secondary	4	5
Greater primary covert	3	9
Greater secondary covert	8	11
Middle secondary covert	6	6
Lesser secondary covert	5	8
Carpal remex covert	4	1
Alula	1	2
Alula covert	3	4

Myiodynastes luteiventris

SULPHUR-BELLIED FLYCATCHER

REFERENCE: "The newly-hatched nestlings . . . bore a 'rather copious, long, dusky down' " (Bent, 1942, p. 102, quoting Skutch MS).

Myiarchus crinitus

CRESTED FLYCATCHER

COLOR: Hair Brown.

SPECIMENS EXAMINED: One, stage B (skin), Port Traverse, Ontario (R.O.M.Z.); Boulton (MS), one specimen.

REFERENCE: "The young are hatched naked [?] and blind, but they soon become scantily clothed in grayish natal down" (Bent, 1942, p. 114).

TABLE 3

MEASUREMENTS (IN MILLIMETERS) AND NUMBER OF NEOSSOPTILES OF *Myiarchus crinitus*

(The data are fragmentary.)

Region	Length	Number	From Boulton
Ocular	7	12	4
Coronal	9	9	11
Occipital	9	6	5
Spinal	9	18	12
Pelvic	—	—	5
Scapular	12	15	10
Femoral	7	9	6
Axillar	3	2	—
Abdominal	4	11	9
Rectrix	1	12	—

Myiarchus cinerascens

ASH-THROATED FLYCATCHER

Bent (1942, p. 132) probably errs in intimating the absence of natal down.

Sayornis phoebe

EASTERN PHOEBE

COLOR: Hair Brown.

SPECIMENS EXAMINED: One late embryo, Damariscotta, Maine; five, stage A, Sutton, Massachusetts (R.F.N.); three, stage A, Plainfield, Wisconsin (F. and F.H.); one, stage A, artifically incubated, Washtenaw County, Michigan (K.T.R.); one, stage A, Livingston County, Michigan (U.M.M.Z.); five, stage B, Washtenaw County, Michigan (U.M.M.Z.); one, stage D, Spencer, Massachusetts (P.G.R.).

REFERENCES: "Down on all the tracts except the primary portion of the wing. Also has down on both eyelids. . . . The down is longer than in most species" (Saunders, MS). "Mouse-gray" (Dwight, 1900, p. 142). ". . . 'Mouse gray' or 'light drab' . . . only scantily covers the feather tracts" (Bent, 1942, p. 144).

Sayornis saya

SAY'S PHOEBE

REFERENCES: ". . . Slight gray fuzz" (Wheelock, 1904, p. 200). ". . . Dark-colored down" (Linsdale, 1938, p. 83).

TABLE 4

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sayornis phoebe*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Ocular	6	17	13	18	21	22
Infra-ocular	1	0	0	0	1	1
Coronal	8	9	12	14	16	17
Superciliary	2	0	0	0	0	2
Auricular	4	16	16	19	20	20
Postauricular	4	0	0	2	4	5
Occipital	10	4	7	10	16	14
Middorsal	9	6	5	10	12	15
Pelvic	6	5		7	9	
Scapular	10	10	9	12	14	14
Femoral	9	10	10	12	13	13
Cervical (ventral)	1	0	0	0	5	3
Axillar	6	0	0	3	4	5
Abdominal	6	12	10	14	15	15
Crural	4	6	6	10	12	12
Rectrix	1	12		12	12	
Upper rectrix covert	2	0		8	8	
Secondary	2	0		1	3	
Greater primary covert	3	5		8	9	
Greater secondary covert	10	10		10	10	
Middle secondary covert	6	8		9	10	
Carpal remex covert	5	1		1	1	
Alula	2	0		2	2	
Patagial covert	2	0		0	1	

Empidonax difficilis

WESTERN FLYCATCHER

REFERENCE: "There was down in the usual areas . . . scapular and mid-back, pelvic area, above eyes and around occiput . . . but also on the ventral tract (behind the 'V') and well out the alar tract" (R. A. Norris, personal communication).

Empidonax flaviventris

YELLOW-BELLIED FLYCATCHER

REFERENCES: "Brownish olive-green" (Dwight, 1900, p. 145). ". . . Black patches of down" (Eaton and Cerry, 1924, p. 481).

Empidonax virescens

ACADIAN FLYCATCHER

REFERENCES: ". . . Sparingly clothed in whitish down" (Bent, 1942, p. 190). ". . . Covered above with whitish-gray down" (Brandt, 1947, p. 80).

Empidonax traillii

ALDER FLYCATCHER

COLOR: White; capital tract Tilleul Buff.

SPECIMENS EXAMINED: One, stage A, Stuttgart, Arkansas (M.B.M.); four, stage C, Monroe County, Michigan, collectors Hinshaw and Tinker (U.M.M.Z.).

REFERENCE: "Pale olive-brown" (Dwight, 1900, p. 146).

Empidonax minimus

LEAST FLYCATCHER

COLOR: Tilleul Buff, tips Olive-Brown.

SPECIMEN EXAMINED: One, stage C, collector G. M. Sutton, Livingston County, Michigan (U.M.M.Z.).

REFERENCE: "The natal down is said by Dr. Dickey to be light gray (MS.)" (Bent, 1942, p. 218).

TABLE 5

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Empidonax traillii*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Ocular	4	12	13	15	16	17
Coronal	6	9	8	11	12	12
Auricular	4	0	0	2	4	4
Postauricular	3	0	0	?	1	3
Occipital	6	5	5	6	7	7
Middorsal	5	6	8	10	11	11
Pelvic	4	2		3	5	
Scapular	6	2	2	5	7	7
Femoral	7	7	6	8	9	10
Abdominal	4	6	8	10	12	11
Crural	3	1	2	5	6	8
Rectrix	1	0		12	12	
Greater primary covert	1	0		3	5	
Greater secondary covert	6	4		9	10	
Middle secondary covert	4	2		7	8	
Carpal remex covert	4	1		1	1	

TABLE 6

MEASUREMENTS (IN MILLIMETERS) AND NUMBER OF NEOSSOPTILES OF *Empidonax minimus*

(The data are incomplete.)

Region	Length	Number
Ocular	4	22
Coronal	5	15
Auricular	3	7
Postauricular	3	6
Malar	3	3
Occipital	6	17
Middorsal	5	13
Pelvic	5	7
Scapular	6	8
Femoral	5	13
Sternal	4	5
Axillar	5	4
Abdominal	5	13
Crural	4	18
Rectrix	1	12
Upper rectrix covert	2	6
Greater primary covert	4	9
Greater secondary covert	7	9
Middle secondary covert	5	9
Carpal remex covert	4	1
Alula	2	2

Empidonax griseus

GRAY FLYCATCHER

REFERENCE: ". . . . Sparse down . . . on wings and backs" (Russell and Woodbury, 1941, p. 33).

Contopus virens

EASTERN WOOD PEWEE

COLOR: White, tips Olive-Brown; ventral tract white.

SPECIMENS EXAMINED: Three, stage C, Livingston County, Michigan (U.M.M.Z.).

REFERENCE: "On the day of hatching, the single nestling was only a bit of animated fuzz, but by the evening of the next day . . . with tufts of whitish gray down on its back and head" (Bent, 1942, p. 270, from notes of Du Bois).

Nuttallornis borealis

OLIVE-SIDED FLYCATCHER

COLOR: Agouti: proximal, Pale Drab-Gray; distal, Hair Brown.

SPECIMEN EXAMINED: One, stage D (skin), Algonquin Park, Ontario (R.O.M.Z.).

Pyrocephalus rubinus

VERMILION FLYCATCHER

REFERENCES: ". . . Grayish down stood

TABLE 7

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Contopus virens*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Ocular	5	13	14	16	18	19
Coronal	5	12	11	12	12	14
Auricular	3	1	0	2	2	2
Postauricular	2	0	0	0	0	2
Malar	2	0	0	0	1	2
Occipital	6	5	5	8	9	11
Spinal	6	19	19	22	24	31
Pelvic	5	5		6	7	
Scapular	6	6	5	8	11	11
Femoral	8	15	14	16	17	18
Axillar	5	1	1	2	2	2
Abdominal	5	12	11	13	13	16
Crural	4	10	10	12	16	14
Rectrix	1	12		12	12	
Upper rectrix covert	4	8		10	10	
Primary	1	0		4	5	
Greater primary covert	7	5		9	10	
Greater secondary covert	5	9		10	11	
Middle secondary covert	6	8		10	10	
Carpal remex covert	4	1		1	1	
Alula	2	0		1	1	
Alula covert	1	0		0	1	

out thickly on the crown and along the back" (Wheelock, 1904, p. 469). Dawson (1923, p. 915) describes "outcropping of white down."

TABLE 8

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Nuttallornis borealis*

(The data are incomplete.)

Region	Length	Number
Ocular	3	12
Coronal	4	13
Occipital	5	7
Spinal	6	30
Scapular	5	10
Femoral	7	15
Abdominal	5	7
Crural	6	9
Rectrix	1	?
Upper rectrix covert	4	?
Greater primary covert	3	?
Greater secondary covert	5	?
Middle secondary covert	5	?

Alauda arvensis

SKYLARK

REFERENCES: "Light sandy, dark at the base of the prepennae giving the whole a peculiar 'leveret' appearance . . . Fairly long and abundant . . . Inner supra-orbital, occipital, humeral, spinal, ulnar, and femoral; spinal tract confined to small area over and just above sacrum" (Ticehurst, 1908, p. 194). "Straw-colour, slightly darker, neutral buff at base" (Ingram, 1920, p. 877). ". . . As soon as their down has dried . . . covered with long, very pale straw-colored down" (Jourdain *in* Bent, 1942, p. 317). "*Die Daunen der Kleinen sind wirrstrahlig und sehen aus wie trocknes Gras, die Körper sind schwärzlich*" (O. and M. Heinroth, 1926, p. 159).

Eremophila alpestris

HORNED LARK

COLOR: Olive-Buff.

SPECIMEN EXAMINED: One, stage D (skin), Toronto, Ontario (R.O.M.Z.).

REFERENCES: ". . . Five days old

. . . covered with a brownish yellow down" (Merrill, 1888, p. 260). "The newly-hatched young . . . covered with dirty gray down" (Jones, 1892, p. 58). ". . . Clothed sparingly in sulphur-yellow down" (Townsend and Allen, 1907, p. 385). ". . . Scantily covered with creamy down" (Kennedy, 1913, p. 135). ". . . Good sized patches . . . of grayish-white down . . . on either side of the forehead, occiput, back and wings" (Terrill, 1917, p. 138). ". . . Unusually heavy . . . cream-buff [Ridgway] . . . a double patch (i.e., one on either side), on the crown, a double tuft on the occiput, a strip along the humerus, a strip along the arm, at the tips of the greater coverts of the secondaries, a strip on either side of the spinal column from below the wings to the tail, and, lastly, a femoral tuft" (Pickwell, 1931, p. 103). ". . . Down, creamy-white . . . Down still clinging to the head,

TABLE 9

MEASUREMENTS (IN MILLIMETERS) AND NUMBER OF NEOSSOPTILES OF *Eremophila alpestris*

(The data are fragmentary.)

Region	Length	Number
Coronal	5	11
Spinal	10	10
Scapular	6	4
Femoral	8	11
Abdominal	6	2
Greater secondary covert	8	8
Middle secondary covert	8	8

upper wing-coverts and secondaries" (Kelso, 1931, pp. 61, 62). ". . . Dirty tan down . . . covered the nestlings after hatching" (Freer, 1933, p. 199). ". . . Covered on top with dense, yellowish tan down" (Linsdale, 1938, p. 90). "At hatching, the young bird showed only a few thin, moist threads about its back and head. In half an hour these had begun to unfurl and separate, some of them having been twisted together by a complete turn or more. Each of the delicate filaments of down, when viewed under a strong magnifying glass, showed numerous finer branches . . . When [the nestling] was ten hours old, nearly all of its natal down was dry, fully three-eighths of an inch long, and very fluffy . . . a marvelous transformation . . . at the age of one day the upper surface of the nestling seems covered with the curious long, buffy down" (Du Bois, 1936, pp. 53, 54). Witherby *et alii* (1938, vol. 1, p. 187) include crural down.

Tachycineta thalassina

VIOLET-GREEN SWALLOW

REFERENCE: "There are slight wisps of creamy down on the back, crown, and the scapulars" (Edson, 1943, p. 399).

Iridoprocne bicolor

TREE SWALLOW

COLOR: White or Pallid Mouse Gray.

SPECIMENS EXAMINED: Three, stage A, Abington, Connecticut; six, stage A, artificially incubated, Boylston, Massachusetts; one, stage B, Charlton, Massachusetts; two stage D, Abington, Connecticut.

Riparia riparia

BANK SWALLOW

COLOR: Pallid Mouse Gray.

SPECIMENS EXAMINED: Eleven, stages A to D, Clinton, Massachusetts.

REFERENCES: "Gray, rather darker on the humeral tract . . . Rather short, scanty . . . Inner supra-orbital, occipital, humeral, spinal and ulnar. On the last two very scanty. Prepennae of ulnar tract present on the secondary coverts" (Ticehurst, 1908, p. 192). On newly hatched birds, "scanty covering of gray down on the back of the head and neck [?], base of wings, and top of back" (Beyer, 1938, p. 127). "Down pale grey, rather short but fairly plentiful. Distribution, inner supra-orbital, occipital, spinal and humeral" (Witherby *et al.*, 1938, vol. 2, p. 241).

Stelgidopteryx ruficollis

ROUGH-WINGED SWALLOW

COLOR: White.

SPECIMENS EXAMINED: Four, stage A, Princeton, Massachusetts; one, stage C, Leicester, Massachusetts.

REFERENCES: ". . . Nearly naked with only a little down on the top of the head and along the back" (Maynard, 1889, p. 162). ". . . Down on the head patches, the dorsal patch and the humeral, but nowhere else" (Saunders, MS). "They are coated with streaks of gray down" (Bent, 1942, p. 429, from MS of Dickey).

TABLE 10

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Iridoprocne bicolor*

Region	Length	Number Minimum		Number Average	Number Maximum	
		Left	Right		Left	Right
Orbital	2	0	0	0	3	5
Coronal	6	2	2	5	9	12
Occipital	6	2	2	2	3	4
Middorsal	9	1	1	3	4	4
Scapular	7	1	1	7	8	9
Pelvic (upper)	3	0		0	1	
Rectrix	1	0		12	12	

TABLE 11

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Riparia riparia*

Region	Length	Number Minimum		Number Average	Number Maximum	
		Left	Right		Left	Right
Coronal	8	3	3	4	8	7
Occipital	9	2	2	3	3	4
Middorsal	12	3	3	4	6	6
Scapular	12	0	3	5	7	8
Rectrix	1	12		12	12	

TABLE 12

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Stelgidopteryx ruficollis*

Region	Length	Number Minimum		Number Average	Number Maximum	
		Left	Right		Left	Right
Coronal	8	3	2	4	4	5
Occipital	8	1	2	2	3	3
Middorsal	10	4	4	5	5	5
Scapular	10	6	6	6	6	6
Rectrix	1	12		12	12	

TABLE 13

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Hirundo rustica*

Region	Length	Number Minimum		Number Average	Number Maximum	
		Left	Right		Left	Right
Coronal	8	6	4	7	10	9
Occipital	9	3	4	6	7	8
Middorsal	12	3	1	4	4	4
Scapular	13	7	9	9	9	10
Femoral	8	0	0	3	3	3
Rectrix	?	?		?	?	

TABLE 14

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Petrochelidon pyrrhonota*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	2	2	7	7	7
Occipital	7	3	2	3	4	4
Middorsal	11	4	4	5	5	5
Scapular	11	8	8	9	9	9
Femoral	10	4	4	5	6	6
Rectrix	1	12		12	12	
Secondary	2	1		1	1	

Delichon urbica

EUROPEAN MARTIN

REFERENCES: "White . . . Rather scanty on all the tracts . . . . Inner supraorbital, occipital, humeral, spinal and femoral" (Ticehurst, 1910, p. 71). "Down greyish-white, long but rather sparse. Distribution, inner supra-orbital, occipital, humeral, spinal and femoral" (Witherby *et al.*, 1938, vol. 2, p. 238).

Hirundo rustica

BARN SWALLOW

COLOR: Drab-Gray.

SPECIMENS EXAMINED: Five, stage C, Spencer, Massachusetts (P.G.R.).

REFERENCES: "Smoke-gray" (Dwight, 1900, p. 227). "Grey . . . Fairly long. Tracts scanty . . . Inner supra-orbital, occipital, humeral and spinal" (Ticehurst, 1908, p. 191). Leigh (1909, p. 153) adds the femoral tract to Ticehurst's description. "The natal down was pale smoke gray" (Smith, 1933, p. 416). "When hatched the young were adorned with dark-gray ["black" (Wood, 1937b, p. 98)] downy tufts, 5 mm. long, located as frontal, occipital, scapular, and mid-dorsal" (Wood, 1937a, p. 31). "The young nestling is scantily covered with 'smoke gray,' or darker, natal down on the forehead, occiput, scapular region, and middle of the back" (Bent, 1942, p. 449). ". . . Have down on the head patches, the dorsal patch and the humeral, but nowhere else . . . the down is very short, and occupies the middle of the back only, and can be seen to occur in two rows, one on each side of the spinal ridge" (Saunders, MS).

Petrochelidon pyrrhonota

CLIFF SWALLOW

COLOR: White.

SPECIMENS EXAMINED: Two, stage A, Yolo County, California (G.W.S.); two, stage B, Princeton, Massachusetts.

REFERENCE: ". . . The heads and backs of the young were covered with a thin down" (Wheelock, 1905, p. 65).

Progne subis

PURPLE MARTIN

REFERENCES: "Most newly hatched Purple Martins I have observed were entirely devoid of natal down. Two individuals possessed a few filaments: one had four grey filaments 4 mm. in length on the occipital region, the other had two of the same length on the spinal tract. Both lost this down on the first or second day of nest life. At hatching the rectrices and remiges can be seen beneath the skin and their tips protrude about $\frac{1}{2}$ mm." (Allen and Nice, 1952, p. 632).

Perisoreus canadensis

CANADA JAY

COLOR: Light Drab.

SPECIMEN EXAMINED: One, stage D, Liscomb, Nova Scotia (N.M.C.).

Cyanocitta cristata

BLUE JAY

Without neossoptiles.

SPECIMENS EXAMINED: Five, stages A and B, Auburn, Massachusetts.

REFERENCES: "Pale mouse-gray" (Dwight, 1900, p. 152). "Inspection of his specimens

TABLE 15

MEASUREMENTS (IN MILLIMETERS) OF NEOSSOPTILES OF *Perisoreus canadensis*

(The data are fragmentary.)

Region	Length
Ocular	6
Coronal	9
Occipital	8
Scapular	13
Femoral	10
Middorsal	12
Pelvic	12
Abdominal	4
Greater primary covert	2
Greater secondary covert	12
Middle secondary covert	9
Carpal remex covert	2

with Dr. Dwight indicates that this statement was probably based on an immature bird in which the downy aftershaft of a reversed feather was mistaken for a neossoptile [see also *Passer domesticus*]" (Miller, 1924, p. 331). "Two young just hatched are entirely naked. They have no down except tiny filaments at the end of rectrices and remiges" (Boulton, MS). "First day: The young are entirely naked with no trace of down or feathers" (Rand, 1936, p. 27). ". . . At the time of hatching . . . entirely naked" (Bent, 1946, p. 38, from J. R. Arnold MS). ". . . Without any down when hatched" (Saunders, MS).

Aphelocoma coerulescens

FLORIDA JAY

REFERENCE: ". . . Probably some form of natal down appears in advance of the juvenile plumage, though I have not seen it" (Bent, 1946, p. 95).

Aphelocoma ultramarina

ARIZONA JAY

REFERENCES: "I have seen only small naked young, none with natal down" (Bent, 1946, p. 121). ". . . Without any natal down" (Gross, 1949, p. 248).

Xanthoura yncas

GREEN JAY

REFERENCE: Of a four-day-old young, "The top of the head and the spinal tract (both the skin and the neosoptiles [*sic*]) were greenish gray in color" (Friedmann, 1925, p. 548).

Pica pica

AMERICAN MAGPIE

REFERENCES: "Down. Absent" (Ticehurst, 1910, p. 72). ". . . They have no down. This evidently is an adaptation to the enclosed type of nest" (Linsdale *in* Bent, 1946, p. 141). Adaptive evidence is questioned by Rand (1947, p. 180), because ". . . we find a similar nakedness in some other species, such as the Blue Jay, which have open nests." ". . .Without any down when hatched" (Saunders, MS). ". . . *Zunächst nackt*" (O. and M. Heinroth, 1926, p. 238).

Corvus corax

RAVEN

COLOR: Vinaceous-Buff.

SPECIMEN EXAMINED: One, stage C, locality unknown (U.S.N.M.).

REFERENCES: "Down, mouse-brown, fairly plentiful but not very long; distribution, inner supra-orbital, occipital, humeral, ulnar, spinal, and femoral" (Witherby *et al.*, 1938, vol. 1, p. 10). ". . . Small patches of grayish down" (Tyrrell, 1945, p. 6). Bent (1946, p. 189, quoting Dickey MS) describes ". . . areas of dusky gray down . . ." and continues, ". . . they had developed only a scanty

TABLE 16

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Corvus corax*

(The data are fragmentary.)

Region	Length	Number
Coronal	4	27
Occipital	2	4
Spinal	11	80
Scapular	11	20
Femoral	11	23
Rectrix	2	12
Secondary	3	3
Greater primary covert	1	7
Greater secondary covert	7	11
Middle secondary covert	6	8
Carpal remex covert	1	1
Alula	3	3

TABLE 17

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Corvus brachyrhynchos*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	21	22	30	34	44
Occipital	5	7	8	13	14	16
Spinal	16	52		58	63	
Scapular	12	12	11	18	22	22
Femoral	12	21	18	23	26	24
Rectrix	3	12		12	12	
Primary	2	10		10	10	
Secondary	4	10		11	11	
Greater primary covert	2	7		8	10	
Greater secondary covert	11	10		11	11	
Middle secondary covert	7	5		8	9	
Carpal remex covert	2	1		1	1	
Alula	2	2		2	3	
Patagial covert	3	0		0	2	

growth of grayish-brown down on the dorsal tract."

Corvus cryptoleucus

WHITE-NECKED RAVEN

REFERENCES: "Nestlings are like other young ravens or crows, naked at first [?] but soon scantily covered with brownish-gray down" (Bent, 1946, p. 218).

Corvus brachyrhynchos

CROW

COLOR: Mouse Gray.

SPECIMENS EXAMINED: Five, stage B, Spencer, Massachusetts (L.D.).

REFERENCES: "Grayish clove-brown" (Dwight, 1900, p. 154). "The young when first hatched are . . . scantly clad with tufts of grayish clove-brown on the head, back, and wings" (Gross *in* Bent, 1946, p. 234). "In the Corvidae, down grows out soon after [?] hatching. Boulton, in converstion, disputed my statement that a young Crow has no natal down, but the birds I observed were less than a day old. I observed lack of down in both the Eastern Crow in Connecticut and the Western in Montana" (Saunders, MS). "At the time of hatching, the bird is partly covered with down, most of it being on the cephalic, humeral, alar, and spinal feather tracts" (Parmalee, 1952, p. 197).

Corvus ossifragus

FISH CROW

COLOR: Light Drab.

SPECIMEN EXAMINED: One, stage A, Wallop's Island, Virginia (U.S.N.M.).

REFERENCE: ". . . Hatched naked [?] but it soon acquires a scanty growth of grayish-brown natal down" (Bent, 1946, p. 278).

TABLE 18

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Corvus ossifragus*

(The data are fragmentary.)

Region	Length	Number
Coronal	7	46
Occipital	4	51
Spinal	15	69
Scapular	9	19
Femoral	12	24
Rectrix	1	12
Primary	1	10
Secondary	4	8
Greater primary covert	2	8
Greater secondary covert	9	12
Middle secondary covert	9	9
Carpal remex covert	2	1
Alula	1	2
Patagial covert	3	4

Corvus frugilegus

ROOK

REFERENCES: "Dusky grey . . . Humeral, spinal, ulnar and femoral" (Leigh, 1910, p. 73). Dunlop (1911, p. 76) recorded as an individual variation a specimen in which "the down was entirely absent." ". . . Completely absent from head, while the humeral and spinal tracts are noticeably abbreviated" (Ingram, 1919, p. 79). "Down, dark greyish-smoke, short and scanty; . . . distribution, spinal, humeral, ulnar, and femoral" (Witherby *et al.*, 1938, vol. 1, p. 21).

Corvus cornix

HOODED CROW

REFERENCES: "Down fairly plentiful, smoke-grey . . . distribution, inner supra-orbital, occipital (short on these), spinal, humeral, ulnar, femoral (longer on these)" (Witherby *et al.*, 1938, vol. 1, p. 17). ". . . Down on ventral tract not detected in [a?] single specimen examined" (Witherby *et al.*, 1938, vol. 1, p. 13).

Gymnorhinus cyanocephalus

PINON JAY

REFERENCE: ". . . Naked slate-colored young" (Cameron, 1907, p. 395). This statement may or may not mean without down.

Nucifraga columbiana

CLARK'S NUTCRACKER

COLOR: White.

SPECIMENS EXAMINED: One, late embryo, and one, stage B, Missoula, Montana (L.R.M.).

REFERENCES: ". . . Three naked [?] youngsters, recently hatched and apparently about three days old". . . . "Nest contained three young, apparently a few days older than those in the previous nest, as they were partly covered with down" (Bradbury, 1917, p. 150). Bent (1946, p. 315) takes his cue from Bradbury in describing intial nakedness. My examination of L. R. Mewaldt's embryo (about 80% developed) in table 19 shows that Bradbury's and Bent's conception of original nakedness is incorrect in this species, as it may be in other species so attributed.

Parus atricapillus

BLACK-CAPPED CHICKADEE

COLOR: Light Drab.

SPECIMENS EXAMINED: Six, stage A (skins), Peninsula, Ontario (R.O.M.Z.).

