

PTERYLOGRAPHY, MOLT, AND AGE DETERMINATION OF AMERICAN  
JAYS OF THE GENUS APHELOCOMA

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The objectives of this paper are mainly to provide a basis for the study of plumages of jays of the genus *Aphelocoma* through detailed examination of pterylography, to determine the order of molt, and to ascertain, insofar as possible, the nature and extent of inter- and intra-specific differences in molt. In addition, the pterylographic data on *Aphelocoma* are offered as groundwork for comparative, phylogenetic studies of garruline genera. Although no extensive comparisons with other passerines are made, the available literature on order and extent of passerine molt has been consulted, and an attempt has been made to augment the usefulness of this paper to students of that general subject. Finally, results reported here are indispensable groundwork for revisionary studies of the genus; so far as accurate identification and description of races are concerned, basis is provided for distinguishing first-year from adult birds.

## MATERIALS AND METHODS

For the study of pterylography, clipped alcoholic specimens of *Aphelocoma coerulescens insularis*, *A. c. oocleptica*, *A. c. superciliosa*, and *A. sordida arizonae* were used. No preserved specimens of *A. unicolor* were available. Of several thousand study skins of *Aphelocoma* which I have used in revisionary studies, 1910 taken during the period of molt or before the first complete molt provide the data on sequence, time, and extent of molt. Among the species and races of *Aphelocoma*, these are distributed as follows: *A. coerulescens coerulescens*, 63, *A. c. texana*, 32, *A. c. woodhouseii*, 156, *A. c. nevadae*, 229, *A. c. superciliosa*, 275, *A. c. californica*, 187, *A. c. oocleptica*, 144, *A. c. obscura*, 181, *A. c. cactophila*, 18, *A. c. hypoleuca*, 44, *A. c. insularis*, 75, *A. c. grisea*, 6, *A. c. cyanotis*, 43, *A. c. sumichrasti*, 12, and *A. c. remota*, 20; *A. unicolor*, 64; *A. sordida arizonae*, 153, *A. s. couchii*, 57, *A. s. colimae*, 32, *A. s. wollweberi*, 42, *A. s. sieberii*, 30, and *A. s. sordida*, 47. These have enabled me to determine molt sequence and periods more extensively than has been done, to my knowledge, for any other American group of closely related species. Comparisons of order and time of molt have been made by defining, for each species, a series of arbitrary molt stages; these are based on preliminary detailed examination of races represented by the largest number of individuals. Finally, two fledglings of *A. c. oocleptica*, obtained at Berkeley, California, in late May, 1945, were reared and examined periodically through the postjuvenile molt for the purposes of preparing a time schedule of that molt and of checking the time limits of arbitrarily defined stages.

For the geographic ranges of the species and races considered here, reference should be made to the A. O. U. Check-list (1931) and to Hellmayr (1934). Changes in the systematics of *Aphelocoma* subsequent to the publication of both these works and which are recognized here are reported by the A. O. U. Check-list Committee (1944:453, 1945:445) and Pitelka (1945:23). In addition, Ridgway's (1904:330) concept of the race *obscura* is adopted here; and Swarth's (1918:413) race *oocleptica* is restricted to the San Francisco Bay region, the coastal populations from Sonoma County northward being regarded as *californica* (Pitelka, MS).

## PTERYLOGRAPHY

Detailed descriptions of the characteristic passerine arrangement of pterylae are available in the works of Nitzsch (1867), Boulton (1927), and Miller (1928, 1931).

For purposes of tentatively enumerating characteristics of corvid pterylography, the figures of *Aphelocoma* provided here should prove adequate. Detailed examinations revealed no differences between *A. coerulescens* and *A. sordida*; examination of study skins of *A. unicolor* did not reveal any differences between that species and the other two. Figures 35 and 36 are based on specimens of *A. c. insularis*.