REFERENCES: "Pale mouse-gray" (Dwight, 1900, p. 302). "Down brownish-grey, short and scanty. Distribution inner supra-orbital, occipital, humeral and spinal" (Witherby *et al.*, 1938, vol. 1, p. 264). "Down feathers are

TABLE 19

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Nucifraga columbiana*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	8	14	13	15	15	15
Occipital	7	10	13	15	14	16
Spinal	12	48		57	67	
Scapular	10	15	16	17	18	18
Femoral	8	14	18	18	18	18
Rectrix	2	12		12	12	
Upper rectrix covert	5	6		6	6	
Primary	2			10		
Secondary	4			9		
Greater primary covert	2			9		
Greater secondary covert	10			10		
Middle secondary covert	7			9		
Carpal remex covert	3			1		
Alula	1			2		

TABLE 20

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Parus atricapillus*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	8	2	4	5	7	7
Occipital	9	3	3	4	4	4
Middorsal	7	0	0	3	4	5
Scapular	8	2	4	5	6	5
Rectrix	1	12		12	12	

located in six small patches, all on the dorsal surface as follows: capital tract, two tufts (superciliary region); humeral tract, two tufts; and dorsal or spinal tract, two tufts (one each on cervical and dorsal regions). There are only two to twelve feathers in each tuft; one bird had only 29 down feathers in all" (Odum, 1941, pp. 528–529).

Parus carolinensis

CAROLINA CHICKADEE

REFERENCE: "There were mere cilia of gray down on the head, back of wing stumps, lower back or rump" (Bent, 1946, p. 347, from MS of Dickey).

Parus hudsonicus

BROWN-CAPPED CHICKADEE

REFERENCE: "Naked save for a few wisps of down on their developing tracts" (Pettingill, 1937, p. 278).

Parus rufescens

CHESTNUT-BACKED CHICKADEE

FRAGMENTARY DATA: Down on following regions: coronal, 7 mm.; occipital, 10 mm.; middorsal, 7 mm.

COLOR: Light Drab.

SPECIMEN EXAMINED: One, stage D (skin), Yakutat, Alaska (R.O.M.Z.).

Parus bicolor

TUFTED TITMOUSE

REFERENCE: ". . . Naked except for 'feather tufts of dusky grey down' on the top of the head, at the base of the skull and in the middle of the back. When 6 days old, the 'body had blue-gray down' " (Bent, 1946, p. 398, from MS of Dickey).

Parus atricristatus

BLACK-CRESTED TITMOUSE

COLOR: Tilleul Buff.

SPECIMEN EXAMINED: Sennett's stage A, Rio Grande, Texas (U.S.N.M.).

REFERENCE: "Young just from the egg are nude, with the exception of a few long dark, downy feathers on the back, nape, and over the eyes" (Sennett, 1879, p. 377).

TABLE 21

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Parus atricristatus*

Region	Length	Number
Coronal	7	4
Occipital	9	4
Middorsal	8	3

Auriparus flaviceps

ARIZONA VERDIN

REFERENCE: ". . . Apparently they are hatched naked [?]" (Bent, 1946, p. 432).

Psaltriparus minimus

COAST BUSH-TIT

REFERENCES: "On the sixth day the young Bush-tits were covered with a hairlike grayish white down [cf. Addicott]" (Wheelock, 1904, p. 300). "The young are naked at hatching and down does not develop" (Addicott, 1938, p. 63). "Down is very scanty and is worn for only a short time, as the juvenile plumage soon pushes it out" (Bent, 1946, p. 144).

Sitta carolinensis

WHITE-BREASTED NUTHATCH

Fragmentary data are for the following regions only: coronal, 7 mm.; occipital, 3 mm.; middorsal, 9 mm.; scapular, 9 mm.

COLOR: White, but darker on head.

SPECIMENS EXAMINED: Two, stage D (skins), Chapel Hill, North Carolina (F.B.M.).

Sitta canadensis

RED-BREASTED NUTHATCH

REFERENCE: ". . . Dark gray" (Bent, 1948, p. 26).

Sitta pusilla

BROWN-HEADED NUTHATCH

COLOR: Light Mouse Gray.

SPECIMENS EXAMINED: Two, stage A, Tifton, Georgia (R.A.N.).

REFERENCE: "Natal down pale gray when dry" (R. A. Norris, personal communication).

Sitta pygmaea

PYGMY NUTHATCH

REFERENCE: "The distribution of down (on only one specimen examined so far) seemed identical with that of *Sitta pusilla*, or very nearly so" (R. A. Norris, personal communication).

Certhia familiaris

BROWN CREEPER

REFERENCE: "Blackish-gray . . Long and plentiful . . Inner supra-orbital and occipital" (Ticehurst, 1910, p. 71). ". . . *Eine Papuatolle*" (O. and M. Heinroth, 1926, p. 137).

Chamaea fasciata

COAST WREN-TIT

REFERENCES: ". . . Perfectly naked when hatched, not even down feathers being in evidence" (Newberry, 1916, p. 67). Pin feathers were the first indication of plumage. "The young at hatching are without down. . . By the third day the . . location of each of the rectrices is marked by a fine hair-like neossoptile a millimeter long. ['The only vestige of a down plumage that ever develops' (Bent, 1948, p. 87).] . . . By the time the young are five days old . . . the vestigial neossoptiles at the tips of the rectrices are three millimeters long" (Erickson, 1938, pp. 292–295).

Cinclus mexicanus

DIPPER

Fragmentary data include down on the following regions: coronal, 11 mm.; occipital, 11 mm.; scapular, 14 mm.; spinal, 14 mm.

COLOR: Avellaneous.

SPECIMEN EXAMINED: One, stage D, Snake River, ? (U.S.N.M.).

REFERENCE: "From the first, the young Ouzel has a complete coat of down" (Steiger, 1940, p. 13). "Newly hatched . . . covered with a coat of down" (Hann, 1950, p. 54).

Troglodytes aedon

HOUSE WREN

COLOR: Hair Brown.

SPECIMENS EXAMINED: Three, stage A, Abington, Connecticut; five, stage A, Cheboygan County, Michigan (U.M.M.Z.); one, stage C, Worcester, Massachusetts.

REFERENCES: "Sepia brown" (Dwight, 1900, p. 294). ". . . Neossoptiles are present when it is hatched. They appear to have attained their full size before the bird emerges from the egg. . . . An examination of over one hundred young Wrens revealed that they were confined to the coronal, occipital and dorsal regions. There is a certain amount of variation in the number of downs in each region as will be seen from the accompanying table. Neossoptiles . . . of the coronal region . . . are attached to the tips of the outermost row of feathers and extend from a point slightly anterior to the eye to a point slightly posterior. In the occipital region there are four downs in a double row on each side of the median line slightly anterior to the diamond shaped whorl [of teleoptiles]. In the dorsal region there are three downs on each side with one at the posterior end on the median line. When the young bird is first hatched, there appear to be filaments of down at the tips of both the rectrices and remiges. Each filament is less than half a millimeter long and consists of a single shaft without any barbs or barbules. It may be that this structure is merely the attenuated tip of the forthcoming feather sheath. I am inclined, however, to regard it as a neossoptile, probably degenerate, although

TABLE 22

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sitta pusilla*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	7	6	5	7	8	9
Occipital	7	3	3	4	4	5
Middorsal	8	5	4	5	5	5
Scapular	6	5	6	6	6	6

TABLE 23

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Troglodytes aedon*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	8	4	4	5	7	6
Occipital	10	3	3	4	5	5
Middorsal	7	0	0	3	5	5
Pelvic (upper)	5	0		1	2	

TABLE 24

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF FIFTEEN NESTLINGS OF *Troglodytes aedon*, FROM BOLTON

Region	Minimum		Number	Maximum	
	Left	Right	Average	Left	Right
Coronal	4	3	5.3–5.5	7	8
Occipital	4	3	4.0–4.0	5	5
Dorsal	2	2	3.5–3.3	5	5
Dorsal median	0		0.6	1	

TABLE 25

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Telmatodytes palustris*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	7	6	6	8	10	12
Occipital	8	2	2	4	6	6
Middorsal	7	1	1	3	4	4
Pelvic (upper)	6	0		1	1	

possibly primitive, but I have not made an histological examination of it" (Boulton, 1927, pp. 399, 401). Boulton's data on 15 nestlings are given in table 24.

Troglodytes troglodytes

WINTER WREN

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 294). "Down greyish sooty-black, rather short and scanty especially on spinal tract. Distribution, inner supra-orbital, occipital and spinal" (Witherby *et al.*, 1938, vol. 2, pp. 216, 218). Harrisson and Buchan (1936, p. 19) state that down on the subspecies *hirtensis* tends to be slightly paler and is absent [?] from the spinal tract.

Thryothorus ludovicianus

CAROLINA WREN

REFERENCE: "Soon after hatching the young wrens are scantily decorated with slate-colored down" (Bent, 1948, p. 209).

Campylorhynchus brunneicapillus

CACTUS WREN

Fragmentary data include down on the following regions: coronal, 10 mm.; occipital, 12 mm.; middorsal, 12 mm.; scapular, 10 mm.; femoral, 10 mm. (only one filament noted).

COLOR: Tilleul Buff.

SPECIMENS EXAMINED: Three, stage D, Onyx, California (M.V.Z.).

REFERENCE: ". . . Sparse sprinkling of whitish down on crown and back" (Wheelock, 1904, p. 278).

Telmatodytes palustris

LONG-BILLED MARSH WREN

COLOR: White.

SPECIMENS EXAMINED: Five, stage A; four, stage B; three, stage D; Ann Arbor, Michigan (U.M.M.Z.). Three, stage C, Collins Lake, Ontario (N.M.C.).

REFERENCES: "White" (Dwight, 1900, p. 296). ". . . Four days . . . [after hatching] a thin buffy down covered the top of their heads and was scattered sparsely over their bodies" (Wheelock, 1904, p. 291). "At hatching . . . partially covered on the capital and spinal tracts by a few pure white neossoptiles" (Welter, 1935, p. 24). ". . . Several days old . . . down on the two head patches, and the back only" (Saunders, MS).

Cistothorus platensis

SHORT-BILLED MARSH WREN

REFERENCE: ". . . Little patches of natal down still remained on its head and back" (Mousley, 1934, p. 444).

Mimus polyglottos

MOCKINGBIRD

FRAGMENTARY DATA: Undetermined number of downs on the following regions: ocular, coronal, occipital, abdominal, crural, greater secondary covert, and middle secondary covert.

TABLE 26

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Dumetella carolinensis*

Region	Length	Number						
		Minimum			Maximum		Boulton	
		Left	Right	Average	Left	Right		
Ocular	4	1	2	5	6	7	8	8
Coronal	8	12	12	13	16	14	14	14
Occipital	9	2	3	4	5	5	6	6
Middorsal	9	3	3	5	6	6	?	?
Pelvic (upper	10	5		5	5		?	?
Pelvic (lower)	7	0		1	1		1	
Scapular	9	4	4	5	5	5	4	4
Femoral	8	2	1	5	7	6	8	8
Rectrix	1	0		12	12		12	
Greater secondary covert	7	4		5	7		5	
Middle secondary covert	5	3		5	6		6	

SPECIMEN EXAMINED: One, stage D, Stuttgart, Arkansas (M.B.M.).

REFERENCES: "Pale sepia-brown" (Dwight, 1900, p. 290). ". . . Entirely naked, save for a few patches of down" (Daniels, 1902, p. 70).

Dumetella carolinensis

CATBIRD

COLOR: Clove Brown or Chaetura Black.

SPECIMENS EXAMINED: One, stage A, Worcester, Massachusetts; one, stage A, artificially incubated, Washtenaw County, Michigan (K.T.R.); one, stage B, Grafton, Massachusetts; two, stage D, Athens, Ohio (H.C.S.)

REFERENCES: Boulton (MS) gives approximate data on one specimen two days old (see table 26); color, "deep slate gray." ". . . Down on both head patches, entire length of the back [interscapular region not implied], tail, femoral, and humeral tracts, and secondaries [coverts], that is, all the upper patches except the primaries [coverts]. The down is very dark gray, nearly black" (Saunders, MS).

Toxostoma rufum

BROWN THRASHER

COLOR: Benzo Brown.

SPECIMEN EXAMINED: One, stage B (skin), Toronto, Ontario (R.O.M.Z.).

REFERENCES: ". . . Have down on both head patches, entire length of the back [interscapular region not implied], tail, femoral, and humeral tracts, and secondaries [coverts], that is, all the upper patches except the primaries [coverts]" (Saunders, MS).

TABLE 27

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Toxostoma rufum*

(The data are incomplete.)

Region	Length	Number
Ocular	5	7
Coronal	12	15
Occipital	11	4
Spinal	14	30
Scapular	12	8
Femoral	11	14
Crural	6	7
Rectrix	?	12
Abdominal	4	9
Greater secondary covert	12	9
Middle secondary covert	8	7

Toxostoma curvirostre

CURVE-BILLED THRASHER

COLOR: "Chaetura drab above, whitish below," J. Van Tyne, collector.

SPECIMEN EXAMINED: One, stage A, Brewster County, Texas (U.M.M.Z.).

REFERENCES: "The down of the nestling was Chaetura Drab above and whitish on the chin and ventral tracts" (Van Tyne and Sutton, 1937, p. 71). ". . . Long gray down is present on the upperparts, about 11 mm. long on the back, and 12 mm. long on the crown, and paler gray down, about 12 mm. long, is present in a line on each side of the abdomen" (Rand, 1941, p. 214).

Toxostoma lecontei

LECONTE'S THRASHER

Fragmentary data include neossoptiles on the following regions: coronal, 14 mm.; occipital; spinal; scapular; femoral; abdominal; crural; rectrix, 8 mm.; greater and middle secondary coverts.

COLOR: Vinaceous-Buff.

SPECIMEN EXAMINED: One, stage C, San Bernardino County, California (M.V.Z.).

TABLE 28

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Toxostoma curvirostre*

Region	Length	Number
Ocular	4	6
Coronal	8	17
Occipital	9	10
Spinal (bilateral)	10	56
Scapular	10	9
Femoral	8	25
Inter-ramal	3	3
Cervical (ventral)	2	3
Abdominal	5	28
Crural	5	20
Rectrix	1	12
Under rectrix covert	4	12
Greater primary covert	3	4
Greater secondary covert	7	7
Middle secondary covert	6	10
Carpal remex covert	3	1

TABLE 29

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Oreoscoptes montanus*

Region	Length	Number
Ocular	4	9
Coronal	10	18
Occipital	11	6
Middorsal	12	7
Pelvic	12	12
Scapular	13	9
Femoral	11	12
Crural	4	5
Rectrix	1	12
Abdominal	4	5
Greater secondary covert	11	9
Middle secondary covert	8	7
Carpal remex covert	2	1

Toxostoma dorsale

CRISSAL THRASHER

REFERENCE: "They are naked, except for the faintest suggestion of down on the head and back" (Wheelock, 1904, p. 276).

Oreoscoptes montanus

STAGE THRASHER

COLOR: Chaetura Drab or Fawn Color.

SPECIMENS EXAMINED: One, stage A (skin) Green River, Wyoming (R.O.M.Z.); one, stage C, Nye County, Wyoming (M.V.Z.).

REFERENCES: ". . . On the second day the down grows more perceptible on head and back" (Wheelock, 1904, p. 270). ". . .Covered with tracts of blackish down" (Linsdale, 1938, p. 106).

Turdus musicus

EUROPEAN RED-WING

REFERENCES: "Buffish white" (Ticehurst, 1908, p. 188). "Down, long and plentiful except on inner supra-orbital where scanty, fawn colour. Distribution, inner supra-orbital, occipital, spinal, humeral and ulnar" (Witherby *et al.*, 1938, vol. 2, p. 123).

Turdus migratorius

ROBIN

COLOR: Pinkish Buff or Vinaceous-Buff or Cinnamon.

SPECIMENS EXAMINED: One, stage A, Plainfield, Wisconsin (F. and F.H.); five, stage B, Worcester, Massachusetts; one, stage B, Moosup, Connecticut; two, stage C, Abington, Connecticut.

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 313). ". . . Nest-life change[s] the color of the down from white to gray [cf. Howell, 1942]" (Saunders, 1920, p. 312). Just hatched, "Length of down on back measures 10 mm.; down on crown measures 8 mm.; down on secondaries (ulna and radius) 7 mm.; down on humerus 11 mm.; down by primaries and primary coverts less than ½ mm.; down on pygostyle less than ½ mm." (Boulton, MS). "Down on both head patches, entire length of back [interscapular region not

TABLE 30

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Turdus migratorius*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	12	8	6	10	15	14
Occipital	14	4	4	5	7	7
Middorsal	17	8	10	12	14	14
Pelvic (lower)	14	2		4	7	
Scapular	18	5	5	8	11	11
Rectrix	3	12		12	12	
Primary	2	2		6	9	
Secondary	2	0		6	9	
Greater primary covert	1	0		4	8	
Greater secondary covert	7	4		8	9	
Alula	1	0		0	2	

implied], humeral, and secondaries [coverts]" (Saunders, MS). "The color of the down is constant throughout the period that it remains attached to the developing bird. The down is dull white on the basal 2 mm.; the remainder being Pale Ochraceous Buff. The down seems to be fully mature when the young hatch" (Howell, 1942, p. 569). Howell's figure 2 labels the "superciliary region, occipital region, humeral tract, alar tract, spinal tract, and caudal tract."

Turdus merula

EUROPEAN BLACKBIRD

REFERENCES: "Greyish white" (Ticehurst, 1908, p. 198). "Smoky-drab. Usually on greater coverts only [of alar tract]" (Ingram, 1920, p. 78). "Down fairly long but rather scanty, pale buffish-grey. Distribution, inner supra-orbital, occipital, humeral, ulnar and spinal" (Witherby *et al.*, 1938, vol. 2, p. 140).

Turdus pilaris

FIELDFARE

REFERENCES: "Down, buff, fairly long and plentiful. Distribution, outer (short) and inner supra-orbital, occipital, spinal, humeral, and ulnar" (Witherby *et al.*, 1938, vol. 2, p. 110). "*Die Daunen sind dunkel wie bei der Amsel* [*T. merula*]" (O. and M. Heinroth, 1926, p. 48).

Ixoreus naevius

VARIED THRUSH

REFERENCE: ". . . Scantily decorated on the head and on the alar and dorsal tracts with long 'vinaceous-buff' down, which is fully an inch long on the back. . . . The young nestling is scantily covered with grayish down" (Bent, 1949, p. 88).

Hylocichla mustelina

WOOD THRUSH

COLOR: Light Drab.

SPECIMENS EXAMINED: One, stage A, Worcester, Massachusetts; one, stage A, Athens County, Ohio (H.C.S.); two, stage B, Spencer, Massachusetts (P.G.R.).

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 308). Two specimens in table 31 (Boulton, MS). ". . . Light gray" (Weaver *in* Bent, 1949, p. 110). "Down is on both head patches, lower half of the back, and the humeral tract" (Saunders, MS).

Hylocichla guttata

HERMIT THRUSH

COLOR: Olive-Brown.

SPECIMENS EXAMINED: Four, stage C, Princeton, Massachusetts.

REFERENCES: ". . . Long, black, downy feathers on the dorsal tract" (Perry and Perry, 1918, p. 320). ". . . Black or grayish black and very sparse" (Linsdale, 1938, p. 108). "At the time of hatching the young are nearly naked, being clothed by only a few scant tufts of dark grayish down on the crown and dorsal tracts of the body" (Gross *in* Bent, 1949, p. 149). "Down is on both head patches, lower half of the back, and humeral tract" (Saunders, MS).

Hylocichla ustulata

OLIVE-BACKED THRUSH

COLOR: Drab.

SPECIMENS EXAMINED: Three, stage A (skins), Amyot, Ontario (R.O.M.Z.); one, stage C, Gogebic County, Michigan (U.M.M.Z.).

REFERENCES: ". . . Sparingly covered with brownish gray down" (Wheelock, 1904, p. 307). Beginning of the first day ". . . a tint of burnt-orange, natal down one-half inch long" (Stanwood, 1913, p. 125). Bent (1949, p. 180) quotes Stanwood, ". . . natal down . . .' so dark brown that it looked black.' "

Hylocichla minima

GRAY-CHEEKED THRUSH

COLOR: Capucine Buff.

SPECIMENS EXAMINED: Two, stage C, Mt. Mansfield, Vermont (G.J.W.).

REFERENCE: "The newly hatched chick . . . entirely naked except for wisps of wet down on the head and dorsal tracts . . . Dark gray or blackish natal down covers the cephalic, dorsal and humeral tracts, but not the alar, femoral, crural, ventral, or caudal tracts" (Wallace, 1939, pp. 324, 343).

Sialis sialis

EASTERN BLUEBIRD

COLOR: Hair Brown.

SPECIMENS EXAMINED: Two, stage B, Abington, Connecticut; two, stage A, Nashville, Tennessee (A.R.L.).

TABLE 31

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Hylocichla mustelina*

Region	Length	Number						
		Minimum			Maximum		From Boulton	
		Left	Right	Average	Left	Right		
Coronal	9	8	9	9	10	10	7	10
Occipital	9	3	3	3	3	3	3	3
Middorsal	10	4	3	5	8	8	3	7
Pelvic (upper)	9	3		4	4		2	4
Scapular	10	4	4	5	6	6	3	4
Rectrix	1	12		12	12		12	12

TABLE 32

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Hylocichla guttata*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	12	9	9	10	11	10
Occipital	16	3	3	5	5	6
Middorsal	17	8	9	10	10	11
Pelvic (upper)	12	0		1	2	
Rectrix	1	12		12	12	
Scapular	16	6	7	7	7	8

TABLE 33

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Hylocichla ustulata*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	11	6	6	7	8	8
Occipital	11	3	3	4	4	6
Middorsal	15	8	6	9	10	10
Pelvic	5	0		0	1	
Scapular	14	4	4	6	7	7
Rectrix	1	0		12	12	

TABLE 34

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Hylocichla minima*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	11	8	7	8	8	9
Occipital	11	4	5	5	6	5
Middorsal	14	10	9	11	11	11
Pelvic (upper)	9	1		2	2	
Scapular	14	6	4	7	7	7
Rectrix	1			12		

TABLE 35

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sialis sialis*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Ocular	7	9	7	9	10	11
Coronal	9	9	8	9	12	13
Occipital	9	3	5	5	7	6
Middorsal	11	8	5	9	10	10
Pelvic	9	1		2	6	
Scapular	10	9	8	9	10	10
Rectrix	1	12		12	12	
Primary	1	9		9	9	
Secondary	1	8		8	8	
Alula	1	2		2	2	

TABLE 36

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sialis mexicana*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	7	5	2	6	6	6
Occipital	7	3	4	4	3	4
Middorsal	7	5	5	5	5	5
Scapular	5	4	4	5	4	5
Rectrix	1	12		12	12	
Primary	1	8		9	9	
Secondary	1	2		5	5	

TABLE 37

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sialia currucoides*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Ocular	10	6	4	8	9	11
Coronal	13	10	11	12	14	14
Occipital	13	5	3	5	5	6
Middorsal	13	8	8	8	9	9
Scapular	16	8	7	9	10	9
Rectrix	2	12		12	12	
Primary	1			9		
Secondary	1			8		
Greater primary covert	1			8		

REFERENCES: ". . . Sparse down on capital, spinal and humeral tracts" (Allen, 1930, p. 209). ". . . Dark mouse gray [Ridgway]" (Smith, 1937, p. 28). "Down on head, dorsal, and humeral tracts" (Saunders, MS).

Sialis mexicana

WESTERN BLUEBIRD

COLOR: Pale Drab-Gray.

SPECIMENS EXAMINED: Two, stage B, Baja California, Mexico (M.V.Z.).

Sialia currucoides

MOUNTAIN BLUEBIRD

COLOR: Chaetura Drab or Wood Brown.

SPECIMENS EXAMINED: One, stage A, Lake Burford, New Mexico (U.S.N.M.).; one, stage A, Sawmill Lake, British Columbia (M.V.Z.).

REFERENCES: Wheelock (1904, p. 507) claims that the newly hatched young are naked. "On the second day down begins to appear in thin hairs on head and back, . . on the sixth day . . . the down is well spread over the bodies." ". . . Dark bluish-gray down on head and back" (Haecker, 1948, p. 218).

Oenanthe oenanthe

WHEATEAR

REFERENCES: "Moderate length . . . It will be noted that there is no ulnar tract, and the spinal tract is a very short one, confined to the middle of the dorsum" (Ticehurst, 1908, p. 189). "Down, dark grey, long and fairly plentiful except on femoral. Distribution, inner supra-orbital, occipital, humeral, pinal and femoral and some very short filaments on caudal tract. Lower portion of spinal tract without down" (Witherby *et al.*, 1938, vol. 2, p. 148).

Luscinia suecica

RED-SPOTTED BLUETHROAT

REFERENCE: "Down dark slate-gray, fairly long and plentiful. Distribution, outer and inner supra-orbital, occipital, humeral and spinal" (Witherby *et al.*, 1938, vol. 2, p. 198).

Myodestes townsendi

TOWNSEND'S SOLITAIRE

COLOR: Avellaneous.

SPECIMENS EXAMINED: One, stage C, Eldorado County, California (G.W.S.); two, stage D, Placer County, California (M.V.Z.).

Phylloscopus trochilus

WILLOW-WARBLER

REFERENCE: "Very lightly grey . . .Fairly long and scanty . . . Inner supra-orbital, occipital, humeral" (Ticehurst, 1909, p. 151).

Polioptila melanura

PLUMBEOUS GNATCATCHER

REFERENCE: "The bodies of the young are entirely bare until the primaries begin to appear" (Woods *in* Bent, 1949, p. 378).

Regulus satrapa

GOLDEN-CROWNED KINGLET

REFERENCE: ". . . A few tufts of fine, gray down" (Bent, 1949, p. 388, quoting MS of Stanwood).

TABLE 38

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Myodestes townsendi*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	13	7	9	10	9	11
Occipital	14	3	3	4	4	4
Middorsal	17	6	7	8	9	9
Pelvic (upper)	16	0		?	2	
Scapular	19	7	6	8	10	9
Rectrix	1			12		
Primary	1			10		
Secondary	1			9		

Motacilla alba

WHITE WAGTAIL

REFERENCES: "Down, smoke-grey. Distribution, inner and outer supra-orbital, occipital, humeral, ulnar, spinal, femoral, crural, and ventral (very scanty on last two)" (Witherby *et al.*, 1938, vol. 1, p. 228). "*Die noch kleinen Nestlinge haben durch die Art ihrer Bedaunung . . . eine gewisse Ähnlichkeit mit den Kindern der Erdsänger und der Fliegenschnäpper, denen ich die Stelzen als bis zu einem gewissen Grade verwandt ansehen möchte*" (O. and M. Heinroth, 1926, p. 146).

Motacilla flava

YELLOW WAGTAIL

REFERENCES: "Down buffish-white; distribution, outer and inner supra-orbital, occipital, spinal, humeral, and ulnar" (Witherby *et al.*, 1938, vol. 1, p. 221). ". . . *Die Daunenfarbe der ganz kleinen Jungen wirkt genau so, als sein die wolligen Dinger mit Insektenpulver eingepudert*" (O. and M. Heinroth, 1926, p. 149).

Anthus spinoletta

AMERICAN PIPIT

COLOR: Drab.

SPECIMEN EXAMINED: One, stage C (skin), Renora District, Ontario (R.O.M.Z.).

REFERENCES: ". . . Smoke-grey" (Ingram, 1920, p. 877). "Down, brown-grey, long and fairly plentiful; distribution, inner and outer supra-orbital, occipital, spinal, humeral, ulnar, femoral, crural, and ventral (short and whitish on last)" (Witherby *et al.*, 1938, vol. 1, p. 209). "The down . . . lead or blue-gray color, scanty, and restricted to the head and occiput, a strip down the center of the back, the secondaries and their coverts (not primaries), and a very little on the thighs" (Pickwell, 1947, p. 8).

TABLE 39

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Anthus spinoletta*

(The data are incomplete.)

Region	Length	Number
Ocular	4	9
Coronal	8	14
Occipital	11	6
Middorsal	10	9
Scapular	10	9
Femoral	5	7
Abdominal	1	4
Crural	3	5
Rectrix	2	12
Greater secondary covert	6	9
Middle secondary covert	4	8

Anthus pratensis

MEADOW PIPIT

REFERENCES: "Whitish grey . . . Moderate in length. . . . Inner and outer supra-orbital, occipital, humeral, spinal, ulnar, femoral and ventral, the last being very scanty" (Ticehurst, 1908, p. 191). ". . . Brownish-grey, fairly long and plentiful" (Witherby *et al.*, 1938, vol. 1, p. 198). Witherby also gives "scanty" crural, not mentioned by either Ticehurst or Bent. "*Auch sie tragen die Farbe des vorjährigen dürren Grasses*" (O. and M. Heinroth, 1926, pp. 156–157).

Anthus cervinus

RED-THROATED PIPIT

REFERENCES: "Greyish black . . Long; femoral and crural tracts scanty. . . . Inner and outer supra-orbital, occipital, humeral, spinal, ulnar, femoral and crural . . . it is possible that the ventral tract, which in the Meadow-Pipit [*Anthus pratensis*] is only slightly developed, may have been overlooked" (Ticehurst, 1908, p. 191). The ventral tract is not mentioned by Witherby. ". . . Dark grey-brown, fairly long and plentiful" (Witherby *et al.*, 1938, vol. 1, p. 201).

Anthus spragueii

SPRAGUE'S PIPIT

REFERENCE: Harris (1933, p. 93), from a detailed study of one bird, states: "Down: light grey in colour, long and dense; on head, 3 to 10 mm. long, beginning in two rows close together on forehead but diverging gradually to pass over tops of eyeballs; on occiput, in two small clumps 10 mm. long, one on each side; about 10 mm. on scapular region, between elbow and wrist, and on spinal tract, . . . two short clumps on crural tract; one tuft on each side of caudal tract [perhaps femoral tracts implied]. . . . T. M. Shortt records

that in a nest of Sprague's Pipit examined by him, the down on the dorsal tract of the young was shortest on the interscapular region. The young were two days old" (Harris, 1933, p. 93). Shortt's interscapular region, so called, probably refers to the middorsal of my terminology.

Bombycilla cedrorum

CEDAR WAXWING

Without neossoptiles.

SPECIMENS EXAMINED: One, stage D (skin), Bigwood, Ontario (R.O.M.Z.); two, stage D, Ohio (L.S.P.).

REFERENCES: Mitchell (1896, p. 3) quotes F. L. Burns as attributing natal down to the Cedar Waxwing. "The newly hatched young were completely naked when examined under a binocular" (Putman, 1949, p. 169). ". . . No down whatever. I have watched birds as they grew up, and the feathers come through, not preceded by down" (Saunders, MS).

Phainopepla nitens

PHAINOPEPLA

REFERENCES: ". . . Naked except for a sprinkling of thin gray down on top of heads and shoulders ['head and back' (Wheelock, 1905, p. 67)]" (Wheelock, 1904, p. 400). ". . . Generous tufts of long white down" (Dawson, 1923, p. 561). "On the bodies of the newly hatched young, long white down covers the lower back, fringes, and wings and forms a circlet or halo around the bare crown of the head. Some of the filaments on the wings approximate 1 centimeter in length" (Woods *in* Bent, 1950, p. 108).

Lanius ludovicianus

LOGGERHEAD SHRIKE

REFERENCES: Based on two nestlings in collection, ". . . entirely bare" (W. DeW. Miller, 1924, p. 331). ". . . Down is nearly lacking, being limited to two single rows of short white neossoptiles on each of the posterior abdominal regions of the ventral tract and a few similar neossoptiles on the elbows. In some broods two or three wisps of down occur on the dorsal region of the spinal tract. The neossoptiles are not over three millimeters in length" (A. H. Miller, 1931, p. 177). "The newly hatched young were completely bare; no trace of down could be detected" (Linsdale, 1938, p. 115).

Sturnus vulgaris

STARLING

COLOR: Anterior, Hair Brown; posterior Drab-Gray to White.

SPECIMENS EXAMINED: Four, stage A, Sutton, Massachusetts (R.F.N.); one, stage A, Ann Arbor, Michigan (U.M.M.Z.).

REFERENCES: "Drab-gray" (Dwight, 1900,

TABLE 40

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Sturnus vulgaris*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	15	10	12	13	13	18
Occipital	15	6	7	8	8	9
Spinal	19	55		64	70	
Scapular	16	8	7	9	9	10
Femoral	15	13	15	16	18	19
Axillar	3	0	0	0	1	1
Abdominal	5	18	18	20	21	23
Crural	5	0	0	5	10	8
Rectrix	3	0		12	12	
Primary	1	9		9	9	
Secondary	10	1		5	8	
Greater primary covert	1	0		0	1	
Greater secondary covert	14	7		9	10	
Middle secondary covert	7	4		7	8	

p. 155). "Greyish white, a shade darker on the head . . . Fairly long and plentiful . . . Inner supra-orbital, occipital, humeral, spinal, ulnar, femoral, and ventral. Spinal tract long and well marked. Ventral tract scanty and not well marked" (Ticehurst, 1908, pp. 193, 194). Witherby *et alii* (1938, vol. 1, p. 43) add, "ventral, crural and femoral where sparse and sometimes absent on ventral." ". . . Fairly well covered with long, drab-gray, or grayish-white natal down, longest and darkest on the head, but present on practically all the principal feather tracts" (Bent, 1950, p. 193).

Vireo huttoni

HUTTON'S VIREO

REFERENCES: "All vireo nestlings are born naked except for the hair-like down that waves thinly on head and back. In this bird family it is even less perceptible than in most birds, almost requiring a microscope to discover it" (Wheelock, 1904, p. 452). "When four days old the young vireos were still quite naked, only a thin down covered their upper parts" (Wheelock, 1905, pp. 66).

Vireo bellii

BELL'S VIREO

REFERENCE: "When one day old they remained entirely naked. Examination through a reading glass disclosed no trace of down or filament on any part of the reddish flesh-colored skin" (Du Bois, 1940, p. 7).

Vireo flavifrons

YELLOW-THROATED VIREO

REFERENCE: "Drab" (Dwight, 1900, p. 238).

Vireo solitarius

BLUE-HEADED VIREO

Fragmentary data include down on the following regions: coronal, 4 mm.; occipital; abdominal; scapular; and femoral.

COLOR: White.

SPECIMEN EXAMINED: One, stage D (skin), Ontario (R.O.M.Z.).

Vireo flavoviridis

YELLOW-GREEN VIREO

REFERENCE: "At first glimpse they appear to be quite naked; but careful scrutiny in a favorable light reveals a few scattered tufts of very short, fine down on the top of the head, back, and wings" (Skutch *in* Bent, 1950, p. 327).

Vireo olivaceus

RED-EYED VIREO

COLOR: Light Drab.

SPECIMENS EXAMINED: Two, stage C, Berlin, Massachusetts.

REFERENCES: "Pale drab-gray" (Dwight,

TABLE 41

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Vireo olivaceus*

Region	Length	Number Minimum		Number Average	Number Maximum	
		Left	Right		Left	Right
Ocular	3	2	4	6	6	7
Coronal	5	8	9	11	9	13
Occipital	6	5	5	8	10	7
Middorsal	6	6	6	8	9	9
Pelvic	6	8		9	9	
Scapular	8	10	12	12	14	12
Femoral	8	6	7	11	15	13
Axillar	4	4	3	7	7	10
Abdominal	4	16	17	18	18	19
Crural	3	0	0	7	5	7
Rectrix	1	12		12	12	
Greater secondary covert	6	5		9	9	
Middle secondary covert	5	5		9	9	
Patagial covert	4	0		0	1	

1900, p. 235). "Down on all patches above and below, except the primaries [coverts] and the eyelids" (Saunders, MS).

Vireo philadelphicus

PHILADELPHIA VIREO

COLOR: Tilleul Buff.

SPECIMEN EXAMINED: One, stage D (skin), Favourable Lake Mine, Ontario (R.O.M.Z.).

REFERENCES: "Pale drab-gray" (Dwight, 1900, p. 236). ". . . Gray down on the upper surfaces of their wings and a few tufts of similar down on their heads. . . . I could see a distinct line of down on each bird, extending from the top of its head along the nape [?] of its neck and the middle of the back" (Lewis, 1921, pp. 40, 185). The interscapular region is probably not implied here, for I find, as does W. DeW. Miller (1924, p. 331), "In none of the Passeres examined has there been any down on the interscapular section of the dorsal tract."

TABLE 42

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Vireo philadelphicus*

(The data are incomplete.)

Region	Length	Number
Ocular	3	4
Coronal	5	12
Occipital	4	4
Middorsal	5	6
Pelvic	2	1
Scapular	4	5
Femoral	4	6
Abdominal	3	14
Greater secondary covert	4	?
Middle secondary covert	3	?

Vireo gilvus

WARBLING VIREO

REFERENCE: "Pale wood-brown" (Dwight, 1900, p. 237).

Mniotilta varia

BLACK AND WHITE WARBLER

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 241). "Down on head, lower back, femoral, and humeral patches" (Saunders, MS).

Protonotaria citrea

PROTHONOTARY WARBLER

Fragmentary data include down on the following regions: coronal, occipital, middorsal, scapular, femoral, secondary covert.

SPECIMEN EXAMINED: One, stage D, Calhoun County, Michigan (U.M.M.Z.).

REFERENCE: "Brownish mouse-gray" (Dwight, 1900, p. 243).

Helmitheros vermivorus

WORM-EATING WARBLER

REFERENCES: Maynard (1889, fig. 39) shows dense down all over the top of the head and a small amount on the scapular (or possibly the dorsal) region. "Brownish mouse-gray" (Dwight, 1900, p. 244).

Vermivora pinus

BLUE-WINGED WARBLER

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 245). Burns (*in* Chapman, 1907, pp. 68–69) notes dark down on capital, spinal, and scapular regions. "Down on head, dorsal, and humeral patches" (Saunders, MS).

Vermivora ruficapilla

NASHVILLE WARBLER

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 247). ". . . Dark, almost black, natal down in patches" (Lawrence, 1948, p. 212).

Parula americana

PARULA WARBLER

REFERENCES: "Smoke-gray" (Dwight, 1900, p. 251). "A less than one-day-old nestling . . . had a sparse patch of rather long silky white down on the head, and another along the mid-line on the dorsum. [Next day] the down of the head and back a trifle darker. [Next day] the down appeared to be even darker" (R. and J. Graber, 1951, p. 81).

Dendroica petechia

YELLOW WARBLER

COLOR: Tilleul Buff.

SPECIMENS EXAMINED: Two, stage A, and two, stage C, Grafton, Massachusetts.

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 254). "The crown of the head and the median line of the back of the nestling were

TABLE 43

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Dendroica petechia*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	6	6	7	6	7
Occipital	7	3	4	4	4	4
Middorsal	6	1	2	3	5	4
Pelvic (upper)	4	0		1	2	
Pelvic (lower)	4	0		1	1	
Scapular	7	5	4	5	6	6
Femoral	5	5	4	6	8	8
Rectrix	1	12		12	12	
Greater secondary covert	5	4		6	8	
Middle secondary covert	3	0		2	4	

downy" at the instant of hatching (Bigglestone, 1913, p. 51). "Down on the head, dorsal, humeral, femoral, primaries [probably secondary coverts intended], and crural patches" (Saunders, MS).

Dendroica magnolia

MAGNOLIA WARBLER

COLOR: Olive-Brown.

SPECIMEN EXAMINED: One, stage D (skin), Nipissing District, Ontario (R.O.M.Z.).

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 259). "On the fourth day. . . covered with long, dark brown down" (Stanwood, 1910b, p. 386). ". . . A few minute tufts of black down" (Nice, 1926, p. 190).

Dendroica caerulescens

BLACK-THROATED BLUE WARBLER

REFERENCES: "The natal down of the newly hatched young was a quarter of an inch in length on the capital, spinal, crural and alar tracts . . . a few wisps of natal down were now visible in the caudal tracts of the day old young" (Harding, 1931, p. 518). "Down on head, middle of dorsal tracts, humeral, femoral, and secondaries [coverts]" (Saunders, MS).

TABLE 44

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Dendroica magnolia*

(The data are incomplete.)

Region	Length	Number
Coronal	6	8
Occipital	6	4
Middorsal	5	2
Pelvic (lower)	3	1
Scapular	5	4
Femoral	6	6
Greater secondary covert	4	?

Dendroica virens

BLACK-THROATED GREEN WARBLER

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 268). "On the third day . . covered with an abundant supply of burnt-umber down" (Stanwood, 1910a, p. 291). "At hatching, down feathers were distributed chiefly over the dorsal tracts of the otherwise naked young (coronal and occipital regions of the capital tract, pelvic region of the spinal tract, also the femoral, crural, alar, and caudal tracts); they were longest on the crown (5 mm.)" (Pitelka, 1940, p. 7).

Dendroica fusca

BLACKBURNIAN WARBLER

REFERENCE: "Sepia-brown" (Dwight, 1900, p. 266).

Dendroica pensylvanica

CHESTNUT-SIDED WARBLER

REFERENCE: "Down on head, dorsal, humeral, and femoral tracts. That on the dorsal tract is very sparse, only a few wisps of down in the middle of the back, and one bird I examined had apparently no dorsal down whatever" (Saunders, MS).

TABLE 45

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Dendroica castanea*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	8	5	5	7	10	8
Occipital	9	3	3	4	4	5
Middorsal	7	1	1	3	3	3[a]
Pelvic (upper)	6	0		1	2	
Pelvic (lower)	5	1		4	6	
Scapular	8	5	4	6	7	7
Femoral	8	6	6	7	8	8
Greater secondary covert	5	4		4	7	
Middle secondary covert	4	0		3	5	

[a] One median.

TABLE 46

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Dendroica kirtlandii*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	8	7	8	8	9
Occipital	8	3	3	3	3	4
Middorsal	8	2	2	3	3	3
Pelvic (upper)	8	2		3	3	
Pelvic (lower)	3	0		?	1	
Scapular	7	5	5	6	6	6
Femoral	7	5	4	5	6	5
Rectrix (outer)	1	2		2	2	
Greater secondary covert	5	4	5	5	5	5

TABLE 47

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Seiurus aurocapillus*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	7	7	9	9	10
Occipital	10	3	3	4	5	5
Middorsal	10	3	3	4	5	5
Pelvic (upper)	10	1		2	2	
Scapular	11	4	1	6	6	6
Femoral	7	3	2	5	6	6
Rectrix	1	12		12	12	
Secondary (covert?)	7	1	1	5	6	6

Dendroica castanea

BAY-BREASTED WARBLER

COLOR: Olive Brown.

SPECIMENS EXAMINED: Five, stage A (skins), Favourable Lake Mine, Ontario (R.O.M.Z.).

Dendroica striata

BLACK-POLL WARBLER

REFERENCE: ". . . Time of hatching . . delicate tufts of grayish down located on the head, humeral, crural, alar, and caudal tracts . . . down is about . . . 8 mm. in length" (Veght, 1947, p. 24).

Dendroica pinus

PINE WARBLER

REFERENCE: "Sepia-brown" (Dwight, 1900, p. 270).

Dendroica kirtlandii

KIRTLAND'S WARBLER

COLOR: Chaetura Drab.

SPECIMENS EXAMINED: Two late embryos, Oscoda County, Michigan (U.M.M.Z.).

Seiurus aurocapillus

OVEN-BIRD

COLOR: Hair Brown but Light Drab posteriorly.

SPECIMENS EXAMINED: Five, stage A, Auburn, Massachusetts.

REFERENCES: "Pale sepia-brown" (Dwight, 1900, p. 274). "Day of Hatching. . . . Dark gray natal down covers the young bird as follows: Coronal tract, seven mm. long; occipital ten mm.; dorsal twelve mm.; femoral, nine mm.; humeral, twelve mm.; alar (secondary), eight mm. This down grows but little after hatching" (Hann, 1937, p. 176). "Down on head, dorsal, humeral, femoral, and secondary tracts" (Saunders, MS).

Seiurus noveboracensis

NORTHERN WATER-THRUSH

COLOR: Clove Brown.

SPECIMEN EXAMINED: One, stage A (skin), Fort Severn, Ontario (R.O.M.Z.).

REFERENCE: "Deep olive-brown" (Dwight, 1900, p. 275).

Seiurus motacilla

LOUISIANA WATER-THRUSH

REFERENCE: "Deep olive-brown" (Dwight, 1900, p. 276).

Oporornis tolmiei

MACGILLIVRAY'S WARBLER

REFERENCE: ". . . Scantily covered with down, a patch showing on top of the head, a line down the middle of the back, and a tuft on the wings" (Wythe, 1916, p. 125).

Geothlypis trichas

YELLOW-THROAT

Fragmentary data include down on the following regions: occipital, 8 mm.; scapular; dorsal; femoral; greater secondary covert.

COLOR: Drab Gray.

SPECIMEN EXAMINED: One, stage D Duluth, Minnesota (P.B.H.).

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 280). "The young when hatched are naked, but gradually become sparsely covered with light down [?]" (Schussler, 1918, p. 64). "Down on the head, lower back, and humeral tracts" (Saunders, MS). Stewart (1952, p. 50) gives measurements of down from one newly hatched nestling: "Coronal, 5.0 mm.; occipital, 3.6 mm.; spinal, 7.5 mm.; humeral, 8.0 mm.; femoral, 5.0 mm. While this figure [Stewart's fig. 1] presents the usual arrangement of the neossoptiles, variations do occur. [One] young bird was peculiar in that there were no neossoptiles in the femoral tracts

TABLE 48

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Seiurus noveboracensis*

Region	Length	Number
Coronal	10	11
Occipital	11	5
Middorsal	10	5
Pelvic (upper)	10	3
Pelvic (lower)	5	1
Scapular	12	10
Femoral	10	11
Rectrix	1	12
Secondary	5	3
Greater secondary covert	9	8
Middle secondary covert	7	6

. . . [I was] unable to find out if this peculiarity held true with the other occupants of the nest. . . [In] another nest . . . I found that neossoptiles were adhering to the barely protruding tips of some of the tertiaries of two [of three] of the young birds" (Stewart, 1952, p. 50). It is hard to believe some parts of Stewart's figure 1, e.g., the medial frontal dot and the uniserial dorsal signification. In no passerine have I found a dorsal region that was not paired, if present, yet his examination was apparently intimate enough for him to record down lengths to a tenth of a millimeter.

Icteria virens

YELLOW-BREASTED CHAT

REFERENCES: "I am not sure that the chats should be included in the wood warbler family. Mr. Aretas A. Saunders tells me that the young are hatched in a naked condition, while all other warblers with which he is acquainted have natal down" (Forbush, 1929, p. 298). ". . . Have no down whatever. I have watched birds as they grew up, and the feather tracts come through, not preceded by down" (Saunders, MS). ". . . Born naked" (Petrides, 1938, p. 186).

TABLE 49

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Wilsonia citrina*

Region	Length	Number
Coronal	8	8
Occipital	8	4
Middorsal	8	2
Scapular	8	7
Femoral	8	6
Rectrix	2	12
Greater secondary covert	6	6

Wilsonia citrina

HOODED WARBLER

COLOR: Vinaceous-Fawn.

SPECIMEN EXAMINED: One, stage B, Dismal Swamp, Virginia (U.S.N.M.).

REFERENCES: "Pale sepia-brown" (Dwight, 1900, p. 283). "The young were hatched almost naked, but soon [?] were clothed in a coat of gray down" (Odum, 1931, p. 317).

Wilsonia pusilla

WILSON'S WARBLER

REFERENCE: "Sepia-brown" (Dwight, 1900, p. 285).

Wilsonia canadensis

CANADA WARBLER

Fragmentary data include down on the following regions: coronal, 8 mm.; occipital; scapular; femoral.

COLOR: Light Drab.

SPECIMEN EXAMINED: One, stage D (skin), Algonquin Park, Ontario (R.O.M.Z.).

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 286). "Down on head, dorsal, humeral, femoral, and secondary [covert] tracts" (Saunders, MS).

Setophaga ruticilla

AMERICAN REDSTART

REFERENCES: "Hair-brown" (Dwight, 1900, p. 287). ". . . Naked except for some natal down on the dorsal feather tracts and on the head" (Baker, 1944, p. 89).

Passer domesticus

ENGLISH SPARROW

Without neossoptiles.

SPECIMENS EXAMINED: Seven, stage A, Chelmsford, Massachusetts (P.F.).

REFERENCES: "Mouse-gray [see *Cyanocitta cristata*]" (Dwight, 1900, p. 171). "Down. Absent" (Ticehurst, 1908, p. 192). ". . . Have no down when hatched, nor when several days old" (Saunders, MS). ". . . *Die neugebornen Jungen nackt sind und auch später keine Daunen bekommen*" (O. and M. Heinroth, 1926, p. 178).

Passer montanus

TREE SPARROW

REFERENCE: "Down. Absent" (Ticehurst, 1908, p. 192).

Dolichonyx oryzivorus

BOBOLINK

REFERENCES: "Buff" (Dwight, 1900, p. 156). ". . . Born naked except for a scanty sprinkling of down" (Wheelock, 1904, p. 392).

Sturnella neglecta

WESTERN MEADOWLARK

REFERENCES: ". . . Pale down" (Grinnell and Linsdale, 1936, p. 114). ". . . Nestlings appear conspicuously whitish" (Linsdale, 1936, p. 112).

Xanthocephalus xanthocephalus

YELLOW-HEADED BLACKBIRD

REFERENCES: ". . . From the very first . . . without feathers or down, except a very little patch on the head and shoulders, and a thin dark strip on either side of the back" (Wheelock, 1904, p. 511). "The most conspicuous patches of neossoptiles occur on the coronal and occipital regions of the head and on the pelvic and dorsal regions of the spinal tract. Two less-noticeable patches occur on each wing and narrow oblong patches are found along the region of the upper part of the femoral tracts and on the abdominal region of the ventral tracts. A very narrow ring of neossoptiles encircles the legs at the lower part of the crural tract" (Fautin, 1941, p. 216).

Agelaius phoeniceus

RED-WING

COLOR: Tilleuf Buff, tips Drab, especially when wet.

SPECIMENS EXAMINED: Two, stage A, Ithaca, New York (J.E.T.); six, stage A, Stuttgart, Arkansas (M.B.M.); two, stage A, Washtenaw County, Michigan (U.M.M.Z.); four, stage D, Grafton, Massachusetts.

REFERENCES: "Pale mouse-gray" (Dwight, 1900, p. 160). "Down on head, back, humeral, femoral, secondary [coverts], and crural tracts" (Saunders, MS). ". . . Down white in color" (Saunders, 1920, p. 312). "The whitish nestling plumage was . . . prominent in the young birds. It is worth mentioning that color of these nestlings apparently is not influenced by the back plumage of adults" (Linsdale, 1936, p. 112). "The young redwings have a few small sparse tracts of black [!] natal down, located as parietal, occipital, ulnar, scapular, lumbar, sacral, and femoral, with an oblique abdominal" (Wood, 1938, p. 144). Otis W. Allen (MS) gives data from 37 individuals (see table 50). His "occipital" is obviously bilateral, and his "spinal," entire.

Icterus cucullatus

HOODED ORIOLE

REFERENCE: ". . . Born naked except for flecks of down on the crown and along the back" (Wheelock, 1904, p. 519).

Icterus galbula

BALTIMORE ORIOLE

COLOR: Tilleul Buff.

TABLE 50

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Agelaius phoeniceus*

Region	Length	Number					
		Minimum			Maximum		From O.W.
		Left	Right	Average	Left	Right	Allen
Coronal	7	11	13	16	22	22	16
Occipital	9	4	4	5	8	7	10
Middorsal	11	4	5	7	9	9	
Pelvic	8	11		15	17		
Middorsal and pelvic							29
Scapular	11	9	9	10	10	10	10
Femoral	9	10	7	11	12	11	10
Abdominal	4	3	4	7	13	15	15
Crural	4	1	0	4	7	11	4
Rectrix	4	10		10	10		10
Secondary	4	0		0	2		1
Greater secondary covert	9	9		10	10		—
Middle secondary covert	9	8		8	9		—
Carpal remex covert	1	0		0	1		?

TABLE 51

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Icterus galbula*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	9	13	13	15	16	16
Occipital	10	4	4	5	6	6
Middorsal	9	5	7	11	20	19
Pelvic	9	9		13	16	
Scapular	10	9	9	9	11	10
Femoral	9	11	11	14	18	13
Axillar	5	0	0	0	0	1
Abdominal	5	13	17	17	18	18
Crural	5	6	4	6	7	8
Rectrix	4	12		12	12	
Primary	2	1		9	9	
Secondary	8	0		8	8	
Greater primary covert	5	7		8	8	
Greater secondary covert	8	7		10	10	
Middle secondary covert	8	7		8	8	
Carpal remex covert	5	1		1	1	
Alula	3	0		2	2	
Alula covert	3	0		0	1	
Patagial covert	4	0		2	4	

SPECIMENS EXAMINED: Two, stage C, Abington, Connecticut; two, stage C, Sutton, Massachusetts (R.F.N.).