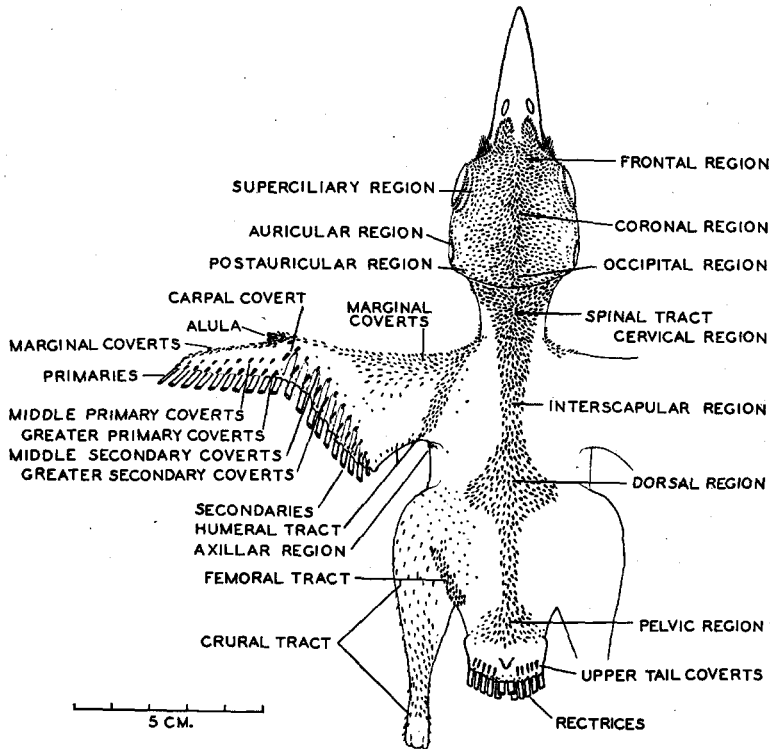


Fig. 35. Pterylography of *Aphelocoma coerulescens insularis*, dorsal view.

To my knowledge, there is no detailed account of corvid pterylography which might serve as a basis for evaluating the feather-tract pattern of *Aphelocoma*. It therefore seems appropriate to enumerate the distinctive features of *Aphelocoma* by comparing it with another comprehensively studied passerine, *Lanius* (Miller, 1931). The extent to which these features provide basis for generic differences among corvids must be left to future study. The alar tract is treated in greater detail than other tracts, and a few comparisons with *Troglodytes* (Boulton, 1927) are made.

**Capital tract.**—A frontal apterium (Miller, 1931: fig. 39) is lacking in *Aphelocoma*, although it is suggested by the median anterior indentation (fig. 35). The side of the head is more densely feathered than in *Lanius*, with a corresponding reduction in the definiteness of certain feather rows and apteria. There is no rictal apterium; the temporal apterium is present but is not distinctly outlined. The eye is surrounded by one complete circle of feathers as in *Lanius*, plus an incomplete outer circle. But one row of feathers encloses the ear opening along its posteroventral margin. The postauricular apterium is practically continuous with the lateral neck apterium.

**Spinal tract.**—The broadened dorsal and pelvic regions of the spinal tract are not so distinctly rhombic in outline as in *Lanius*.

**Caudal tract.**—There are ten fully developed upper tail coverts, those corresponding to the center pair of rectrices being reduced to small, soft feathers. The anal circling is not a simple "circling" in

*Aphelocoma*, being rather two groups of short, stiff feathers placed lateral to the anal opening and more or less enclosing the anus. The principal row of under tail coverts consists, again, of only ten feathers, those corresponding to the center pair of rectrices being absent.

*Ventral tract*.—The interrampal region does not reach the posterior margin of the lower mandible.