Icterus bullockii

BULLOCK'S ORIOLE

REFERENCES: ". . . Newly hatched . . are naked . . . with little tufts of thin white down on head and back . . . either side of crown and about the shoulders" (Wheelock, 1904, p. 522). ". . . White" (Linsdale, 1936, p. 112).

Euphagus carolinus

RUSTY BLACKBIRD

Fragmentary data include down on the following regions: coronal, 11 mm.; occipital; spinal; scapular; femoral; abdominal; crural; upper rectrix covert.

COLOR: Agouti: Tilleul Buff, Wood Brown tips.

SPECIMEN EXAMINED: One, stage D (skin), Peninsula, Ontario (R.O.M.Z.).

REFERENCE: "The young, when hatched, are covered with a long, thin, fuscous natal down" (Kennard, 1920, p. 420).

Euphagus cyanocephalus

BREWER'S BLACKBIRD

REFERENCES: ". . . [On] the second day developed thin mouse-colored down on head and back" (Wheelock, 1904, p. 414). ". . . The down was nearly black" (Linsdale, 1936, p. 112). ". . . When young were just hatching, some of the nests contained young with all of the down patches, and in other nests the abdominal patch was missing" (Saunders, MS).

Cassidix mexicanus

BOAT-TAILED GRACKLE

Fragmentary data include down on the following regions: coronal, 10 mm.; occipital; pelvic.

COLOR: Light Drab.

SPECIMEN EXAMINED: One, stage D (skin), (F.B.M.).

REFERENCE: ". . . Sparsely covered with a few tufts of cream-tan down" (McIlhenny, 1937, p. 275).

Quiscalus quiscula

PURPLE GRACKLE

COLOR: Light Drab or Hair Brown.

TABLE 52

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Quiscalus quiscula*

Region	Length	Number				
		Minimum		Average	Maximum	
		Left	Right		Left	Right
Coronal	10	12	13	17	21	23
Occipital	11	4	4	5	6	6
Middorsal	15	4	6	7	9	9
Pelvic	11	13		15	16	
Scapular	16	9	9	10	10	10
Femoral	11	13	13	15	18	16
Abdominal	5	3	5	7	13	11
Crural	5	3	3	7	10	12
Rectrix	4	10		10	10	
Under rectrix covert	2	0		0	1	
Secondary	6	0		0	1	
Greater secondary covert	13	8		10	10	
Middle secondary covert	11	8		8	8	
Carpal remex covert	3	0		1	1	
Patagial covert	3	0		0	1	
Tertiary	2	0		0	2	

SPECIMENS EXAMINED: Three, stage A, Stuttgart, Arkansas (M.B.M.); one, stage D, Spencer, Massachusetts (P.G.R.).

REFERENCES: "Pale sepia-bown" (Dwight, 1900, p. 168). "At hatching the arrangement of down tracts is very similar [to that of *Agelaius phoeniceus*], with the exception that the Grackle has one down feather in the position of an alula and in the position of the primary and greater primary coverts there are five down feathers [insignificant in my data]" (Otis W. Allen, MS). Regarding abdominal pterylae, Allen also says (MS), "The Redwing showed average greater than the Grackle, but the number was highly variable."

Tangavius aeneus

RED-EYED COWBIRD

REFERENCE: At one day old the down is "mouse gray ['dusky,' p. 337] and present on the head, spinal, humeral, alar, and femoral tracts, longest on the head and shortest on the spinal tract . . . On the second day . . no new neossoptiles appear and the old ones apparently do not increase in length" (Friedmann, 1929, p. 334).

Molothrus ater

COWBIRD

COLOR: Tilleul Buff, posterior lighter.

SPECIMENS EXAMINED: Two, stage A, and one, stage C, Ithaca, New York (J.E.T.); five, stage A, artificially incubated, Washtenaw County, Michigan (K.T.R.); one, stage B (skin), Toronto, Ontario (R.O.M.Z.).

REFERENCES: "Olive-gray" (Dwight, 1900, p. 159). Friedmann (1929, p. 262) describes young less than an hour old, ". . . the neossoptiles were a dirty grayish varying in length from 9 to 11 mm., being shortest on the uropygial and postoccipital pterylae. There was no indication of the abdominal, interscapular, neck, and crural pterylae; the alar tract did not extend beyond the carpus, while the femoral, dorsal, and supra-orbital pterylae were prominent . . . .By the end of the second day the down has grown considerably where present . . . a few neossoptiles have sprouted at the lower end of the shanks indicating for the first time the crural tracts; the secondaries, tertials, and their upper coverts have prominent down." "The little Cowbird is strikingly different from its nestmates [*Melospiza melodia*], being covered with light greyish down instead of black" (Nice, 1937, p. 156). "Cowbirds are easily distinguished from the Oven-birds at hatching time by their large size, light colored down, and characteristic shape of the beak" (Hann, 1937, p. 204). "Down on head patches, dorsal,

TABLE 53

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Molothrus ater*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	9	5	6	11	14	14
Occipital	9	1	2	3	5	5
Middorsal	11	5	4	7	9	9
Pelvic	9	9		12	14	
Scapular	10	9	8	10	10	10
Femoral	9	9	9	11	15	14
Abdominal	3	0	0	4	9	6
Crural	4	0	0	5	10	8
Rectrix	3	10		10	12	
Secondary	4	0		1	1	
Greater secondary covert	9	8		10	10	
Middle secondary covert	7	4		8	9	
Carpal remex covert	1	0		1	1	

humeral, femoral, caudal, secondary, abdominal, and crural patches. All but the primaries [coverts]. In a Red-eyed Vireo nest, containing a young Cowbird, I could not tell the Cowbird from the vireos by down patches. The only clews were a slightly heavier bill, and a pink color of inside of mouth in the Cowbird. The vireo had inside of mouth pale yellow" (Saunders, MS). "The Cowbird . . . [in nest of *Empidonax virescens*] was covered with blackish-gray down" (Brandt, 1947, p. 80). ". . . Nearly naked, except for a tuft of mouse-coloured down . . . on each side of the head, and some on the wings . . . [in nest of *Geothlypis trichas*]" (Mousley, 1933, pp. 6, 7). ". . . Tufts of grey natal down [in nest of *Vermivora ruficapilla*]" (Lawrence, 1948, p. 212). ". . . The other [young], with nearly white down, was assumed to be a cowbird [in nest of *Junco aikeni*]" (Miller, 1948, p. 92).

TABLE 54

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Richmondena cardinalis*

(The data are incomplete.)

Region	Length	Number
Coronal	7	3
Occipital	7	4
Middorsal	10	6
Pelvic	9	9
Scapular	9	8
Femoral	7	8
Greater secondary covert	7	9
Middle secondary covert	7	8

Richmondena cardinalis

CARDINAL

SPECIMEN EXAMINED: One, stage D, Stuttgart, Arkansas (M.B.M.).

REFERENCE: "Mouse-gray" (Dwight, 1900, p. 208). ". . . Grayish brown" (Sutton, 1935, p. 6).

Pheucticus ludovicianus

ROSE-BREASTED GROSBEAK

COLOR: White.

SPECIMEN EXAMINED: One, stage C (skin), Lockton, Ontario (R.O.M.Z.).

REFERENCES: "White" (Dwight, 1900, p. 208). ". . . Covered, or partly covered, with a whitish down which stood out from the body and up from the top of the head" (Allen, 1916, p. 54). ". . . Pure white" (Sutton, 1935, p. 6). ". . . Has all down patches except the caudal" (Saunders, MS). "A slight variation was noted in the length of down between the nestlings of the two pairs, but otherwise they seemed alike" (Ivor, 1944, pp. 95, 96).

TABLE 55

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Pheucticus ludovicianus*

(The data are incomplete.)

Region	Length	Number
Coronal	11	11
Occipital	10	4
Middorsal	12	7
Pelvic	10	15
Scapular	12	8
Femoral	10	19
Abdominal	6	13
Crural	6	6
Rectrix	3	12
Greater secondary covert	10	10
Middle secondary covert	10	8
Carpal remex covert	5	1

Pheucticus melanocephalus

BLACK-HEADED GROSBEAK

COLOR: Tilleul Buff.

SPECIMENS EXAMINED: One, stage B, Williams, Arizona (U.S.N.M.).

REFERENCE: ". . . Sparse hair-like down on crown and shoulders" (Wheelock, 1904, p. 255).

Guiraca caerulea

BLUE GROSBEAK

REFERENCE: "Brownish mouse-gray" (Dwight, 1900, p. 210).

TABLE 56

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Pheucticus melanocephalus*

(The data are incomplete.)

Region	Length	Number
Coronal	8	19
Occipital	7	8
Postauricular	3	2
Spinal	8	17
Pelvic	5	13
Scapular	9	13
Femoral	9	21
Abdominal	5	21
Crural	4	12
Rectrix	4	12
Secondary	4	3
Greater primary covert	2	5
Greater secondary covert	7	10
Middle secondary covert	7	8
Carpal remex covert	3	1
Patagial covert	3	2

Passerina cyanea

INDIGO BUNTING

COLOR: Wood Brown. "Mouse gray," G. M. Sutton, collector.

SPECIMENS EXAMINED: Two, stage D, Worcester, Massachusetts: one, stage A, Livingston County, Michigan (U.M.M.Z.).

REFERENCES: "Brownish mouse-gray" (Dwight, 1900, p. 211). "Down on head, lower back, humeral, femoral, and secondary

TABLE 57

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Passerina cyanea*

Region	Length	Number				
		Minimum		Average	Maximum	
		Left	Right		Left	Right
Coronal	7	4	5	6	6	6
Occipital	8	4	4	5	5	6
Middorsal	6	2	2	4	5	6
Pelvic	6	0		4	7	
Scapular	8	6	6	7	8	8
Femoral	5	3	4	5	6	6
Rectrix	2	8		12	12	
Greater secondary covert	6	4		9	9	
Middle secondary covert	5	4		7	7	
Carpal remex covert	1	0		0	1	

tracts" (Saunders, MS). ". . . Downy state, brownish in color" (Jenkins, 1935, p. 194).

Passerina amoena

LAZULI BUNTING

REFERENCE: ". . . Thin hair-like down on their heads and shoulders" (Wheelock, 1904, p. 500).

Spiza americana

DICKCISSEL

COLOR: White, yellowish when wet.

SPECIMENS EXAMINED: Three, stage A, Stuttgart, Arkansas (M.B.M.).

REFERENCE: "The natal plumage . . when dry is pure white, there being no traces of the occipital, humeral, spinal, ulnar, ventral, femoral and crural. Pre-pennae of the ulnar tract are attached to the secondaries only. Ventral tract well marked at the posterior end" (Ticehurst, 1908, p. 193).

Coccothraustes coccothraustes

HAWFINCH

REFERENCES: "Down, white, long, and plentiful; distribution, inner supra-orbital, occipital, humeral, spinal, ulnar, femoral, ventral, and crural" (Witherby *et al.*, 1938, vol. 1, p. 53). " . . . *Sehr dicht weiss bedaunt*" (O. and M. Heinroth, 1926, p. 214).

TABLE 58

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Spiza americana*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	7	4	4	5	5	5
Occipital	7	3	4	4	6	4
Middorsal	10	3	2	3	4	3
Pelvic	9	6		11	14	
Scapular	10	6	7	7	7	8
Femoral	8	7	6	8	9	9
Rectrix	3	12		12	12	
Greater secondary covert	7	8		10	10	
Middle secondary covert	6	8		8	8	

brown or gray tinges so commonly seen in the down of other passerine birds . . . three small areas on the dorsal-posterior part of the head, 1 median, 2 lateral, which collectively may be known as a head tract, one tract on each scapular region; two smaller tracts on the dorsal side of each wing; one elongate tract in the mid-dorsal line and one shorter tract on each side running parallel to the mid-dorsal tract. There is no down on the ventral aspect of the body, the entire underparts being naked until the juvenile plumage appears" (Gross, 1921, p. 170).

Fringilla montifringilla

BRAMBLING

REFERENCE: "White . . . Length moderate, well developed, except on the crural tract. . . . Inner and outer supra-orbital,

Hesperiphona vespertina

EVENING GROSBEAK

Fragmentary data include down on the following regions: coronal, 10 mm.; occipital; spinal; scapular; femoral; axillar; abdominal; crural; upper rectrix covert, 4 mm.; greater primary covert, 10 mm.; greater secondary covert, 10 mm.; middle secondary covert, 7 mm.

COLOR: White.

SPECIMEN EXAMINED: One, stage D (skin), Lake Sasajewan, Ontario (R.O.M.Z.).

REFERENCE: ". . . Pure white down patches" (Fleming, 1903, p. 214).

Pyrrhula pyrrhula

BULLFINCH

REFERENCES: "Down, sooty grey, fairly long and plentiful; distribution, inner supra-

orbital, occipital, humeral, spinal, ulnar, femoral, ventral, and crural" (Witherby *et al.*, 1938, vol. 1, p. 87). "[*Pyrrhula europaea*] Pre-pennae of the ulnar tract are present on the secondaries and their coverts" (Ticehurst, 1908, p. 193).

Carpodacus mexicanus

HOUSE FINCH

REFERENCES: ". . . Scant bit of down on head and back" (Wheelock, 1904, p. 482). ". . . The young up to the fourth day seem naked, but are really partly covered by a minute down which appears in streaks, there being four lines on the head, *i.e.*, one along the skull in the long axis of the body [cf. Knight, MS], one over each eye, and one over the occiput, transverse to the long axis of the head. There is also one along the dorsum of each wing, one over each scapula parallel with the vertebral column, an inter-acetabular dorsal patch, a streak down the outside of each thigh, and a sternal streak which bifurcates, one fork going under each wing, and on the second day an interscapular vertebral streak appears [teleoptiles probably intended]. All these areas grow rapidly and soon appear to coalesce; and by the fourth day the body seems to be covered all over with down, except the belly, and, by this time, the wing quills are just budding" (Bergtold, 1913, pp. 57, 58). ". . . Covered with whitish down" (Grinnell and Linsdale, 1936, p. 121). Knight (MS) shows that the streak "along the skull in the long axis of the body (Bergtold, 1913)" is probably the left and right coronal rows. Knight's daily measurements also indicate that the neossoptiles have negligible if any growth after hatching time. "Coronal 10 mm., orbital 10 mm., occipital, spinal 9 mm., caudal, scapular 8 mm., femoral 8 mm., crural 4 mm., alar 4 mm., abdominal 5 mm."

Leucosticte tephrocotis

ROSY FINCH

REFERENCES: "The newly hatched young are only thinly sprinkled with hair-like gray down and look not unlike baby juncos" (Wheelock, 1904, p. 211). ". . . Irregularly tufted with fluffy gray down" (Shaw, 1936, p. 147).

Carduelis carduelis

EUROPEAN GOLDFINCH

REFERENCES: "White" (Ingram, 1920, p. 876). "Down darkish grey, medium length, scanty on ventral and crural tracts; distribution, inner and outer supra-orbital, occipital, spinal, humeral, ulnar, femoral, crural, and ventral" (Witherby *et al.*, 1938, vol. 1, p. 60).

Acanthis flammea

REDPOLL

COLOR: Agouti; proximal white, distal buff.

SPECIMEN EXAMINED: One, stage C (skin), Kenora District, Ontario (R.O.M.Z.).

REFERENCES: "[*Linota rufescens*] Greyish . . . Long; ventral and crural tracts scanty, pre-pennae on the secondaries only [?] make up the ulnar tract. . . . Inner supra-orbital, occipital, humeral, spinal, ulnar, femoral, ventral and crural" (Ticehurst, 1908, p. 193). "[*Carduelis flammea*]. Down, darkish grey, fairly long and plentiful; distribution, outer supra-orbital (small tuft), inner supra-orbital, occipital, spinal, humeral, ulnar, femoral, crural, and ventral (last two very short)" (Witherby *et al.*, 1938, vol. 1, p. 72). ". . . Dark to light mouse gray down about 7 mm. long" (Walkinshaw, 1948, p. 67).

TABLE 59

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Acanthis flammea*

(The data are incomplete.)

Region	Length	Number
Coronal	7	12
Occipital	10	8
Middorsal	9	9
Pelvic	5	8
Scapular	8	8
Femoral	6	5
Axillar	3	2
Abdominal	2	8
Crural	2	3
Greater secondary covert	6	9
Middle secondary covert	5	8

Spinus tristis

EASTERN GOLDFINCH

COLOR: Tilleul Buff or White.

SPECIMENS EXAMINED: One, stage D (skin), Mt. Dennis, Ontario (R.O.M.Z.); one, stage A, Livingston County, Michigan (U.M.M.Z.).

REFERENCES: "Patches of down were prominent on the head, as well as other parts of the body, especially the wings" (Mousley, 1932, p. 202). "The body and head were covered with light grayish natal down, 5 to 6 mm. long on the frontal and occipital regions of the head. In this region the down extended in a horse-shoe shape from the frontal to the occipital region then back to the frontal again. The down on the mid-dorsal, scapular, femoral and humeral regions was about 5 mm. long and that on the crural region about 3 mm. and the abdominal 2 mm." (Walkinshaw, 1939a, p. 3).

TABLE 60

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Spinus tristis*

Region	Length	Number
Ocular	2	1
Coronal	6	10
Occipital	8	6
Middorsal	8	6
Pelvic (upper)	7	2
Scapular	7	10
Femoral	6	7
Abdominal	2	10
Crural	2	4
Primary	1	4
Secondary	1	2
Greater primary covert	1	5
Greater secondary covert	5	10
Middle secondary covert	4	8
Carpal remex covert	1	1

Loxia curvirostra

RED CROSSBILL

REFERENCES: ". . . Scantily clad with tufts of softly-tinted greyish-brown down" (Walpole-Bond, 1910, p. 407). "Very dark grey. . . . Fairly long and plentiful, except on the outer supra-orbital, ventral and crural tracts. . . . Inner and outer supra-orbital, occipital, humeral, spinal, ulnar, femoral, ventral and crural" (Ticehurst, 1910, p. 71). "The young were naked save for small patches of filamentous gray down on the head and back" (Munro, 1919, p. 60).

Chlorura chlorura

GREEN-TAILED TOWHEE

REFERENCE: ". . . Thin whitish down" (Wheelock, 1904, p. 252).

Pipilo erythrophthalmus

TOWHEE

COLOR: Drab-Gray; capital tract, Drab.

SPECIMENS EXAMINED: One, stage A, Spencer, Massachusetts; one, stage C, Four Mile Run, Virginia (U.S.N.M.); one, stage C (skin), Toronto, Ontario (R.O.M.Z.).

REFERENCES: "Pale clove-brown" (Dwight, 1900, p. 206). "Down on head, back, humeral, femoral, and secondary [covert] tracts" (Saunders, MS).

Pipilo maculatus

OREGON TOWHEE

REFERENCE: ". . . When first hatched . . . covered with thin greyish-white down" (Cohen, 1899, p. 63).

Calamospiza melanocerys

LARK BUNTING

REFERENCE: "Mouse-gray" (Dwight, 1900, p. 218).

Passerculus sandwichensis

SAVANNAH SPARROW

COLOR: Anterior, Bister; posterior, Wood Brown or Olive-Brown.

SPECIMENS EXAMINED: One, stage C (skin), Amyot, Ontario (R.O.M.Z.); two, stage C, Chippewa County, Michigan (U.M.M.Z.).

REFERENCES: "The natal down . . . is dull brownish gray" (Sutton, 1935, p. 19). ". . . Dull mouse-grey" (Cartwright, Shortt, and Harris, 1937, p. 176).

Ammodramus savannarum

GRASSHOPPER SPARROW

COLOR: Vinaceous-Buff.

SPECIMENS EXAMINED: One, stage A, and two, stage B, Livingston County, Michigan (U.M.M.Z.); one stage A, Calhoun County, Michigan (U.M.M.Z.).

TABLE 61

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Pipilo erythrophthalmus*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	10	4	7	7	8	7
Occipital	11	3	4	4	4	4
Middorsal	12	3	4	5	6	6
Pelvic (upper)	9	1		3	4	
Pelvic (lower)	8	3		5	8	
Scapular	9	3	4	5	6	5
Femoral	9	6	8	9	10	11
Rectrix	1	12		12	12	
Greater secondary covert	9	6		7	8	
Middle secondary covert	6	2		4	6	

TABLE 62

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Passerculus sandwichensis*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	9	12	13	13	13	13
Occipital	10	4	4	4	4	4
Middorsal	12	4	4	5	6	5
Pelvic (upper)	10	1		2	2	
Scapular	10	7	7	7	7	7
Femoral	7	5	5	6	6	6
Rectrix	1	12		12	12	
Greater secondary covert	8	8		8	8	
Middle secondary covert	8	3		6	6	

TABLE 63

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Ammodramus savannarum*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	9	6	7	9	9	11
Occipital	10	3	3	4	4	4
Middorsal	10	4	4	5	6	6
Pelvic (upper)	8	2		2	3	
Pelvic (lower)	8	4		6	7	
Scapular	11	6		6	7	
Femoral	8	9	8	10	11	12
Abdominal	5	4	4	7	10	9
Crural	2	0	0	2	5	5
Rectrix	2	12		12	12	
Greater secondary covert	9	7		10	10	
Middle secondary covert	6	6		8	8	

TABLE 64

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Passerherbulus caudacutus*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	7	7	8	9	10	10
Occipital	7	4	4	4	4	4
Middorsal	9	6	6	6	6	6
Pelvic (upper)	7	1		1	1	
Scapular	9	4	5	6	6	6
Femoral	7	6	6	7	7	7
Abdominal	1	0	0	0	0	1
Secondary	1	0		1	1	
Greater secondary covert	7	8		9	9	

REFERENCE: ". . . Covered with dirty looking down" (Jones, 1892b, p. 72).

Ammodramus bairdii

BAIRD'S SPARROW

REFERENCE: "Newly hatched young . . . are clothed with pale smoky-grey down, this being longest and densest on the head (capital tract). Down also shows along the spinal, humeral, alar (between the elbow and wrist) and femoral tracts" (Cartwright, Shortt, and Harris, 1937, p. 175).

Passerherbulus caudacutus

LECONTE'S SPARROW

COLOR: Wood Brown.

SPECIMENS EXAMINED: Three, stage A, Chippewa County, Michigan (U.M.M.Z.).

REFERENCE: ". . . Natal down was grayish" (Walkinshaw, 1937, p. 313).

Passerherbulus henslowii

HENSLOW'S SPARROW

COLOR: Tilleul Buff.

SPECIMEN EXAMINED: One, stage B, Livingston County, Michigan (U.M.M.Z.).

REFERENCES: "Smoke-gray" (Dwight, 1900, p. 189). ". . . Had a pale gray colored down adhering to the feathers of the head and upper back. The down was so light in color that it may have been white when the birds were first hatched" (Saunders, 1922, p. 264). ". . . About four hours old . . . superciliary patch of about two tufts on each side; a patch on the back of the head; one on the middle of the back; one lateral to the femur; a humero-scapular tract of two tufts, and a patch on the posterior margin of the ulna. On the upper parts the distribution is essentially the same as Gross (1921:170) found on the nestling Dickicissel (*Spiza americana*) . . . Henslow's Sparrow may differ in having the lateral tracts further ventrad than they are in the Dickcissel [?]. In a four-day old bird . . . the down was pale buffy gray" (Hyde, 1939, p. 55).

Ammospiza caudacuta

SHARP-TAILED SPARROW

REFERENCES: "Grayish wood-brown" (Dwight, 1900, p. 190). ". . . The natal down varies from brownish black on the head to mouse grey on the rump. It is entirely absent from the ventral and crural feather tracts and somewhat unevenly distributed on the

TABLE 65

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Passerherbulus henslowii*

(The data are incomplete.)

Region	Length	Number
Coronal	7	4
Occipital	8	3
Middorsal	10	5
Pelvic (upper)	6	1
Scapular	9	4
Femoral	9	5
Rectrix	1	12
Greater secondary covert	5	6

TABLE 66

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Pooectes gramineus*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	9	6	8	9	10	9
Occipital	12	3	3	4	5	5
Middorsal	12	5	3	6	7	7
Pelvic (upper)	10	1		3	4	
Pelvic (lower)	7	0		1	2	
Scapular	11	6	6	7	9	8
Femoral	9	4	4	6	7	6
Rectrix	2	12		12	12	
Primary	1	9		9	9	
Secondary	1	0		?	2	
Greater secondary covert	10	6		10	10	
Middle secondary covert	7	0		7	7	
Patagial covert	7	0		0	1	

capital, dorsal, humeral, and femoral tracts, and on the greater coverts. It is heaviest on the sides of the head and on the rump" (Rand, 1929, pp. 243, 244).

Pooectes gramineus

VESPER SPARROW

COLOR: Anterior, Snuff Brown; posterior, Vinaceous Buff or Light Drab, tips darker.

SPECIMENS EXAMINED: One, stage A, and two, stage B, Luce, Crawford, and Livingston counties, Michigan (U.M.M.Z): three, stage C (skins), Chapleau, Ontario (R.O.M.Z.).

REFERENCES: ". . . Entirely naked, with the exception of a row of short down feathers extending from the crown of the head to the tail [without interruption?]" (Perry and Perry, 1918, p. 314). ". . . Partly covered with grayish white down" (Wetmore, 1920, p. 405). "Down on head, back, humeral, femoral, caudal, and secondary [covert] tracts" (Saunders, MS).

Chondestes grammacus

LARK SPARROW

REFERENCE: ". . . Naked, except for thin down" (Wheelock, 1904, p. 222).

Aimophila ruficeps

RUFOUS-CROWNED SPARROW

REFERENCE: ". . . Partially covered with tufts of black down" (Myers, 1909, p. 132).

Amphispiza bilineata

BLACK-THROATED SPARROW

REFERENCE: ". . . White, slightly grayish, and very fluffy" (Linsdale, 1936, p. 113).

Junco aikeni

WHITE-WINGED JUNCO

REFERENCE: "One of the young [in a cowbird-parasitized nest] had dry black down and was evidently a young junco" (Miller, 1948, p. 92).

Junco hyemalis

SLATE-COLORED JUNCO

COLOR: Warm Sepia.

SPECIMENS EXAMINED: Four, stage B, Crawford County, Michigan (U.M.M.Z.).