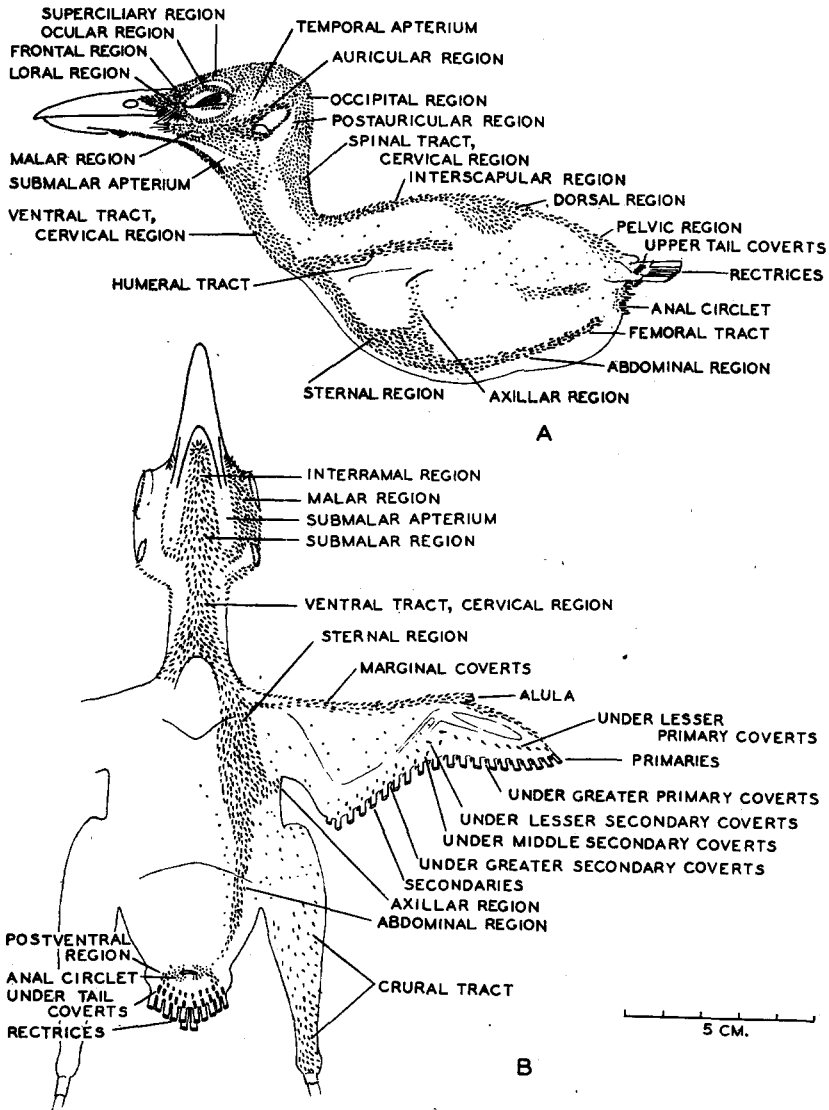


Fig. 36. Pterylography of *Aphelocoma coerulescens insularis*. A, lateral view; B, ventral view.

At the point of junction of the cervical region with the marginal coverts of the wing, there is a small, more or less triangular apterium. The sternal region is broader than in *Lanius* and is not divided posteriorly.

*Alar tract*.—The remiges total twenty (fig. 37). There is no evidence of a vestigial eleventh primary in *Aphelocoma*. The tenth secondary is short and, on the intact, folded wing, extends posteriorly eight or nine millimeters beyond the line formed by the posterior margin of the larger, distal greater secondary coverts. Actually it is smaller than most of these coverts (fig. 37). In all three species, the

tenth secondary differs from the coverts with which it might be confused by being slightly duller than the coverts; moreover, proximally, the greater coverts become smaller as do the secondaries, and the tenth covert is only about one-half the size of the larger, distal coverts. In *Lanius*, a vestigial tenth secondary occurs and corresponds to the tenth greater covert to be seen in the figure prepared by Miller (1931:127). Secondaries of corvids are of eutaxic arrangement; so far as known, this is true of all passerines (W. DeW. Miller, 1924:312).