REFERENCES: "Slate-gray" (Dwight, 1900, p. 200). "Down ['dark gray' (Saunders, 1926, p. 483)] on the head, back, femoral, humeral, secondaries [probably coverts intended], and abdominal tracts [not in my data]. On the last named the down is lighter color than on the others. When three days old a coarse white down [neossoptiles?] appears on the tail, preceding the growing out of the rectrices" (Saunders, MS).

Junco oreganus

OREGON JUNCO

REFERENCE: ". . . Covered with a thin growth of long black down" (Skinner, 1920, p. 168).

TABLE 67

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Junco hyemalis*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	13	9	9	11	12	13
Occipital	13	4	3	4	5	5
Middorsal	14	5	5	6	6	7
Pelvic (upper)	12	1		2	2	
Scapular	13	5	5	6	7	7
Femoral	10	6	6	7	7	7
Rectrix	1	12		12	12	
Greater secondary covert	10	9		9	9	
Middle secondary covert	6	0		3	4	

Junco caniceps

GRAY-HEADED JUNCO

REFERENCE: ". . . Dark, slate-colored" (Linsdale, 1936, p. 113).

Spizella arborea

TREE SPARROW

REFERENCES: "Down: Fuscous; sparse tufts disposed as follows: 1 on base of each leg. 5–6 on middle of back. 1 on scapulars and upper humerus. 2–3 on femur, 2–3 at base of skull. Large tuft over each eye. Scarcely perceptible on ventral surface" (Baumgartner, 1938, p. 70). The word "tufts" probably refers to pterylae, not individual neossoptiles. ". . . Down is mouse-gray, about five to seven millimeters in length" (Walkinshaw, 1948, p. 70).

Spizella passerina

CHIPPING SPARROW

COLOR: Wood Brown or Clove Brown.

TABLE 68

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Spizella passerina*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Ocular	5	4	5	5	5	5
Coronal	9	12	12	13	14	13
Occipital	10	5	4	5	5	5
Middorsal	9	6	5	7	7	6
Pelvic	5	13		15	18	
Scapular	10	7	7	8	9	8
Femoral	10	14	13	16	17	17
Axillar	4	0	0	0	1	1
Abdominal	6	9	9	12	15	14
Crural	4	8	8	10	12	11
Rectrix	3	12		12	12	
Primary	1	3		4	5	
Secondary	4	2		3	3	
Greater primary covert	4	6		7	9	
Greater secondary covert	9	9		10	10	
Middle secondary covert	9	8		8	9	
Carpal remex covert	5	1		1	1	
Alula	2	1		1	1	

SPECIMENS EXAMINED: One, stage A, Ann Arbor, Michigan (K.T.R.); one, stage A, Livingston County, Michigan (U.M.M.Z.); one, stage B, Nashville, Tennessee (A.R.L.); three, stage D, Sutton, Massachusetts (R.F.N.).

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 198). ". . . Covered with dark-colored down" (Grinnell and Linsdale, 1936, p. 127). ". . . The down is darker than the average for other passerine birds" (Linsdale, 1936, p. 113). "Down on the head, back, humeral, femoral, caudal, secondaries [coverts probably intended], primaries [coverts], crural, and abdominal patches . . . none on eyelids" (Saunders, MS). "Its down is much longer and darker [than the closely related Clay-colored and Field Sparrows], described by Dwight (1900:198) as 'Mouse-gray,' though it seems to me darker than that and rather to be described as 'Deep Mouse-Gray' " (Walkinshaw, 1944, p. 200).

Spizella pallida

CLAY-COLORED SPARROW

COLOR: Warm Sepia or Hair Brown.

SPECIMENS EXAMINED: Four, stage B, Crawford County, Michigan (U.M.M.Z.); one, stage D (skin), St. Charles, Manitoba (R.O.M.Z.).

REFERENCE: "At hatching . . . adorned only with a few dark gray neossoptiles on the frontal, occipital, scapular, and sacral regions" (Walkinshaw, 1939b, p. 20).

Spizella breweri

BREWER'S SPARROW

COLOR: Light Drab to Drab-Gray.

SPECIMENS EXAMINED: One, stage A, Lake Burford, New Mexico (U.S.N.M.); two, stage C, Gorenlock, Saskatchewan (N.M.C.); one, stage D (skin), Mountainview, Wyoming (R.O.M.Z.).

REFERENCE: ". . . Dark, slaty gray" (Linsdale, 1936, p. 113).

Spizella pusilla

FIELD SPARROW

COLOR: Anterior, Wood Brown; posterior, Vinaceous-Buff.

SPECIMENS EXAMINED: One, stage A, Livingston County, Michigan (U.M.M.Z.); one, stage A, artificially incubated, Ann Arbor, Michigan (K.T.R.).

REFERENCES: "Mouse-gray" (Dwight, 1900, p. 199). Walkinshaw (1939c, p. 149) gives the following:

"Coronal	5 mm.	4– 6 tufts
Occipital	5	5– 7
Mid-Dorsal	6–7	10–12
Scapular	6	4– 5
Humeral	4	2
Femoral	5–6	6
On femur	4	2
Abdominal	5	10–12"

TABLE 69

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Spizella pallida*

Region	Length	Number				
		Minimum		Average	Maximum	
		Left	Right		Left	Right
Ocular	3	0	0	0	0	1
Coronal	7	11	11	12	13	13
Occipital	8	2	2	3	3	3
Middorsal	7	3	3	4	4	5
Pelvic (upper)	7	1		1	2	
Pelvic (lower)	5	5		6	6	
Scapular	8	5	5	6	6	6
Femoral	8	8	8	9	9	10
Abdominal	3	7	8	8	10	8
Crural	2	1	1	3	4	4
Rectrix	1	12		12	12	
Greater secondary covert	8	9		9	9	
Middle secondary covert	5	6		7	8	
Carpal remex covert	2	0		1	1	

TABLE 70

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Spizella breweri*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Ocular	8	0	1	2	2	1
Coronal	4	11	12	13	13	15
Occipital	8	3	3	5	5	5
Middorsal	6	5	5	6	7	6
Pelvic (upper)	6	2		3	3	
Pelvic (lower)	4	6		9	12	
Scapular	7	8	8	9	10	11
Femoral	8	11	16	16	17	17
Abdominal	5	12	14	15	16	16
Axillar	5	0	0	2	5	6
Crural	2	5	5	7	10	12
Rectrix	3	12		12	12	
Secondary	2	0		1	3	
Greater primary covert	2	0		8	8	
Greater secondary covert	7	9		10	10	
Middle secondary covert	8	7		8	8	
Carpal remex covert	8	0		1	1	

"Down on head, back, humeral, femoral, caudal, secondary [covert], and abdominal tracts. Although in the same genus as the Chipping Sparrow, I did not note down on the crural tract [both tabulated data include the crural tract]" (Saunders, MS).

Spizella atrogularis

BLACK-CHINNED SPARROW

Fragmentary data include down on the following regions: coronal, occipital, middorsal, scapular, femoral, abdominal, crural, rectrix, greater and middle secondary coverts, carpal remex covert.

SPECIMENS EXAMINED: Two, stage C, San Bernardino County, California (H.L.C.).

Zonotrichia querula

HARRIS'S SPARROW

REFERENCE: ". . . Thin, fluffy, wide-

TABLE 71

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Spizella pusilla*

Region	Length	Minimum		Number	Maximum	
		Left	Right	Average	Left	Right
Coronal	5	9	10	11	10	12
Occipital	6	3	3	4	4	4
Middorsal	7	3	3	4	4	4
Pelvic (upper)	6	1		2	2	
Pelvic (lower)	4	0		?	3	
Scapular	6	6	6	7	7	7
Femoral	7	8	8	9	9	9
Abdominal	4	9	10	11	11	12
Crural	2	0		?	2	
Rectrix	1	10		10	10	
Greater secondary covert	5	8		9	9	
Middle secondary covert	4	3		6	6	

TABLE 72

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Zonotrichia albicollis*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	12	9	9	11	12	11
Occipital	15	4	1	5	7	5
Middorsal	16	7	5	7	8	8
Pelvic (upper)	13	1		5	7	
Scapular	14	4	4	6	7	7
Femoral	12	6	6	7	8	8
Crural	2	0	0	0	0	1
Rectrix	1	10		12	12	
Greater secondary covert	11	7		9	10	
Middle secondary covert	7	3		5	5	

spreading down stood erect for nearly an inch. . . . The tracts of the upper parts are well furnished with Chaetura Drab down; that on the crown is particularly luxuriant" (Harper, 1953, pp. 98, 101).

Zonotrichia albicollis

WHITE-THROATED SPARROW

COLOR: Benzo Brown or Bister to Wood Brown.

SPECIMENS EXAMINED: Four, stage B (skins), Amyot, Ontario (R.O.M.Z.); three, stage B, Luce County, Michigan (U. M.M. Z.).

REFERENCE: "Pale clove-brown" (Dwight, 1900, p. 196).

Melospiza georgiana

SWAMP SPARROW

Fragmentary data include down on the following regions: coronal, 8 mm.; occipital; spinal, 12 mm.; scapular; femoral; abdominal; rectrix; greater secondary covert; middle secondary covert.

COLOR: Clove-Brown.

SPECIMENS EXAMINED: Two, stage D, Brookfield, Massachusetts.

REFERENCE: "Sepia-brown" (Dwight, 1900, p. 204).

Melospiza melodia

SONG SPARROW

COLOR: Drab or Sayal Brown.

TABLE 73

MEASUREMENTS (IN MILLIMETERS) AND COUNTS OF NEOSSOPTILES OF *Melospiza melodia*

Region	Length	Number				
		Minimum			Maximum	
		Left	Right	Average	Left	Right
Coronal	10	3	4	6	8	9
Occipital	10	3	3	4	5	5
Middorsal	12	5	4	6	6	6
Pelvic (upper)	8	0		2	7	
Pelvic (lower)	7	0		2	4	
Scapular	10	5	5	6	7	6
Femoral	8	6	6	7	7	7
Rectrix	2	10		12	12	
Secondary	5	0		1	2	
Greater secondary covert	8	8		9	9	
Middle secondary covert	4	0		1	2	

SPECIMENS EXAMINED: One, stage A, artificially incubated, Ann Arbor, Michigan (K.T.R.); one, stage B and stage C, Worcester, Massachusetts; two, stage D, Spencer, Massachusetts (P.G.R.); one, stage B, Livingston County, Michigan (U.M.M.Z.).

REFERENCES: "Sepia-brown" (Dwight, 1900, p. 201). "Down on head, back, humeral, and femoral tracts" (Saunders, MS). "At hatching black down is prominent on the dorsal, femoral and occipital regions and on the coverts. For the first two days there is little change except in increased length [?] of down" (Nice, 1943, p. 14).

Rhynchophanes mccownii

McCOWN'S LONGSPUR

REFERENCES: ". . . Protected above by fluffy natal down, about one-fourth inch long, of a whitish buff or pale dead-grass color" (Du Bois, 1937, p. 237). ". . . Dorsal feather tracts were covered with long, buffy down" (Mickey, 1943, p. 195).

Calcarius lapponicus

LAPLAND LONGSPUR

COLOR: Agouti; Tilleul Buff and Clove Brown.

SPECIMENS EXAMINED: One, stage C (skin), Kenora District, Ontario (R.O.M.Z.); three, stage D, North West Territories (N.M.C.).

TABLE 74

MEASUREMENTS (IN MILLIMETERS) AND NUMBERS OF NEOSSOPTILES OF *Calcarius lapponicus*

(The data are incomplete.)

Region	Length	Number
Ocular	6	4
Coronal	9	17
Occipital	8	6
Middorsal	10	8
Pelvic	8	10
Scapular	14	9
Femoral	9	7
Crural	3	5
Rectrix	1	12
Greater primary covert	3	6
Greater secondary covert	10	9
Middle secondary covert	8	8
Carpal remex covert	6	1

REFERENCES: "The down is very pale, tawny in color, almost white, and is quite long" (Palmer, 1899, p. 423). "[First day] Down present on dorsal tract (none on back of neck), wing, sides of capital tract; none on ventral or caudal [?] tracts. Down grayish white, with darker, smoky-looking tips. Longest down 10 mm. Day 2. Same as Day 1, except down of capital tract definitely in three parts: over each eye and on back of head; crural tract, row of down about 6 mm. long; tibial tract, small tuft of down present at lower extremity. Down buff, marked partly with grayish black . . . Day 9 . . down still present except on ventral tract, where probably removed by wriggling in nest . . . Day 10 . . . a little down still present on innermost secondaries" (Grinnell, 1944, pp. 557–558).

Calcarius pictus

SMITH'S LONGSPUR

Fragmentary data include down on the following regions: ocular, 7 mm.; coronal, 11 mm.; occipital; spinal; scapular; femoral; abdominal; crural.

COLOR: Agouti, Tilleul Buff proximally, Clove Brown distally.

SPECIMEN EXAMINED: One, stage D (skin), Kenora District, Ontario (R.O.M.Z.).

Calcarius ornatus

CHESTNUT-COLLARED LONGSPUR

REFERENCES: "The young are at first covered with buff-colored down" (Cameron, 1907, p. 406). Down "whitish-grey to buffy-grey" (Cartwright, Shortt, and Harris, 1937, p. 176). "They are covered with buffy gray down about one-fourth inch long. On the capital tract two rows of down, beginning at the loral region, run posteriorly to the occipital region, where they join a transversely placed tuft. An isolated tuft stands above each eyelid. A wide patch occurs in the spinal region, narrowing as it enters the pelvic region. Down is abundant in the humeral tract. In the alar tract, it is distributed in two rows on the dorsal surface. A prominent patch is found in each femoral tract, and scattered tufts can be detected in the crural tract" (Harris, 1944, p. 110).

Plectrophenax nivalis

SNOW BUNTING

Fragmentary data include down on the following regions: coronal, 10 mm.; occipital; spinal; scapular; femoral; crural; alar coverts.

COLOR: Agouti, Drab-Gray proximally, Drab distally.

SPECIMEN EXAMINED: One, stage D (skin), (R.O.M.Z.).

REFERENCES: ". . . The long dusky down is abundant along the sides of the head and along the sides of the back and on the rump" (Palmer, 1899, p. 424). "Dark grey . . Fairly long, spinal tract thicker anteriorly than posteriorly, crural very scanty and minute, the other tracts well marked. . . . Inner supra-orbital, occipital, humeral, spinal, ulnar, femoral and crural" (Ticehurst, 1908, p. 193). "Natal down gray, distributed in tracts on the crown, nape, scapulars, forewings, femora and a dorsal median tract" (Gross, 1937, p. 39).

DISCUSSION

ABOUT 60 PER CENT OF THE 8600 species of living birds belong to the Order Passeriformes. At present we are ignorant of the evolutionary relationships of most of the passerine families and many of the genera. Unexamined anatomical systems must be investigated to throw new light on these relationships. The natal pteryloses here surveyed, while woefully incomplete and inadequate to serve as bases for categorical diagnoses, test to my satisfaction the positive value of this anatomical system (in conjunction with other systems) in the delimitation of many families and genera, and thus provide another set of clues to this stubborn problem.

FAMILY SYNOPSES

Tables 75–87 represent tentative family synopses based on natal plumages. It must be emphasized that the single-character synopses advocated here are not presented in lieu of taxonomic diagnoses that use many characters. Study of this single character was done for its own sake, because it was believed that taxonomists should refine their understanding of the characters they use and should establish empirically based discrimination between levity and gravity.

The text figures are qualitative abstractions, serving only to illuminate the tables, which should be referred to for the exact information. The tables serve to bring into focus the manner in which any particular species examined contrasts with the average for its family.

"Average characters" represent an average of the species (not of genera) and exclude naked species.

"Number" refers to the average number of neossoptiles found unilaterally in the specified tract.

"Length" refers to the average greatest length of the neossoptiles.

"Aggregate" refers to the average bilateral aggregate of down in millimeters determined by the product of "Number" and "Length" of each subsumed species bearing down on that tract.

"Average total number" refers to the average of the total bilateral number of neossoptiles of the subsumed species, including naked species.

"Average total aggregate" refers to the average of the total aggregate (in millimeters) of down found in the subsumed species, including naked species.

The basic pterylologic plan of each family, while tentative at best, in addition to providing a taxonomic criterion, was determined with the belief that deviations in direction and magnitude from the norm might provide a measure of adaptive evolution when more is known about the functional relationships between the deviations and the peculiar environmental and genetic conditions that sustain them. It is regrettable that the paucity of data did not allow synoptic treatment at a level lower than the families.

At the species level, in addition to the formulas of down distributions, the numbers of individual neossoptiles, and the specific down aggregates, it was deemed desirable to present another characterization (relatively independent of the numerical distributions), namely, the coefficient of down growth, "Coefficient." This coefficient, the quotient of total neossoptile aggregate by total neossoptile number, might be useful in small taxonomic units for the correlation of downy plumages with incubation periods, nestling periods, and other developmental, temporal relationships when we have more precise data. Such correlation may yet be serviceable as a clue to the real meaning of differential developments in natal plumages in passerines.

COTINGIDAE

No information.

TYRANNIDAE

The basic pterylological plan is given in figure 2.

DEVIATIONS FROM BASIC PLAN: The auricular region, dense and constant in *Sayornis phoebe*, was weak in the other species. Lesser secondary coverts were found only in *T. tyrannus* and *Muscivora forficata*. *Sayornis phoebe* and *Empidonax traillii* had no primaries; *E. traillii* and *Contopus virens*, no secondaries.

TAXONOMY AND ADAPTATION: There are insufficient data from which to conclude that the differences encountered are constant intergeneric discontinuities. That the phenomenal amount of white down on *T. tyrannus* is adaptive in sun-exposed nesting sites is only speculation, for *Bombycilla cedrorum* (of another family), nesting at present in practically identical situations, has no down at all. *Empidonax traillii* has considerable down reduction for a flycatcher. The Tyrannidae examined had by far the greatest number of neossoptiles (292% of the average for the order) and downy regions found among the passerines. The length of the neossoptiles, however, was consistently below the average length. They had 231 per cent of the average down aggregate for the order. The auricular and postauricular down seems to be peculiar to this family. There is an analogous postauricular region in certain Fringillidae. The finite auricular ring, especially as found in *Sayornis*, is a most striking peculiarity, and one is tempted to speculate on its adaptive significance. Auditory acuity and ectoparasite relationships might well be studied. There is a tendency towards appearance of neossoptiles in extraordinary locations in the

TABLE 75

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF TYRANNIDAE

Region	Number	Length	Aggregate
Ocular	18	5	193
Coronal	16	7	224
Superciliary	? or absent	?	?
Infra-ocular	? or absent	?	?
Malar	? or absent	?	?
Auricular	8 or absent	4	60
Postauricular	3 or absent	4	24
Occipital	15	7	199
Spinal	23	7	349
Pelvic	5	5	27
Scapular	12	7	191
Tertiary	? or absent	?	?
Femoral	16	8	265
Inter-ramal	? or absent	?	?
Cervical (ventral)	? or absent	?	?
Sternal	1 or absent	3	6
Axillar	3	5	27
Abdominal	15	5	135
Crural	11	4	83
Rectrix	6	1	14
Upper rectrix covert	5 or absent	4	35
Under rectrix covert	3 or absent	2	12
Primary	8 or absent	1	23
Secondary	4 or absent	4	35
Greater primary covert	8	4	61
Greater secondary covert	10	7	152
Middle primary covert	3 or absent	1	6
Middle secondary covert	8	6	103
Lesser secondary covert	8 or absent	5	80
Carpal remex covert	1	4	9
Alula	2 or absent	2	5
Alula covert	4 or absent	3	18
Patagial covert	6 or absent	2	244

Average total number: 380 neossoptiles
Average total aggregate: 2185 mm.

Tyrannidae (infraocular, malar, and cervical regions). Within the common down regions the neossoptiles are usually aligned in more complex and confluent patterns than in the other families. The qualitative and quantitative down differences between this family (at least some members) and other families of the Passeriformes seem commensurate with its present separation into the Suborder Tyranni.

ALAUDIDAE

Unsatisfactory data from *Eremophila alpestris* and *Alauda arvensis* only include coronal, occipital, spinal, scapular, femoral, abdominal, crural?, secondary?, and greater

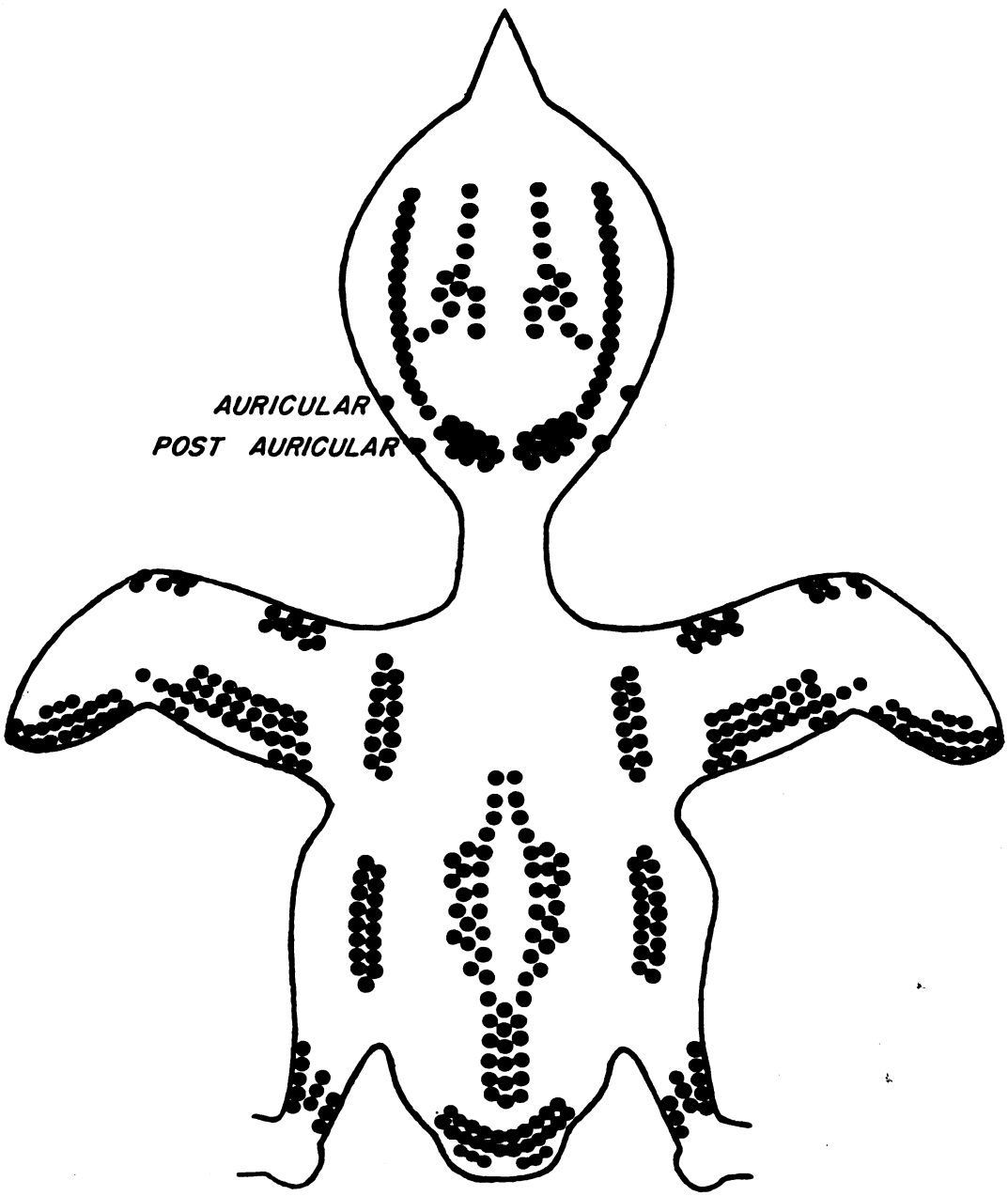


FIG. 2. Basic neossoptile pterylosis of the Tyrannidae.

and middle secondary covert tracts at least.

ADAPTATION: *Eremophila alpestris* is described as having unusually heavy natal down; *A. arvensis*, as having agouti neossoptiles.

HIRUNDINIDAE

The basic pterylological plan is given in figure 3.

DEVIATIONS FROM BASIC PLAN: Only *Hirundo* and *Petrochelidon* (also credited to *Delichon urbica* by Ticehurst, 1908, and by Witherby *et al.*, 1938) had femoral tracts. Only *Petrochelidon* had a secondary. *Progne* is bare (Allen and Nice, 1952). Ticehurst (1908) noted secondary coverts on *Riparia*, but Witherby *et alii* did not.