*Aphelocoma* possesses ten greater upper primary coverts and nine middle upper primary coverts, the first (proximal) one being absent. The covert of the so-called "carpal remex" lies at the base of the first primary (Boulton, 1927:396) and is in the approximate position of the first middle primary covert (as also in *Lanius*; see Miller, 1931:fig. 39). Lesser upper primary coverts are lacking. Each of



Fig. 37. Dorsal view of left wing of *Aphelocoma coerulescens oocleptica*. Note: twenty remiges; covert of carpal remex separating series of greater primary coverts, of which only eight are evident, from greater secondary coverts; alula, middle secondary coverts, and marginals.

the ten greater upper secondary coverts is inserted at the base of and slightly proximal to the corresponding secondary. There are nine middle upper secondary coverts which, in their insertion, alternate with the greater coverts. Possibly the distalmost feather of this series, placed between the covert of the carpal remex and the first greater secondary covert, is the tenth. Distal to the latter feather is another small covert of comparable form lying posterior and medial to the innermost of the three feathers of the alula. It is not possible to distinguish lesser secondary coverts. The alular coverts form the distal terminus of the middle secondary covert series; all other feathers along the base of the alula are not distinguishable from coverts along the anterior margin.

Like *Troglodytes* (Boulton, 1927:397), *Aphelocoma* lacks middle under primary coverts. The greater under primary coverts number ten, lesser coverts nine (numbers 2-10). But the position of the first lesser covert is occupied by an outwardly directed lesser covert which represents the distal tip of the secondary series of these feathers (fig. 38). Excluding the lesser covert just mentioned, those of the under wing secondary series number nine. What appears to be a series of middle under secondary coverts consists of ten feathers in the larger *Aphelocoma c. insularis*, nine in *A. c. superciliosa* from western Stanislaus County and *A. c. oocleptica* from Alameda County, California. The distalmost of these is apparently the feather which Boulton (1927:397) identifies as the "under carpal remex covert." If, as appears to be the case, this is a feather of the series of under wing middle secondary coverts, then its correspondence to the upper covert of the carpal remex is doubtful. The suggestion that the two main series of under wing secondary coverts are lesser and middle coverts is supported by the fact that the series of greater under primary coverts continues medially, the feathers in the secondary series being considerably reduced and numbering only seven (fig. 38); those of secondaries 8, 9, and 10 are absent. In arrangement of under wing covert series, *Aphelocoma* resembles *Lanius*; however, the

series here regarded as under lesser primary coverts is termed by Miller (1931:125) under middle coverts, and under lesser and middle secondary coverts of this paper are there termed under middle and greater coverts, respectively. Although present at at least distally in *Lanius*, under greater secondary coverts of this paper are not indicated in Miller's figures (*loc. cit.*), in which the position of much reduced under greater coverts is taken by stubs of the large-sized dorsal greater secondary coverts.

As in *Lanius* (Miller, 1928:396), a series of vestigial tertiaries numbering five or six is present along the posterior, distal humeral margin. The proximalmost of these are not distinguishable from the feathers of the humeral tract proper; the distalmost has the form of a proximal greater secondary covert.

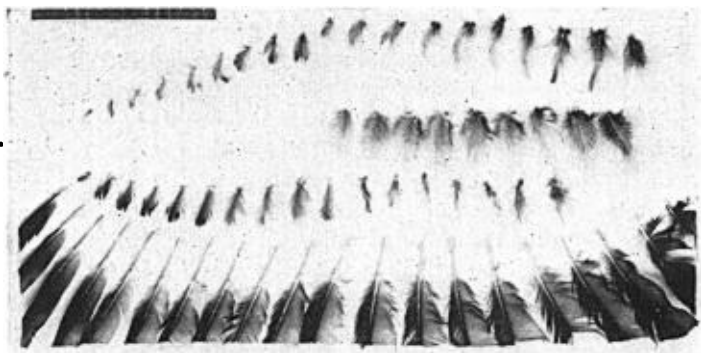


Fig. 38. Under wing coverts and remiges from the right wing of *Aphelocoma coerulescens superciliosa*, arranged to show principal series: lesser and greater primary coverts; lesser, middle, and the incomplete series of "greater" secondary coverts.

At the bases of the first primary and all secondaries except the tenth are downy feathers which remain when all remiges and coverts are removed from the forearm. A similar series of five or six feathers occurs at the base of the greater secondary coverts in the midregion of the series.

*Comparisons of Aphelocoma with other corvids.*—Nitzsch (1867:75) based his descriptions of pterylography in the "Corvinae" on *Corvus fuliginosus* [?= *Psilorhinus morio*], *C. azureus* [= *Cyanocorax caeruleus*], *C. pica* [= *Pica pica*], *C. vagabundus* [= *Dendrocitta rufa*], *Glaucopis leucoptera* [= *Platysmurus leucopterus*], and *Glaucopis varians* [= *Crypsirina varians*]. Nitzsch included in this group *Glaucopis* [= *Callaeas*] *cinerea*, one of several "crows" of the Australian region which are probably more closely related to the Sturnidae than to the Corvidae (Stonor, 1942:9). These species are said to have the saddle of the spinal tract (= dorsal region) laterally acute-angled, enclosing an elongated, fissure-like space. *Aphelocoma* differs in that the saddle is not acute-angled; this, however, is not a surprising difference and may be one separating genera. But variation among corvids in this respect is probably more extensive than suggested by the departure of *Aphelocoma*, as in *Corvus*, the dilatation of the spinal tract is only slight and definitely not acute-angled. *Aphelocoma* differs also in the absence of a fissure-like space in the dorsal region. This departure of *Aphelocoma* is a more intriguing one, as it is an example of the type of difference existing between major passerine groups, let alone related genera. The apterium is absent in *Cyanocitta*, and in *Kitta* [= *Cissa*], which last is listed by Nitzsch (1867:76) under the Paradisidae and is figured by him. But in *Corvus*, a middorsal apterium as described by him is present. It is not possible to determine with certainty the presence or absence of this apterium from study skins, and Nitzsch's contention with respect to *Cyanocorax*, perhaps the closest relative of *Aphelocoma* among the genera mentioned by him, can be confirmed or rejected only

by examination of preserved specimens. At any rate, here is an intrafamilial difference whose significance along with others mentioned in this account needs to be established by comparative study of corvid genera. At this time, it is possible only to say that among Palearctic as well as Nearctic jays a middorsal apterium may or may not occur; it does not occur in *Aphelocoma* and *Cyanocitta*.

Nitzsch further stated that in the "Corvinae," the dilatation of the pectoral band is separated from the main stem for a considerable distance. Figure 36 shows this not to be the case in *Aphelocoma*, in which the dilatation is broad, but obtuse-angled posteriorly, with a lateral branch under and behind the wing. The validity of Nitzsch's statements can, of course, be established by study of preserved specimens of the forms he mentions. Some misidentifications, however, may be involved. "*Corvus fuliginosus*" is not listed by Sharp (1877) nor Ridgway (1904), although both of these authorities list "*Pica fuliginosa*" as a synonym of *Psilorhinus morio*. Meinertzhagen (1926:113) does not list *fuliginosus* among names applied to the genus *Corvus*.

According to Nitzsch (1867:75), the "Corvinae" possess "nineteen, and in rare instances twenty remiges, of which ten are on the hand." In one instance, *Platysmurus*, Nitzsch found only eighteen remiges (and only ten rectrices). Among American jays, twenty is apparently the characteristic number of remiges. I have examined study skins of all genera except *Uroleuca*. Among Palearctic genera, some of which occur also in North America, twenty remiges have been found in specimens of *Corvus*, *Cissa*, *Urocissa*, *Dendrocitta*, *Pica*, and *Nucifraga*; *Platysmurus*, Nitzsch notwithstanding, and *Perisoreus*, *Garrulus*, and *Cyanopica* appear to have nineteen, but if the tenth secondary is markedly reduced, its presence in these forms cannot be determined safely from study skins. At any rate, it is evident that twenty remiges are a common and probably characteristic number among corvids.