TAXONOMY AND ADAPTATION: Three groups

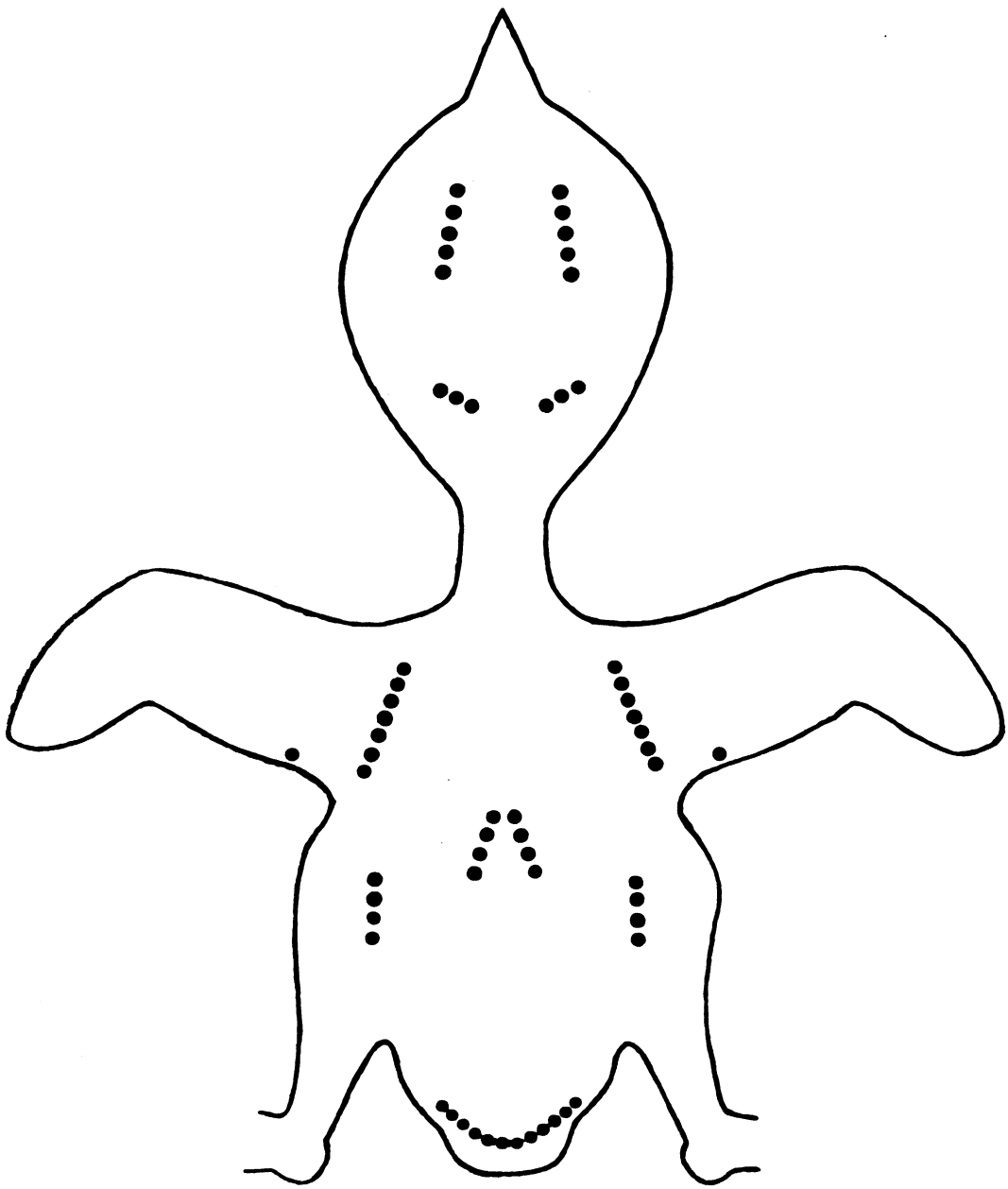


FIG. 3. Basic neossoptile pterylosis of the Hirundinidae.

TABLE 76

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF HIRUNDINIDAE

Region	Number	Length	Aggregate
Ocular	? usually absent	?	?
Coronal	5	7	80
Occipital	3	8	52
Middorsal	4	11	91
Pelvic (upper)	? usually absent	?	?
Scapular	7	11	154
Femoral	4 or absent	9	74
Rectrix	6	1	12
Secondary	1 or absent	2	4

Average total number: 46 neossoptiles
Average total aggregate: 349 mm.

appear on the basis of comparisons of numbers and aggregates of neossoptiles: (1) *Iridoprocne*, *Riparia*, and *Stelgidopteryx;* (2) *Hirundo* and *Petrochelidon* (also characterized by a femoral tract); and (3) *Progne*. It is to be noted that the second group coincides with similarities in mode of nesting. The segregation may therefore be either an expression of adaptation or genetic relationship or both. I feel that the presence of the femoral tract in *Hirundo* and *Petrochelidon* is of sufficient importance to ally these two forms, thereby confirming a statement by Mayr and Bond (1943, p. 340). Where femoral tracts are present they are sparse as measured by the usual 1/1 ratio of femoral-tract neossoptiles to scapular-tract neossoptiles. From *Hirundo* to *Iridoprocne* and *Progne* there is a reduction of natal down correlated with greater enclosure of the nest. The departure of *Riparia* from the white color of the down of *Stelgidopteryx* is puzzling in consideration of the present similarity of nidification and down aggregate. The drab gray down of *Hirundo*, the darkest down found in the swallows, is correlated with greatest down aggregate and least enclosure of nest, although it is not implied that this correlation is necessarily meaningful in reference to adaptation mechanisms. The Hirundinidae examined had considerable reduction of natal down: only 35 per cent of the average number for the order; 37 per cent of the average aggregate; and one-fourth of the possible down regions.

CORVIDAE

The basic pterylological plan is given in figure 4.

DEVIATIONS FROM BASIC PLAN: *Cyanocitta cristata* and apparently *Aphelocoma ultramarina* (Gross, 1949), *Pica pica* (Bent, 1946), and *Gymnorhinus cyanocephalus* (Cameron, 1907) are without neossoptiles. In Europe *Garrulus glandarius* is also naked (Witherby *et al.*, 1938). *Perisoreus canadensis* alone had ocular and abdominal down. *Corvus frugilegus* apparently has neither coronal nor occipital down. *Nucifraga columbiana* alone had neossoptiles on the upper rectrix coverts. Patagial down was found to be variable on *Corvus brachyrhynchos* and *C. ossifragus*.

TAXONOMY AND ADAPTATION: *Perisoreus canadensis* differs from *C. cristata* of the same subfamily (Garrulinae) in definitely having natal down. The high incidence of nakedness in this family expresses itself independently (paralellism) in members of the recognized subfamilies. Rand (1947, p. 180) dismissed the probability of adaptive significance of nudity in nestling *P. pica*, borne in an enclosed nest, on the basis that the also nude young of *C. cristata* are found in open nests. I have theorized (see Introduction, Adaptation) that the latter may have become nude in a remote period of cryptic brooding and not regained natal down on resumption of open-nesting habits. Further, the heavy pigmentation and scurfy appearance of the nestlings' epidermis might be compensatory. *Perisoreus canadensis* of the subfamily Garrulinae

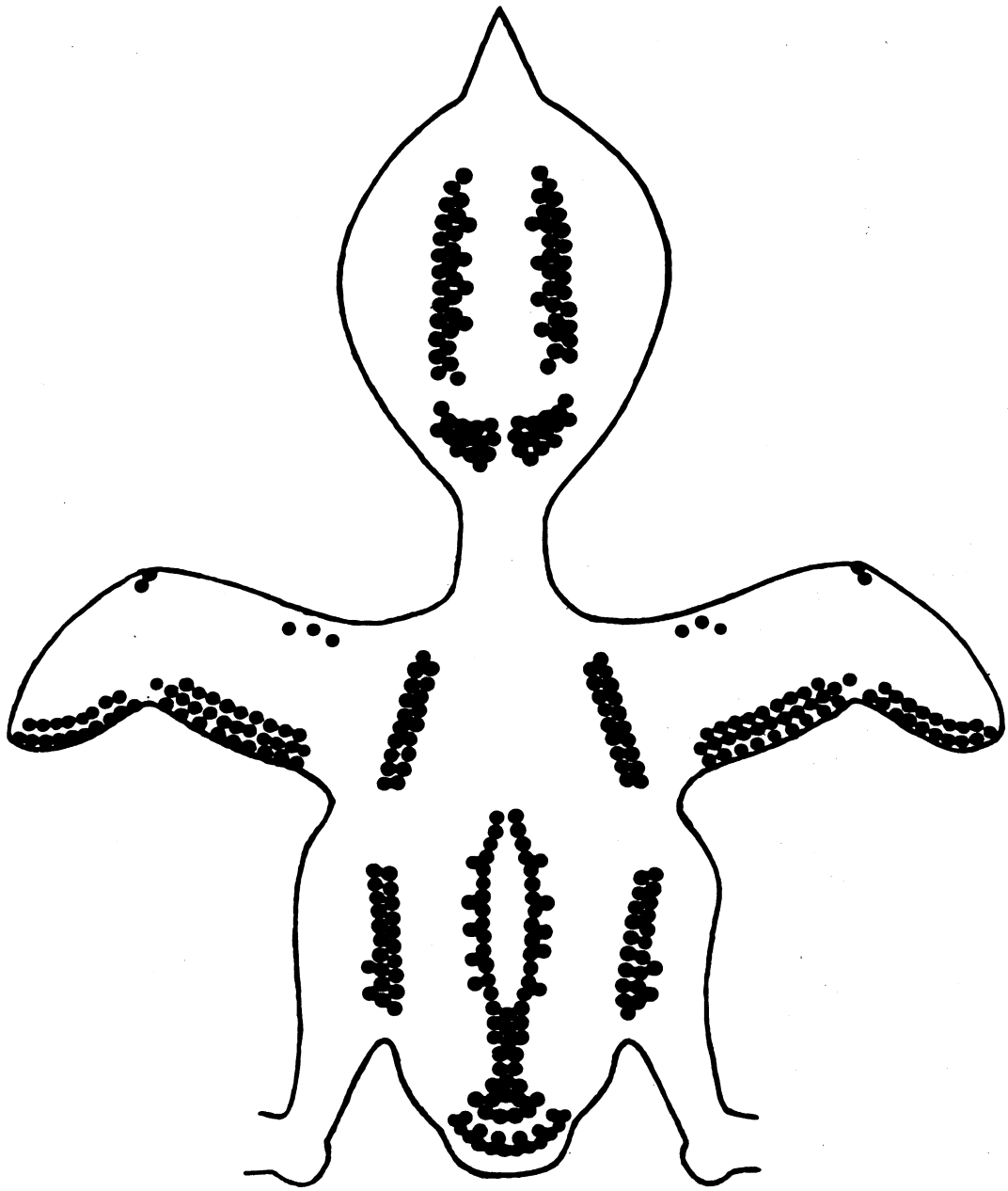


FIG. 4. Basic neossoptile pterylosis of the Corvidae.

showed ocular and abdominal down, whereas the six species of the subfamily Corvinae on which there are data do not. Upper rectrix coverts on *N. columbiana* may be peculiar to the genus. The apparent lack of down on the coronal and occipital regions in *C. frugilegus* is theoretically attributable to a relaxation of adaptive selection in this particular in a colonial type of nesting by Ingram (1920) but Amadon (personal communication) points out to me that this condition is the more interesting "inasmuch as the immature plumage does have the head feathered, whereas in the adult it becomes bare again!" The five Corvidae tallied (in spite of the three naked species included in this computa-

TABLE 77

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF CORVIDAE

Region	Number	Length	Aggregate
Ocular	? or absent	?	?
Coronal	23	8	330
Occipital	15	7	170
Spinal	38	14	806
Scapular	18	11	386
Femoral	21	10	320
Rectrix	6	3	30
Upper rectrix covert	3 or absent	5	30
Abdominal	? or absent	?	?
Primary	10	2	40
Secondary	10	4	80
Greater primary covert	9	2	34
Greater secondary covert	11	11	221
Middle secondary covert	9	7	119
Carpal remex covert	1	3	5
Alula	2	2	6
Patagial covert	? or absent	?	?

Average total number: 341 neossoptiles (136, including three bare species)
Average total aggregate: 2562 mm. (1025 mm., including three bare species)

tion) had an average down number 105 per cent, and down aggregate 108 per cent, of the average for the order, though perhaps not disproportionate to their large body size. The down length in the coronal and occipital regions (not including species in which these regions are absent) is less than the average for the order and may well indicate a trend in the family, for *C. frugilegus* entirely lacks these neossoptile regions, the only species known that lacks capital down in the presence of down elsewhere on the upper body.

PARIDAE

The basic pterylological plan is given in figure 5.

DEVIATIONS FROM BASIC PLAN: *Parus atricapillus* has scapular down, whereas *P. atricristatus* apparently does not. Rectrices are probably variable. *Psaltriparus minimus* is described as bare by Addicott (1938).

TAXONOMY AND ADAPTATION: The single specimen of *P. atricristatus* apparently differing from *P. atricapillus* in having no scapular down (a conservative tract) is reminiscent of the old separation of the two species into the genera *Baeolophus* and *Parus*, respectively. Of the five species of *Parus* for which there is down distribution given by Witherby *et alii* (1938) *P. cristatus* (crested as are our titmice) is the only one without "humeral" down. However, Witherby *et alii* give different dis-

TABLE 78

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF PARIDAE

Region	Number	Length	Aggregate
Coronal	5	8	68
Occipital	4	9	72
Middorsal	3	8	45
Scapular	5 or absent	8	80
Rectrix	6 or absent	1	12

Average total number: 34 neossoptiles
Average total aggregate: 231 mm.

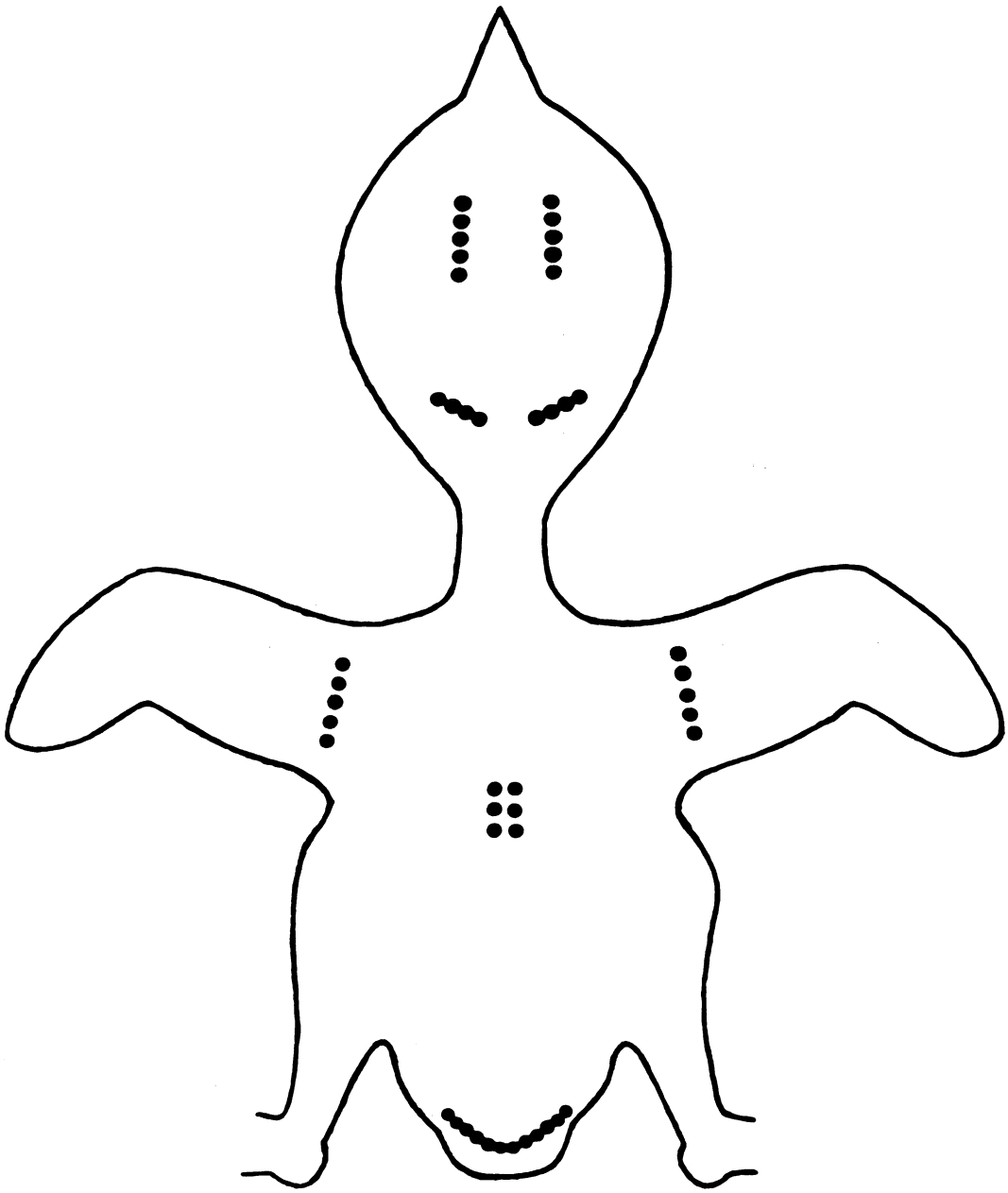


FIG. 5. Basic neossoptile pterylosis of the Paridae.

tributions for *Parus* than do the Heinroths (1926), who state ". . . *der Haubenmeise* [*P. cristatus*] *sind regelmässig auch in der Schultergegend noch Daunen. Aegithalos caudatus* and *Panurus biarmicus*, European genera of this family, are naked according to Witherby *et alii*. Also *P. caeruleus* is allegedly without spinal down. The Paridae examined had extreme reduction of natal plumage: down number, 26 per cent of the average, aggregate 24 per cent, for the order.

SITTIDAE

The basic pterylological plan is based on *Sitta pusilla* only.

The fragmentary data from *Sitta caroli-*

TABLE 79

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF SITTIDAE

Region	Number	Length	Aggregate
Coronal	7	7	98
Occipital	4	7	56
Middorsal	5	8	80
Scapular	6	6	72

nensis agree with those for *S. pusilla*. *Sitta pygmaea* is also similar according to Norris (personal communication). *Sitta europeae* has similar distribution (Witherby *et al.*, 1938).

TAXONOMY AND ADAPTATION: The quantity of down is comparable to that in the Paridae and Troglodytidae. The single species examined had 34 per cent of the number of neossoptiles that is average for the order; 32 per cent of the average aggregate. It is noteworthy that in these families with only slight down the lengths of downs present are not correspondingly reduced. Oskar and M. Heinroth (1926, pp. 129, 130), without really clear evidence, state, "*. . . in . . Jugendbedaunung . . . eine nahe Verwandtschaft mit den Waldmeisen (Parus) nicht besteht.*" (*Op. cit.*, p. 133): "*Die Art der Bedaunung geht aus den Bildern klarhervor: sie entspricht weder der der Meisen noch der der Baumläufer [Certhia], da sie auf dem Kopfe nicht besonders stark und auf dem Rücken sehr deutlich vorhanden ist.*"

CERTHIDAE

There are only unsatisfactory data in the literature. Oskar and M. Heinroth (1926, p. 137) write, "*Mit seinem sonst nackten Körperchen* [?] *erinnert der Nestling an gewisse Meisen, nicht aber an den Kleibef* [*Sitta*]." Witherby *et alii* (1938) give only the coronal and occipital tracts.

CHAMAEIDAE

There are only fragmentary data in the literature. *Chamaea fasciata* is probably correctly described by Erickson (1938) as being naked, save for down 3 mm. long on the rectrices.

CINCLIDAE

Incomplete data from *Cinclus mexicanus* include only the coronal, occipital, scapular, and spinal regions. Witherby *et alii* (1938) add nothing further for *C. cinclus*.

TROGLODYTIDAE

The basic pterylological plan is given in figure 6.

DEVIATIONS FROM BASIC PLAN: *Campylorhynchus* had scapular and femoral tracts.

TAXONOMY AND ADAPTATION: The similarity of *Troglodytes aedon* and *Telmatodytes palustris* is striking and argues for marked genetic homogeneity for this character. The larger quantitity of down in *Campylorhynchus brunneicapillus*, a desert species, may be

TABLE 80

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF TROGLODYTIDAE

Region	Number	Length	Aggregate
Coronal	7	8	96
Occipital	4	9	72
Middorsal	3	7	42
Pelvic (upper)	1 or absent	6	6
Scapular	? or absent	?	?
Femoral	? or absent	?	?

Average total number: 28 neossoptiles
Average total aggregate: 216 mm.

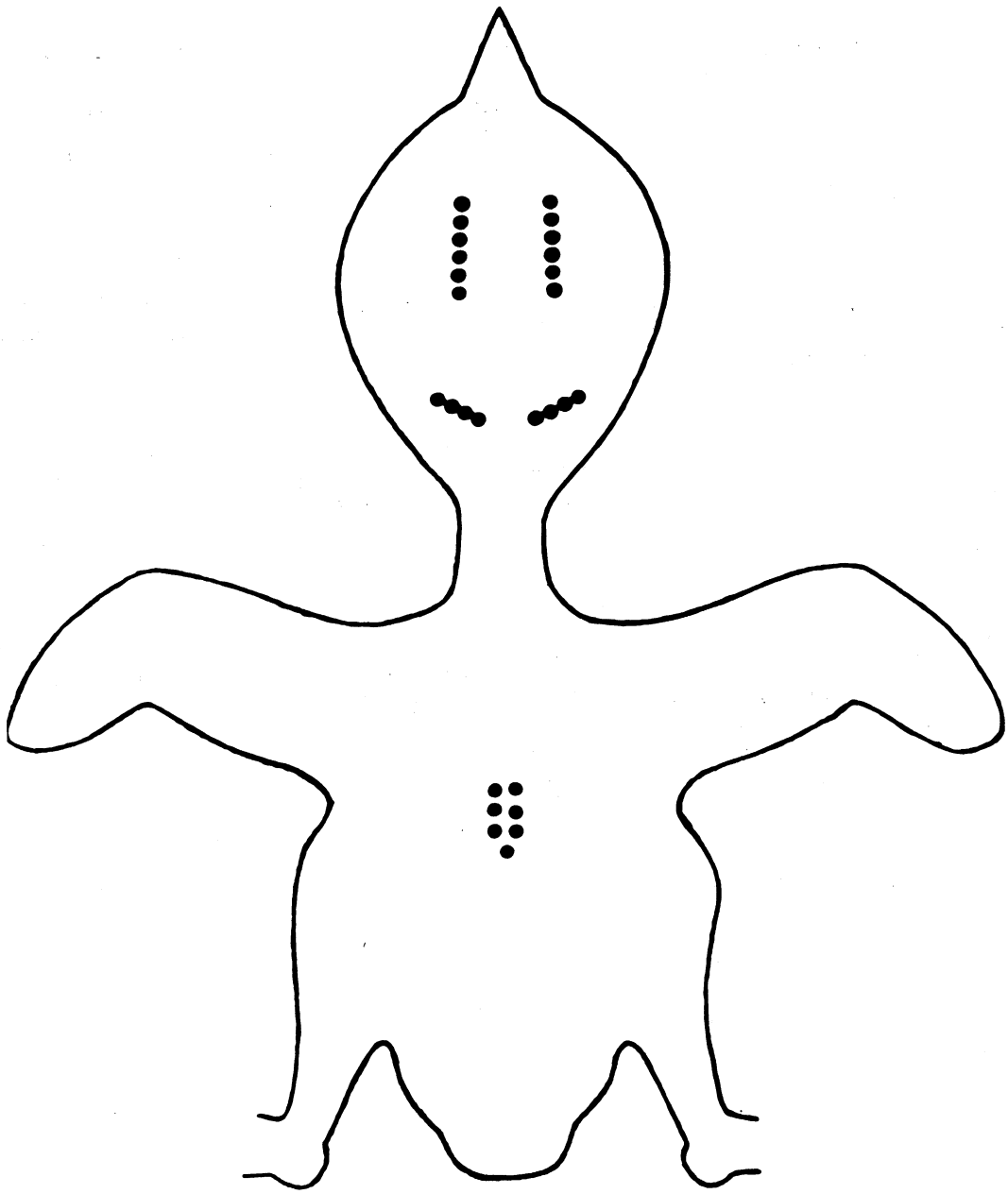


FIG. 6. Basic neossoptile pterylosis of the Troglodytidae.

adaptive or preadaptive (see Mimidae). Harrisson and Buchan (1936, pp. 19, 20), in attributing different distribution of down to *T. troglodytes hirtensis* than to the mainland form, probably err. Yet they also claim that the down is lighter in color. In the light of Jourdain's observation (1919) that the eggs of the subspecies *hirtensis* also show constant differences, the down distributions should be re-investigated. The Troglodytidae examined had extreme reduction of natal plumage: down number, 22 per cent of the average for passerines; down aggregate, 22 per cent. The reduction is correlated with cryptic nesting habit.

MIMIDAE

The basic pterylological plan is given in figure 7.

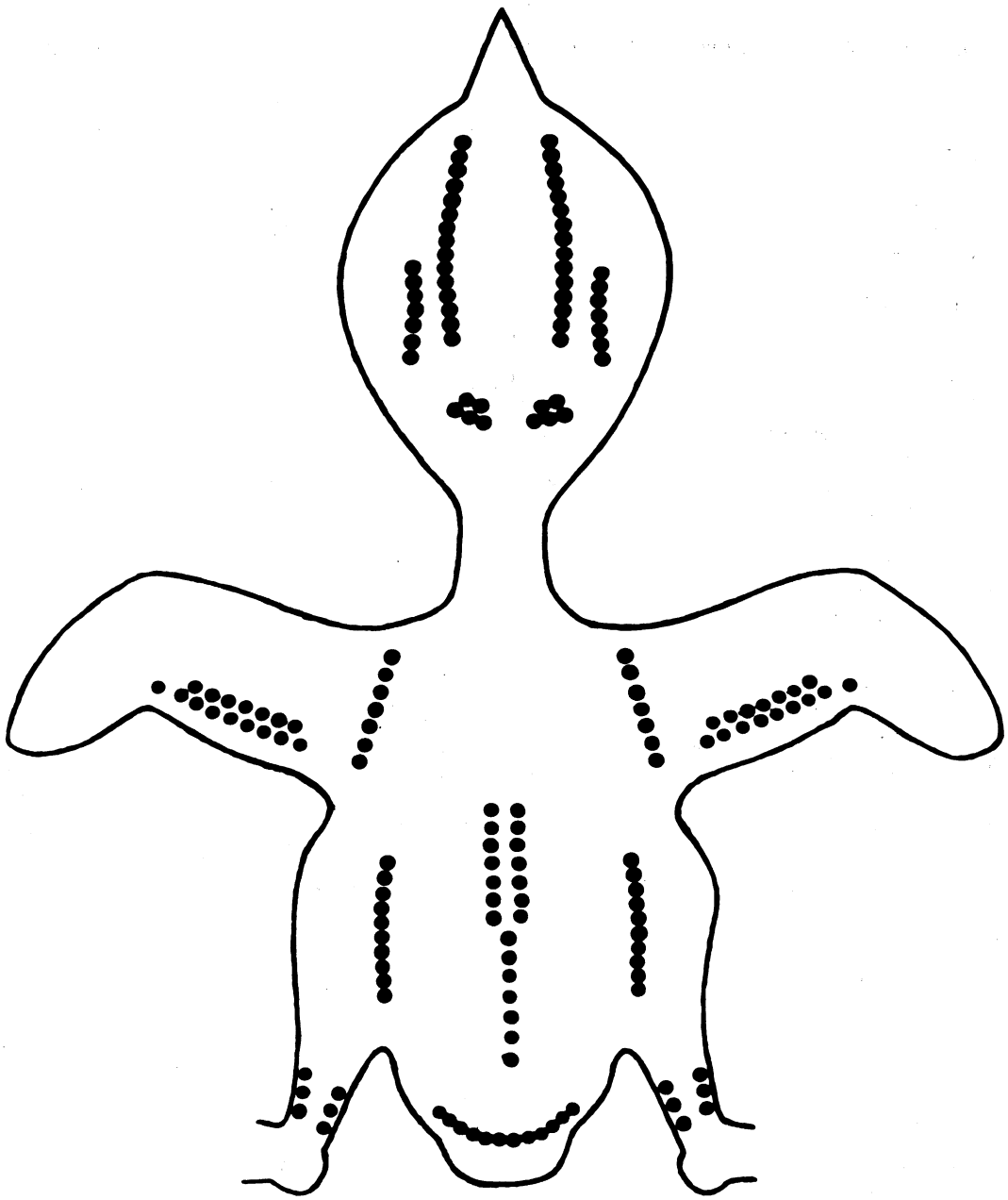


FIG. 7. Basic neossoptile pterylosis of the Mimidae.