#### POSTJUVENAL MOLT

As reported for corvids in general by Dwight (1900:152), the postjuvenal or first fall molt is always partial. All body feathers are replaced; rectrices are retained; most and usually all of the remiges are retained; but the degree of replacement of wing coverts is highly variable. Some of Dwight's generalizations with respect to wing molt are incorrect. In *Corvus*, for instance, the postjuvenal molt does not always involve all wing coverts; Witherby (1913:135) describes this molt more correctly, if a generalization is to be made, when he states that it does not involve, in *Corvus frugilegus*, "the remiges, bastard-wing, [greater] primary coverts, majority of greater [secondary] coverts . . . and rectrices." (See also Emlen, 1936:100.) Likewise, in *Aphelocoma*, in general, the feathers of the alula, greater primary coverts, a variable number of greater secondary coverts, remiges, and rectrices are retained through the postjuvenal molt. There are, however, notable exceptions involving significant interspecific as well as intraspecific differences, chiefly in molt of wing coverts.

*Inception of molt.*—Examination of juvenal specimens of *Aphelocoma* might at first cause one to suspect early inception of the postjuvenal molt for two reasons. First, near the time of departure from the nest and for a period of two or three weeks afterward, active growth of marginal feathers of the wing occurs; new marginals may be seen to be breaking sheaths even after departure from the nest. But these marginals are blue, not dull bluish brown, the color of the juvenal middle secondary coverts and the distalmost marginals. Whether this growth follows a limited molt or not cannot be said at this time; it is necessary to observe developing nestlings to settle the point. But the growth stages observed on study skins and on living birds obtained at the time of departure from the nest would indicate that these coverts represent part of the develop-

ing juvenal plumage whose emergence has been delayed until the growth of the arm has declined and until the patagial membrane is grown. At this time the downy, small brown feathers of the arm margin are overlain and possibly replaced by the blue coverts. All the marginal coverts are subsequently replaced. Thus, whether an abbreviated molt occurs at the time of departure from the nest or not, the fact remains that growth of marginals is then active on the anterior portion of the dorsal patagial surface, which is otherwise naked. Subsequently, new supramarginals emerge posteriorly and medially.

The second reason for suspecting early inception of molt concerns the occurrence of blue feathers on areas normally brown before the postjuvenal molt. In the juvenal plumage, the greater coverts, remiges, and rectrices are of a blue approaching that of the adult plumage; all other dark areas are gray-brown. If, at the time the blue marginal coverts emerge, any juvenal feathers of the areas to become blue in subsequent molts are lost, they, too, are replaced by blue feathers. Thus, scattered blue feathers on head,