DEVIATIONS FROM BASIC PLAN: *Dumetella carolinensis* lacked crural and abdominal tracts. The discrepancy in quantitity of down between the thrashers and *D. carolinensis* was considerable. *Toxostoma lecontei* had relatively long rectrices.

TAXONOMY AND ADAPTATION: The lack of crural and abdominal tracts may be diagnostic for *Dumetella*. The relatively large down aggregates of the thrashers (an obvious index of which is the 8-mm. long rectrix down of *T. lecontei* and the propensity of *T. curvirostre* to have down on extraordinary loci: interramal and cervical regions) may be adaptive or preadaptive in arid habitats. A comparable example (perhaps parallel) is provided by

TABLE 81

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF MIMIDAE

Region	Number	Length	Aggregate
Ocular	7	4	53
Coronal	16	9	235
Occipital	7	10	128
Spinal	23	11	340
Scapular	8	11	168
Femoral	14	9	247
Inter-ramal	? or absent	?	?
Cervical	? or absent	?	?
Abdominal	17 or absent	5	160
Crural	13 or absent	5	120
Rectrix	6	1	12
Under rectrix covert	6 or absent	4	48
Greater primary covert	4 or absent	3	24
Greater secondary covert	8	8	131
Middle secondary covert	7	6	94
Carpal remex covert	1 or absent	3	5

Average total number: 224 neossoptiles
Average total aggregate: 1632 mm.

Campylorhynchus brunneicapillus, a desert wren. The three mimids tallied had down numbers 172 per cent, and down aggregates 173 per cent, of the averages for the order. Contrasted to the Turdidae, the Mimidae have femoral, abdominal, crural, and middle secondary coverts. The dorsal neossoptiles are longer than the average for the order.

TURDIDAE

The basic pterylological plan is given in figure 8.

DEVIATIONS FROM BASIC PLAN: Only *Turdus* had the spinal tract regularly extending into the lower pelvic region. The alar tract was totally lacking in *Hylocichla*. Witherby *et alii* (1938) attributed a femoral

TABLE 82

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF TURDIDAE

Region	Number	Length	Aggregate
Ocular	9 or absent	9	143
Coronal	9	10	216
Occipital	4	10	104
Middorsal	9	17	242
Pelvic (upper)	2 or absent	10	21
Pelvic (lower)	4 or absent	14	56
Scapular	7	14	198
Rectrix	6	1	15
Primary	9 or absent	1	20
Secondary	7 or absent	1	17
Greater primary covert	6 or absent	1	12
Greater secondary covert	8 or absent	7	112
Alula	2 or absent	1	4

Average total number: 98 neossoptiles
Average total aggregate: 861 mm.

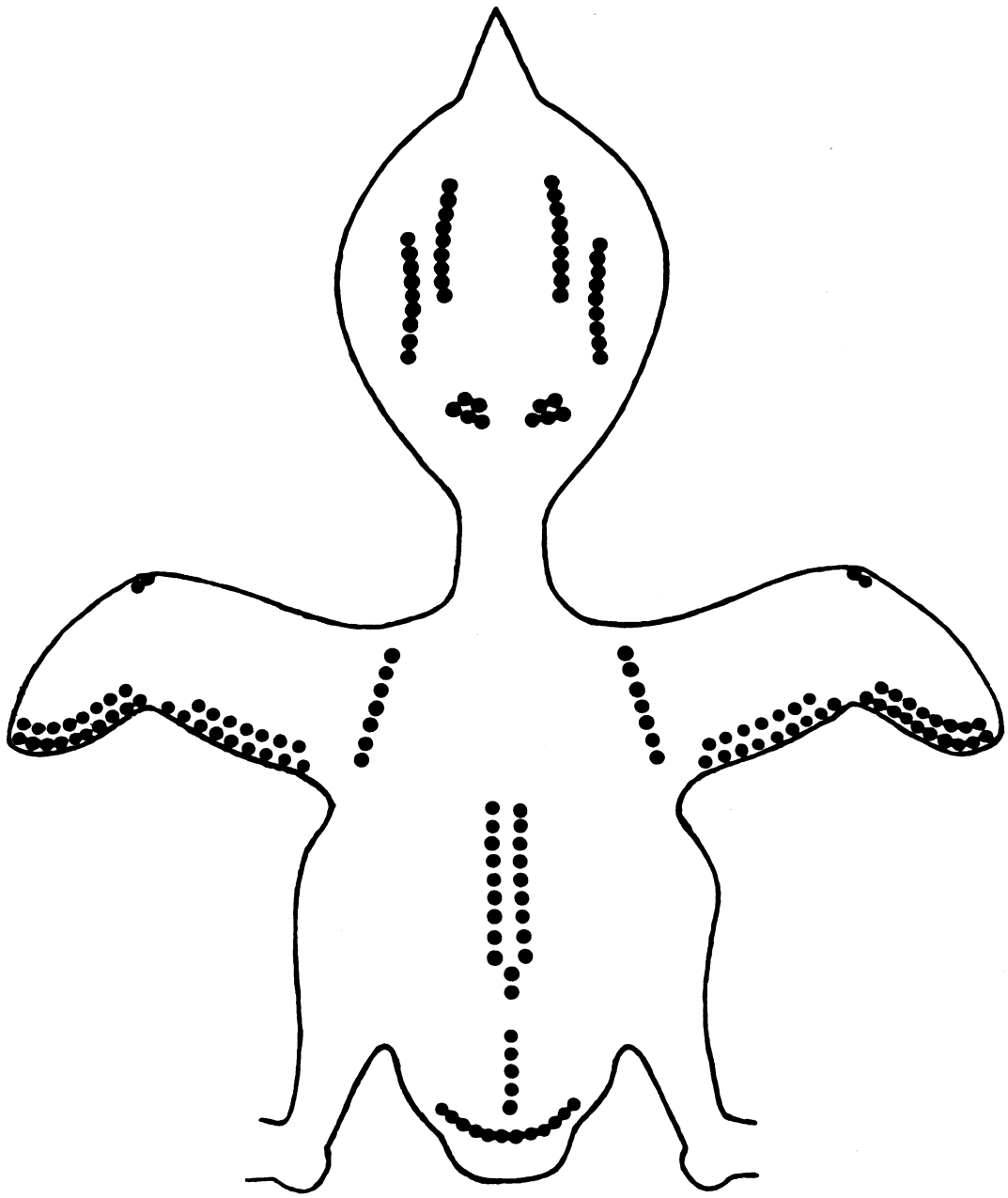


FIG. 8. Basic neossoptile pterylosis of the Turdidae.

tract to *Oenanthe* and to *Luscinia megarhyncha*.

TAXONOMY AND ADAPTATION: *Sialis* shows no reduction in number or aggregate of natal down correlated with cavity nesting; in fact the genus has appreciably higher values than the contemporary non-cavity nesting *Hylocichla*. The pigmented type of eggshell of *Sialis* has, however, previously served as argument for their only recent acquisition of cavity nesting. The apparent reduction of down in *S. mexicana* should be re-investigated. The data indicate consistent generic agreement within *Hylocichla* and *Sialis* and obvious intergeneric discontinuities between the turdid genera. The nine Turdidae tallied

had a down number 75 per cent and a down aggregate 91 per cent of the average for the order. Neossoptiles were usually greatly longer than the average. Contrasted to the Mimidae examined, these Turdidae lacked femoral, abdominal, crural, and middle secondary covert down.

SYLVIIDAE

There are only unsatisfactory data from the literature. *Polioptila melanura* has been described as being without neossoptiles (Bent, 1949). For Old World sylviids Heinroth (*in* O. and M. Heinroth, 1926, p. 76) states, "*Ich bin mir wohl bewusst, dass diese Gruppe* [*Phylloscopus, Sylvia, Hippolais, Acrocephalus,* and *Locustella*] *nicht einheitlich ist. Die Laubsänger* [*Phylloscopus*] . . . *haben stark bedaunte Junge . . . alle übrigen . . . Kinder sind bis auf die der Schwirle* [*Locustella*] *nackt.*" For the Old World *Regulus regulus* there is a discrepancy between the statement of Witherby *et alii* (1938, vol. 1, p. 318), ". . . inner supra-orbital and occipital . . . " and that of the Heinroths (1926, p. 140), "*Bei den Jungen sind die Daunen über die ganze Oberseite verbricht und nicht mur auf den Kopf beschränkt.*"

PRUNELLIDAE

Two European prunellids have coronal, occipital, scapular, alar, spinal, and femoral tracts, according to Witherby *et alii* (1938).

MOTACILLIDAE

There are freagmentary data based on one specimen of *Anthus spinoletta* only; down is found on the ocular, coronal, occipital, middorsal, scapular, femoral, abdominal, crural, rectrix regions, and greater and middle secondary coverts. The femoral, abdominal, and crural tracts are not mentioned in the literature for *Motacilla flava,* nor is the abdominal region for *Anthus spragueii.* For *Anthus cervinus* and *Motacilla cinerea* the ventral tracts are not mentioned by Witherby *et alii* (1938).

PTILOGONATIDAE

Unsatisfactory data from the literature on *Phainopepla nitens* only include coronal, occipital, spinal, alar, and scapular regions at least.

LANIIDAE

There are data from Miller (1931) on *Lanius ludovicianus* only: abdominal, middorsal (some broods), and alar tracts only have down. It seems a quirk of evolution that general reduction of down should spare the abdominal region, the region that is absent in so many other families and that would seem to be of least necessity in heat conservation and concealing function.

STURNIDAE

The basic pterylological plan is given in figure 9.

TABLE 83

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF STURNIDAE

Region	Number	Length	Aggregate
Coronal	13	15	390
Occipital	8	15	240
Spinal	32	19	1216
Scapular	9	16	288
Femoral	16	15	480
Axillar	?	?	?
Abdominal	20	5	200
Crural	5	5	50
Rectrix	6	3	36
Primary	9	1	18
Secondary	5	10	100
Greater primary covert	?	?	?
Greater secondary covert	9	14	252
Middle secondary covert	7	7	98

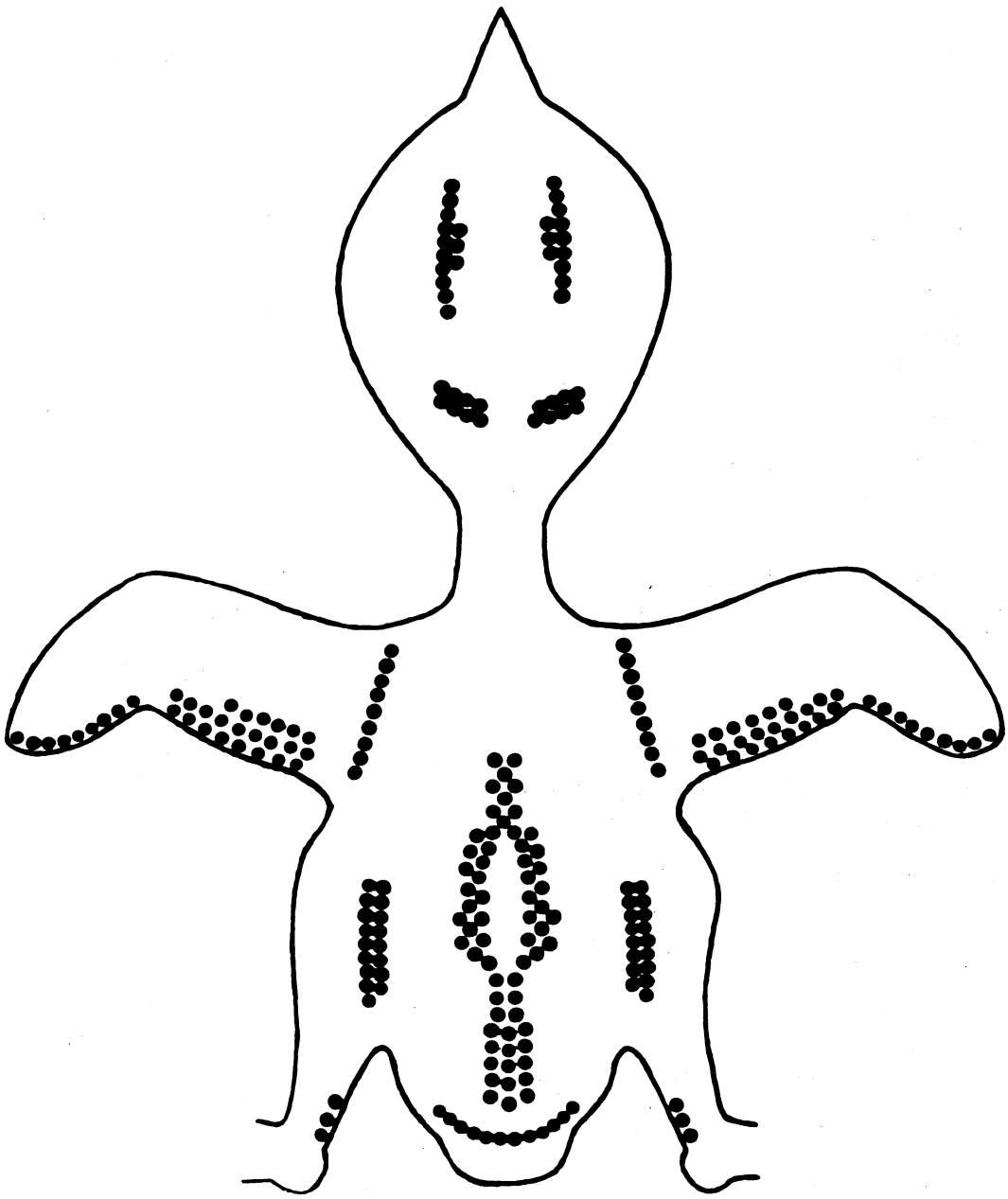


FIG. 9. Basic neossoptile pterylosis of the Sturnidae.

TAXONOMY AND ADAPTATION: The relatively darker capital tract down may have some adaptive significance. In juvenile plumages it has been suggested that light colors about the cloaca function as guide patterns for the adults in the disposal of fecal sacs as soon as they appear. If such were the functional explanation of passerine downy plumages, however, one would expect not to find the entire body down light and only the head dark. The Starling had 214 per cent of the average passerine number of neossoptiles and 356 per cent of the average down aggregate for the order. The neossoptiles were very long; for example, those of the spinal tract were 8 mm. longer than the average for the

TABLE 84

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF VIREONIDAE

Region	Number	Length	Aggregate
Ocular	6	3	36
Coronal	11	5	110
Occipital	8	6	96
Middorsal	8	6	96
Pelvic	9	6	54
Scapular	12	8	192
Femoral	11	8	176
Axillar	7	4	56
Abdominal	18	4	144
Crural	7	3	42
Rectrix	6	1	12
Greater secondary covert	9	6	108
Middle secondary covert	9	5	90
Patagial covert	? or absent	?	?

order (excluding naked species). The great down aggregate is the more unusual when one considers the present cryptic nidification of this species.

VIREONIDAE

The basic pterylological plan is given in figure 10.

DEVIATIONS FROM BASIC PLAN: *Vireo bellii*, according to Du Bois (1940), is without down.

TAXONOMY AND ADAPTATION: This species has 179 per cent of the average number and 128 per cent of the average down aggregate for the order. Down tufts of this family are relatively sparse and fragile. In the subgenus *Vireo*, *V. bellii* is apparently without down, yet *huttoni* has down (Wheelock, 1905). Figure 10, based on *Vireo olivaceus*, was prepared before I learned of its possible implications regarding the relationships between the Vireonidae and the Vireolaniidae. I concur with Wetmore (1951, p. 11) that *Vireo* (*olivaceus* at least) has a rhomboid middorsal region in the adult, yet the neossoptile middorsal region struck me as being decidedly, though narrowly, forked such as Wetmore describes for adult shrike-vireos. I would like to see my limited observations confirmed before further significance be assigned.

COEREBIDAE

No information.

PARULIDAE

The basic pterylological plan is given in figure 11.

DEVIATIONS FROM BASIC PLAN: *Icteria*, according to Saunders (MS), is without neossoptiles. The middorsal medial neossoptile found in two specimens of *Dendroica castanea* is most unusual among passerines. In cases in which data are lacking for the upper pelvic and rectrix region, it is suspected that the absence is an artifact. The lower pelvic region was absent in all five specimens of *Seiurus aurocapillus*. Middle (and perhaps greater) secondary coverts were wanting in *S. aurocapillus;* middle secondary coverts, in *D. kirtlandi*. The absence of the middle secondary coverts in *Wilsonia citrina* and *D. magnolia* is not certain. Secondaries were found only in *Seiurus* (*aurocapillus*?). Saunders (MS) records crural tract down for *D. petechia;* my four specimens did not show it. Harding (1931) records crural tracts for *D. caerulescens* (but the femoral tract was not mentioned). Pitelka (1940) records crural tracts for *D. virens*. It is evident that the material at hand is unsatisfactory for significant analysis.

TAXONOMY AND ADAPTATION: The disparity in neossoptile number and aggregate found between *Seiurus aurocapillus* and *S. noveboracensis* is inexplicable. Amadon (personal communication) suggests, however, from other sources that these birds may not

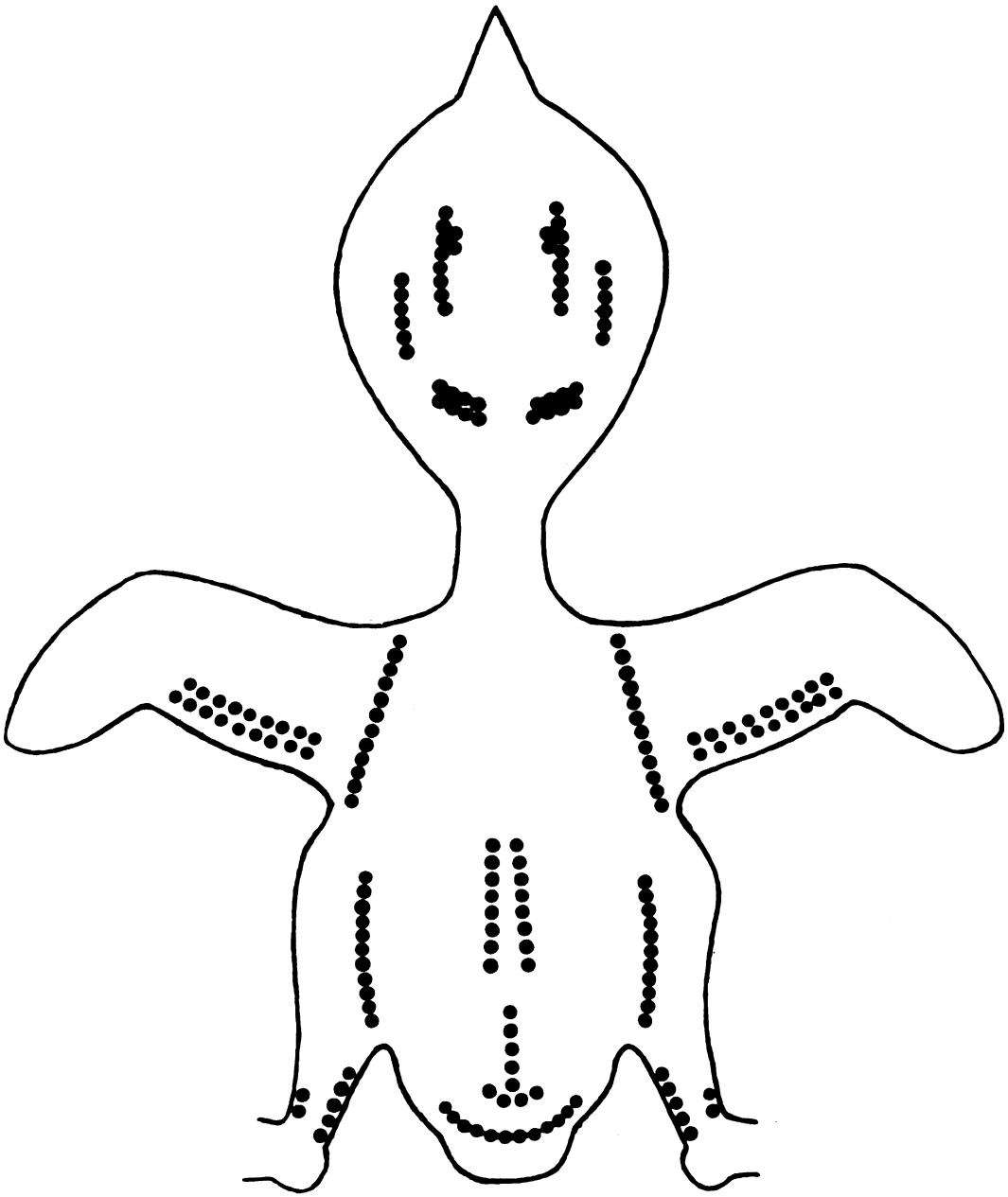


FIG. 10. Basic neossoptile pterylosis of the Vireonidae.

be so closely related as the current practice of placing them in the genus *Seiurus* would indicate. The significance of the darker coloration of the capital tract of *S. aurocapillus* is unknown. The nakedness of *Icteria virens*, an anomaly in this family, has already been commented on by Saunders (MS) and by Forbush (1929). The Parulidae examined had a reduction of the natal plumage 56 per cent of the average number and average aggregate for passerines. The family Parulidae, with its large number of closely related forms and ecological radiation, would be ideal for study of the adaptive value of natal-down differences.

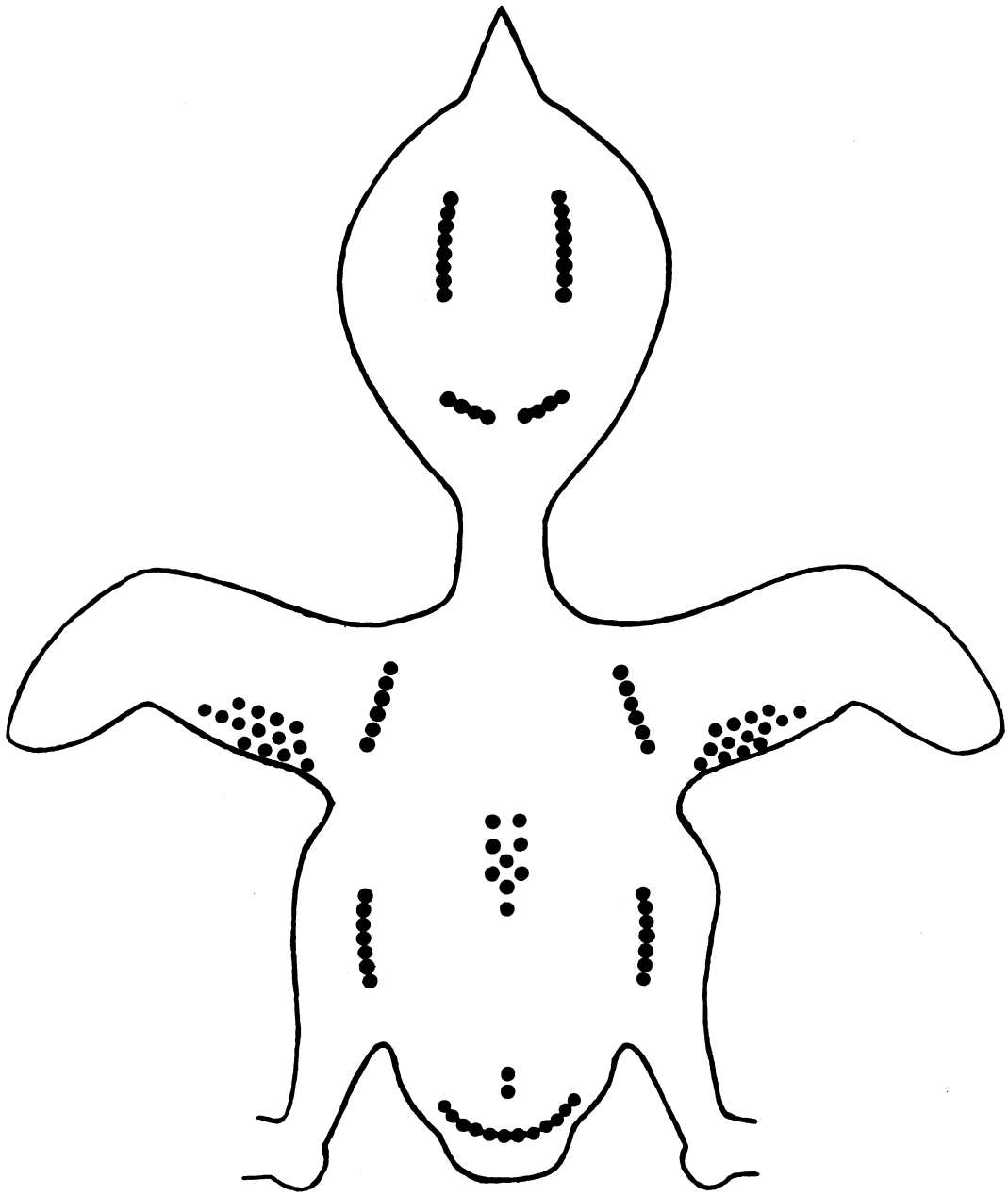


FIG. 11. Basic neossoptile pterylosis of the Parulidae.

ICTERIDAE

The basic pterylological plan is given in figure 12.

DEVIATIONS FROM BASIC PLAN: Upper rectrix coverts were found only in *Euphagus carolinus*. Secondaries were rarely found in *Agelaius phoeniceus* and *Quiscalus quiscula*. *Icterus galbula* had several wing elements not found in the other species.

TAXONOMY AND ADAPTATION: *Icterus galbula* is outstanding with its relatively great quantity of down on the alar tracts. The single secondary neossoptile of *M. ater* seems to be of diagnostic value. *Agelaius phoeniceus*, *Q. quiscula*, and *M. ater* agree quite closely.

TABLE 85

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF PARULIDAE

Region	Number	Length	Aggregate
Coronal	8	8	133
Occipital	4	9	72
Middorsal	3	8	58
Middorsal (medial)	1 or absent	7	7
Pelvic (upper)	2 or absent	8	17
Pelvic (lower)	2 or absent	4	8
Scapular	7	9	122
Femoral	7	8	105
Rectrix	5 or absent	1	10
Secondary	4 or absent	6	50
Greater secondary covert	6 or absent	6	73
Middle secondary covert	4 or absent	5	40

Average total number: 73 neossoptiles
Average total aggregate: 528 mm.

The Icteridae examined had 155 per cent of the neossoptile number and 173 per cent of the down aggregate that was the average of those of passerines. In most particulars the pterylosis of this family seems to be similar to that of the Fringillidae.

THRAUPIDAE

No information.

FRINGILLIDAE

The basic pterylological plan is given in figure 13.

TABLE 86

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF ICTERIDAE

Region	Number	Length	Aggregate
Coronal	15	9	258
Occipital	5	10	89
Middorsal	8	12	179
Pelvic	16	9	100
Scapular	10	12	230
Femoral	13	10	203
Axillar	? or absent	?	?
Abdominal	9	4	80
Crural	6	5	51
Rectrix	5	4	40
Upper rectrix covert	?	?	?
Primary	9 or absent	2	36
Secondary	5 or absent	6	68
Greater primary covert	8 or absent	5	80
Greater secondary covert	10	10	195
Middle secondary covert	8	9	140
Carpal remex covert	1	3	6
Alula	2 or absent	3	12
Alula covert	? or absent	?	?
Patagial covert	2 or absent	4	16
Tertiary	?	?	?

Average total number: 202 neossoptiles
Average total aggregate: 1638 mm.

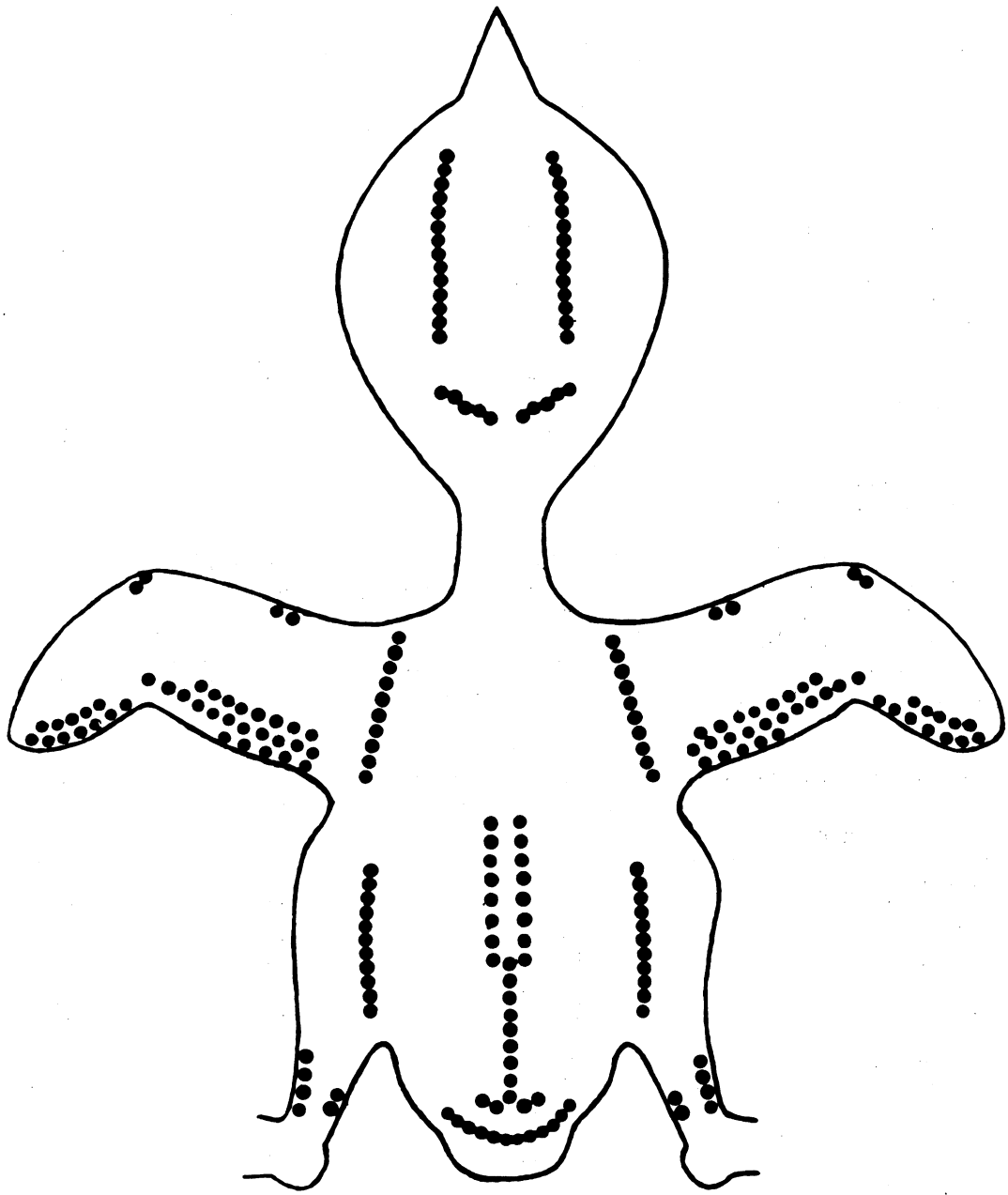


FIG. 12. Basic neossoptile pterylosis of the Icteridae.

DEVIATIONS FROM BASIC PLAN: *Pheucticus melanocephalus* was peculiar among the species examined in having upper rectrix covert down and postauricular down. The latter is a more dorsomedial region than the postauricular region of the Tyrannidae. The rectrices of *Spinus tristis* and of *Passerherbulus caudacutus*, while not recorded, may appear in larger samples. The absence of middle secondary coverts in the latter was unique among the fringillids examined.

TAXONOMY AND ADAPTATION: There are no arresting deviations between the Richmondeninae (two species), Carduelinae (one species), and Emberizinae (nine species). No judgment is justifiable here regarding the

TABLE 87

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES OF FRINGILLIDAE

Region	Number	Length	Aggregate
Ocular	3 or absent	4	23
Coronal	10	9	156
Postauricular	? or absent	?	?
Occipital	4	10	83
Middorsal	5	10	109
Pelvic	6	8	46
Scapular	7	10	130
Femoral	9	8	143
Axillar	2 or absent	5	20
Abdominal	10 or absent	4	90
Crural	4 or absent	3	25
Rectrix	6	2	20
Upper rectrix covert	? or absent	?	?
Primary	? or absent	?	?
Secondary	2 or absent	3	9
Greater primary covert	7 or absent	2	33
Greater secondary covert	9	8	146
Middle secondary covert	6	6	82
Carpal remex covert	1 or absent	4	8
Alula	1 or absent	2	4
Patagial covert	? or absent	?	?

Average total number: 136 neossoptiles
Average total aggregate: 972 mm.

TABLE 88

ANALYSIS OF 11 SPECIMENS OF *Riparia riparia*

Region	$\bar{x}$	σ^{2a}	95% Confidence $\bar{x}$	95% Confidence σ^2
Coronal	8.82	5.76	7.21, 10.43	2.81, 17.75
Occipital	5.82	1.16	5.10, 6.54	0.57, 3.58
Middorsal	8.45	2.87	7.31, 9.59	1.40, 8.85
Scapular	10.00	7.60	8.15, 11.85	3.71, 23.41
Rectrix	12.00	0.00	12.00, 12.00	0.00, 0.00
Total	45.09	30.09	41.40, 48.78	14.69, 92.67

[a] Calculation for σ^2 involved N-1 degrees of freedom.

TABLE 89

ANALYSIS OF 15 SPECIMENS OF *Telmatodytes palustris*

Region	$\bar{x}$	$\bar{x}^{2a}$	95% Confidence $\bar{x}$	95% Confidence $\bar{x}^2$
Coronal	16.40	5.11	15.15, 17.65	2.74, 12.72
Occipital	7.13	7.41	6.11, 8.15	1.83, 8.48
Middorsal	6.53	3.27	5.53, 7.53	1.75, 8.12
Pelvic	0.60	0.257	0.32, 0.88	0.14, 0.64
Total	30.67	14.67	28.55, 32.79	7.86, 36.48

[a] Calculation for σ^2 involved N-1 degrees of freedom.

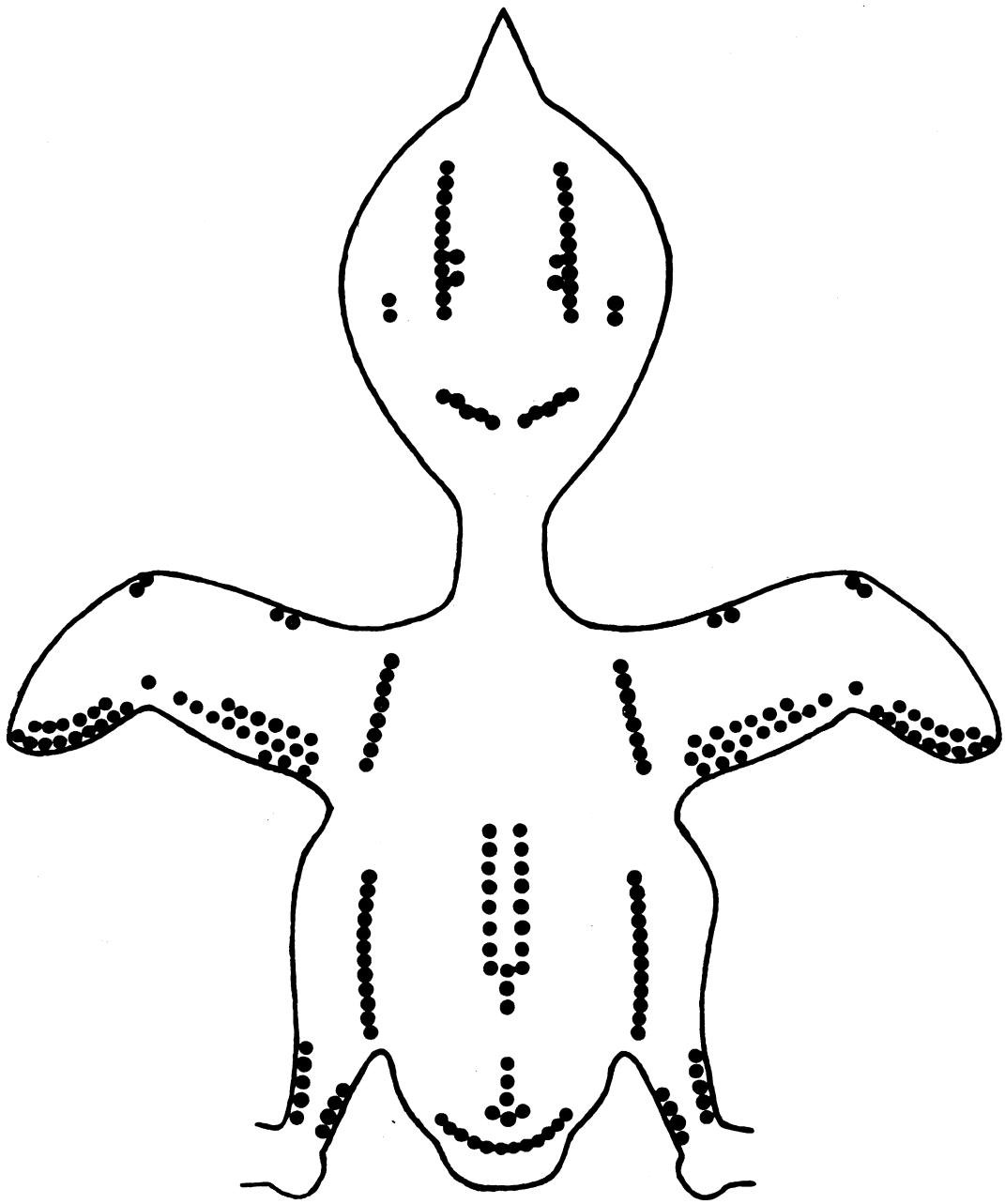


FIG. 13. Basic neossoptile pterylosis of the Fringillidae.

merits of two recent fringillid classifications—Mayr and Amadon (1951) and Tordoff (1951). The heavy natal pterylosis, especially the strong alar regions of *Spinus tristis* (considered by Tordoff to be a ploceid), is at least approached by *Spizella passerina*. Although the color of the down seemed to be of little taxonomic significance in most groups, the cardueline finches consistently had light and usually pure white natal down. The data on *Spizella* show that *passerina* and *breweri* segregate from *pallida* and *pusilla*. The differences are only quantitative except for the extent of the reduction-vulnerable alar regions. The surprising absence of the middle secondary coverts in *Passerherbulus*

caudacutus (only three specimens examined) strongly separated it from the other species. The Fringillidae have a tendency to have the pelvic region divided into upper and lower regions, while the Icteridae show no such tendency. The Fringillidae had a neossoptile number 105 per cent of the average, and a down aggregate 103 per cent of the average, for the passerines examined.

VARIATION

For only two species were the samples suitable for statistical analysis. (See tables 88 and 89).

These two species have the same degree of variability (variance not significantly different) in the three tracts common to both. The difference in means is significant (as expected) at the 5 per cent level. It would be interesting to test whether or not the social parasite *Molothrus ater* has broader variability than *Agelaius phoeniceus*. If there is no greater variation, as I believe to be the case, natal pterylosis can be demonstrated to be highly conservative in evolution.

CONCLUSIONS

A SATISFACTORY ANALYSIS of the adaptive significance of natal down must be postponed until much more information is available. Each species presents a different problem in adaptation. Even when we learn what functional relationships exist between down color, distribution, structure, temperature, illumination, and concealment our knowledge will still be deficient without detailed information on the behavior of the young and the parents and without a record of the changes in the history of nesting sites and behavior.

It is possible that remiges and rectrices in the juvenile plumages of certain passerine species may be modified in length as a consequence of having generated the neossoptiles. If such a modification exists, it is easy to overlook in passerines, because the deciduous-down structure does not leave the conspicuous notch that is typical in other orders. Taxonomic diagnoses based on wing formulas, wing lengths, tail formulas, and tail lengths bear reëxamination in the light of data on the lengths and loci of neossoptiles. Reference to such data might at least indicate in which groups discrepant measurements (if any) are to be found. In the same vein, functional consequences from neossoptile deciduousness may exist. The diminished wing surface may put a selective advantage on a juvenile pre-migratory molt or contribute to age segregation in feeding on parental territory and especially in migrations. Or the corollary might well be examined: that alar and caudal neossoptiles occur only where juvenile powers of flight are not jeopardized or compensated for in some way. It is noteworthy that long alar down, when it occurs, is usually restricted to coverts and is seldom found on the remiges themselves.

A total absence of natal plumage involves the following North American species:

Progne subis (Allen and Nice, 1952)
Cyanocitta cristata
Aphelocoma ultramarina (Gross, 1949)
Pica pica (Linsdale *in* Bent, 1946)
?Gymnorhinus cyanocephalus (Cameron, 1907)
?Psaltriparus minimus (Addicott, 1938)
Chamaea fasciata (Newberry, 1916; Erickson, 1938)
?Polioptila melanura (Woods *in* Bent, 1949)
Bombycilla cedrorum
?Vireo bellii (Du Bois, 1940)
Icteria virens (Saunders *in* Forbush, 1929; Petrides, 1938)
Passer domesticus
Passer montanus (Ticehurst, 1908)

When the myriad combinations in numbers and in loci that can exist in the deployment of neossoptiles over the body are considered, the close similarity of *Troglodytes aedon* and *Telmatodytes palustris*, both represented in the data by relatively large samples, is remarkable. That this phenomenon, duplicated in other taxa, is anything but a deep-seated genetic characteristic would seem doubtful notwithstanding the rough (but not strict) parallelism in neossoptile reduction between certain Troglodytidae, Paridae, and Sittidae.

I believe from these examinations that in bird speciation an oscillating increase and decrease of natal plumage operate, perhaps in part by passive linkage with a coenogenetic turmoil of acceleration-deacceleration in phases of specific embryonic ontogenies, yet in nice modulation itself by selective pressures; that in general the differential acceleration is reflected in the details of natal pterylosis and reveal specific affinities; and that the evolutionary oscillation operates relatively congruently within hierarchies of genetic homogeneity, in genera, in families, and in orders.

Irreversibility of down reduction has not been established as fact. If irreversibility were to be demonstrated, the value of down-reduction criteria as a tool in systematics would exceed our expectations, but there is good ground for questioning irreversibility. Neossoptiles are not independent structures in themselves; they are an embryonic expression of the feather germs which of course are not lost but are only retarded in time of development. Therefore neossoptile loss is not comparable to evolutionary loss of other structures.

The crux of the taxonomic problem is whether natal pterylosis is determined directly by genetic mechanisms or if it is determined by genetic mechanisms via the embryonic hormonal system. Hormonal ex-

TABLE 90

AVERAGE MEASUREMENTS (IN MILLIMETERS) AND COUNT OF NEOSSOPTILES BY SPECIES

Species	Number	Aggregate	Coefficient
Tyrannus tyrannus	565	3518	6.2
Muscivora forficata	478	2610	5.5
Sayornis phoebe	337	2176	6.5
Empidonax traillii	199	924	4.6
Contopus virens	320	1698	5.3
Iridoprocne bicolor	46	248	5.4
Riparia riparia	44	346	7.9
Stelgidopteryx ruficollis	46	328	7.1
Hirundo rustica	70	610	8.7
Petrochelidon pyrrhonota	72	564	7.8
Progne subis	0	0	—
Cyanocitta cristata	0	0	—
Aphelocoma ultramarina	0	0	—
Pica pica	0	0	—
Corvus brachyrhynchos	358	2824	7.9
Nucifraga columbiana	324	2300	7.1
Parus atricapillus	46	286	6.2
Parus atricristatus	22	176	8.0
Sitta pusilla	44	306	7.0
Troglodytes aedon	25	207	8.2
Telmatodytes palustris	31	224	7.2
Dumetella carolinensis	116	797	6.9
Toxostoma curvirostre	357	2322	6.5
Oreoscoptes montanus	200	1778	8.9
Turdus migratorius	134	1336	10.1
Hylocichla mustelina	60	464	7.7
Hylocichla guttata	77	988	12.9
Hylocichla ustulata	64	846	13.2
Hylocichla minima	76	820	10.8
Sialis sialis	134	824	6.1
Sialis mexicana	80	300	3.7
Sialis currucoides	146	1172	8.0
Myodestes townsendi	110	998	9.0
Bombycilla cedrorum	0	0	—
Sturnus vulgaris	278	3368	12.1
Vireo olivaceus	233	1212	5.2
Dendroica petechia	80	412	5.2
Dendroica castanea	73	531	7.3
Dendroica kirtlandii	66	441	6.7
Seiurus aurocapillus	80	590	7.3
Seiurus noveboracensis	134	1195	8.9
Wilsonia citrina	0	0	—
Passer domesticus	0	0	—
Passer montanus	0	0	—
Agelaius phoeniceus	181	1458	8.1
Icterus galbula	275	1965	7.2
Quiscalus quiscula	189	1822	9.6
Molothrus ater	164	1308	8.0
Passerina cyanea	102	600	5.9
Spiza americana	113	825	7.3
Spinus tristis	170	798	4.7
Pipilo erythrophthalmus	102	878	8.6
Passerculus sandwichensis	112	914	8.2
Amodramus savannarum	142	1076	7.5
Passerherbulus caudacutus	85	631	7.4
Pooecetes gramineus	132	1044	7.9
Junco hyemalis	106	963	9.1
Spizella passerina	243	1735	7.1
Spizella pallida	143	851	6.0
Spizella breweri	230	1386	6.0
Spizella pusilla	141	698	5.0
Zonotrichia albicollis	116	1389	11.9
Melospiza melodia	96	794	8.3

perimentation with the embryonated eggs of the naked species *Passer domesticus* would go a long way towards answering the question. The relationship of neossoptile loci to molt centers might also be profitably studied. I find no correlation between length and number of neossoptiles from species to species. This fact favors a direct, all-or-none, genetic interpretation.

If down diminution is not irreversible it must at least be closely tied up with the evolutionary trend of embryonic patterns *in toto*. I know of no other way to explain the nakedness of certain species which at the present time nest in situations in which other species apparently find natal down beneficial. Correlations between quantity of down at hatching and relative telescoping of specific ontogenies are to be expected. It would follow that in species with short nestling periods a premium is put on early initiation of feather-germ activity, and conversely that in species with long nestling periods (cavity nesting, single brooded, or species with other mechanisms of nestling safety) are gymnopaedic because of an opposite shift in embryonic sequence of hatching and feathering.

Not until the causes and consequences of shifts in developmental sequence have been illuminated by adequate studies in incubation periods, nestling development, and nesting ecology will there be much understanding of the evolutionary vectors responsible for the diversity and amplitude of passerine natal plumages.

Of the 30 regions of down pterylae recorded in passerines, five regions are conservative, appearing in most or all species with down that were examined. These are the middorsal, coronal, occipital, scapular, and femoral regions. The femoral region seems to be the least conservative of these five. The tracts or regions most often lost in evolution are the ventral, crural, ocular, and alar.

The universal condition in passerines of the bifurcation of the medial, pelvic, neossoptile region to form a biserial middorsal neossoptile region, regardless of the presence or absence of a wide ephippial apterium between these forks in the adult, may have some evolutionary significance. Either the neossoptile pteryla forking was requisite for the development of the ephippial space between, or there has been an annihilation of the ephippial space by the mesial fusing of an originally double middorsal region. The former seems less likely, for those species that have an ephippial space have the most generalized neossoptile pteryloses otherwise; those without the space have the most specialized (greatest reduction).

Intensive studies on smaller but complete taxonomic units are desirable.

SUMMARY

NATAL-DOWN PTERYLAE consist of definitely arranged rows of neossoptiles superimposed on certain presumptive contour-feather pterylae. Neossoptiles are essentially only modified downy tips of certain teleoptile feathers; thus the natal plumage is only a transitory phase of the juvenile plumage. Reduction of the natal plumage is considered to be a product of specialization, but it is here proposed that reduction is a by-product of total embryonic specialization. Complete loss of the natal plumage has occurred independently in some members of several families: Hirundinidae, Corvidae, Chamaeidae, Bombycillidae, Vireonidae, Parulidae, Ploceidae; possibly in Paridae and Sylviidae; and perhaps in others, notably Troglodytidae and Laniidae. Gradual definite reduction has resulted in generally similar natal-down pteryloses in members of any given taxonomic unit.

There is some individual variation within the species in natal plumage, usually involving the number of neossoptiles in given tracts, but rarely in the presence or absence of tracts themselves. Because of the fragility of the natal plumage, most variations observed are due to abrasion rather than to genetic differences. Observations on the colors of natal plumages show this character to be the least trustworthy for comparative analysis. Color characteristics vary considerably as a result of fading, soiling, and abrasion. Head-tract down is often darker than down elsewhere. Though post-natal growth of neossoptiles has been credited to some species my measurements seemed to indicate that the natal down completes its elongation before the time of hatching. Post-embryonic down growth might be referable to the Heinroths' "*Pelzdaunenkleid.*" The adaptive relationships (if they exist) of down color, distribution, and structure with temperature, illumination, and concealment have yet to be functionally demonstrated. There is admittedly a tendency for over-all reduction or complete disappearance of natal down correlated with enclosed types of nidification.

In domestic canaries there is probably a genetic relationship between color of teleoptiles and length of neossoptiles. The distribution of neossoptiles, their number per pteryla, and the length of neossoptiles are amenable to quantitative analysis and thus provide a needed quantitative tool for the delimitation of genera and families and for the interpretation of possible phylogenetic relationships. Deviations in direction and magnitude from the basic pterylological plan of each family should provide a quantitative measure of adaptation. In passerines, the average total number of neossoptiles per species is 130 (151 if we exclude the naked species); the average total aggregate is 945 mm. (1096 mm. if we exclude the naked species) as determined by these data. Tentative familial and generic synopses were prepared with the material at hand.

Some of the Tyrannidae had the greatest number of neossoptiles and downy regions found among the passerines, which differentiate that family clearly from all the others. A previously undescribed auricular ring in *Sayornis* was noted. Three groups of swallows were segregated similarly according to the manner of nesting. *Hirundo* and *Petrochelidon* showed allied characters. In the Corvidae there appeared a tendency for parallelism towards nakedness. The genus *Baeolophus* was indicated as possibly still usefully expressive of relationships in the Paridae. The Sittidae, Paridae, and Certhidae had a comparable degree of down reduction but are no more similar to one another in pattern than they are to the Troglodytidae or Parulidae. Desert wrens and thrashers seem to have relatively greater down aggregates than species from less arid environments. The members of the Mimidae and Turdidae that were examined were characterized generically by natal-down pteryloses. *Sturnus vulgaris*, with its large quantity of down, presented one of several exceptions to alleged correlations of nudity and cavity nesting. The Vireonidae had down of greater fragility than that of other families. Disparity in neossoptile number and aggregate between *Seiurus aurocapillus* and *S. noveboracensis* is thought provocative. The Icteridae and Fringillidae showed many similarities. *Molothrus ater*, in spite of its social parasitism, retains the typical natal-down pterylosis of its family. Cardueline finches were consistently white

downed. In *Spizella* differences of down aggregate (but not of distribution) from species to species showed interesting amplitude in a currently recognized genus.

Statistical treatment of two species showed the positive value of natal pterylosis as a tool in systematics even with small samples. A hypothesis was proposed, that natal-plumage characters are probably not so much selected for as such as they are modified passively by linkage with changing embryonic sequential patterns in evolution. Absence of correlation between length and number of neossoptiles from species to species favored a direct genetic control of neossoptiles rather than a hormonal control. Of the major pterylae the following five neossoptile regions were the most constantly present: middorsal, coronal, occipital, scapular, and femoral. Ventral, crural, rectrix, and alar tracts were lost most often in evolution. The more generalized neossoptile pteryloses of species with an adult ephippial apterium in species with specialized neossoptile pteryloses suggest that the ephippial space is a primitive character in passerines.

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