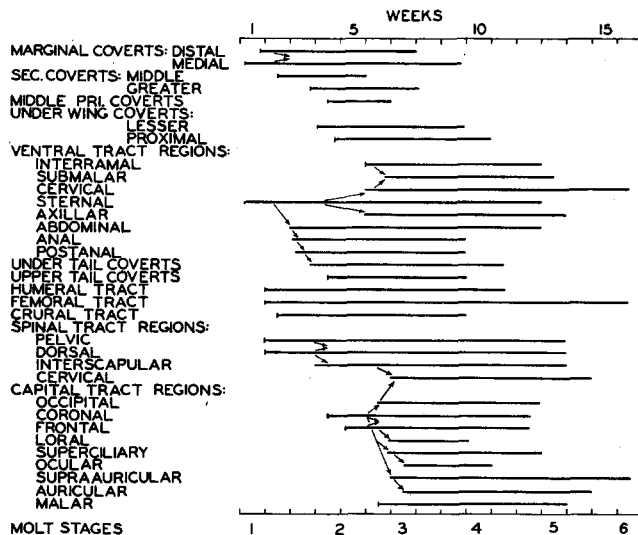


Fig. 39. Time chart of the postjuvenal molt of two caged individuals of *Aphelocoma coerulescens oocleptica*. Order of inception of molt at different loci shown by relative position of those black lines which begin at the left with a short vertical line. Spread of molt to other parts of the body shown by small arrows. Time scale shown along top margin; relation of molt stages defined in table 1 to molt of caged birds shown along bottom margin.

neck, or collar areas occur occasionally which are suggestive of the postjuvenal molt, but which actually represent adventitious replacement. At any rate, these observations are evidence of a significant step in developmental physiology: The mechanism of pigment deposition is altered so that blue coloration appears in body feathers developed well before the beginning of the postjuvenal molt.

At the time of departure from the nest, under wing coverts are still lacking. They emerge within the first week afterward and complete their growth in two to three weeks. In spite of the delay in their appearance, some replacement, at least, occurs during the postjuvenal molt (fig. 39).

Subsequent to events described above, there is no evidence of feather loss or growth for a period of two to three weeks. In the case of two jays which left a nest at Berkeley on May 10 and 11, 1945, respectively, loss of feathers marking the beginning of the postjuvinal molt occurred on June 15. Thus, the postjuvinal molt began about five weeks after departure from the nest.

*Molt stages.*—In spite of individual variation, the order of feather replacement is generally consistent. Examination of large series of study skins of Californian races of *A. coerulescens* has enabled me to define six arbitrary stages (table 1) in terms of

Table 1  
Arbitrary Stages of the Postjuvinal Molt in *Aphelocoma coerulescens*

Ventral tract	Alar tract	Capital tract, dorsally	Capital tract, laterally	Spinal tract	Tail coverts
1 <sup>1</sup> Feathers of sternal region breaking sheaths	Marginal feathers partially grown				
2 Sternal region re-feathered <sup>2</sup> ; molt progressing anteriorly and posteriorly	Middle sec. cov. well grown; gr. sec. cov. breaking sheaths	Partially refeathered	Feathers breaking sheaths on malar region	Scattered new feathers evident	Breaking sheaths
3 Middle of throat re-feathered; old feathers on sides of throat and neck	Gr. sec. cov. about half grown	More than half refeathered	Feathers breaking sheaths also on auricular area; old feathers on sides of head	Patchwork of new and old feathers	Partially grown; some old feathers still present
4 Some juvenal feathers on abdomen; those of lower throat partially grown	Gr. sec. cov. well grown	Refeathered	Old and partially grown new feathers mixed	A few scattered juvenal feathers	Well grown
5 Growth of ventral tract incomplete	Fully grown	Scattered feathers of lateral occipital region not fully grown	Active growth of new feathers	Scattered feathers incompletely grown	Growth complete
6 Scattered feathers of interramal and lateral throat areas partially grown.		Growth complete	Few feathers partially grown	Growth complete	

<sup>1</sup> Stage number.

<sup>2</sup> New feathers predominant superficially and well grown, but sheathed basally.

which molt can be timed and compared between different geographic areas. As defined in table 1, these stages are applicable to all western North American races of *A. coerulescens*; too few specimens were available to test their applicability to Floridan and Mexican races. In table 1, and similar ones beyond, no attempt is made to include more than key evidences of molt. It may be added that throughout this study each specimen undergoing molt was judged in terms of the series of characters given for each stage. Although but six stages are defined for the postjuvinal molt, the assignment of combined numbers, as "2-3" to indicate intermediacy, increased the usable number of molt stages to 11. The data obtained by this method were compiled by plotting the molt stages of individual specimens against time (fig. 40).

*Period of molt.*—Within the range of *A. c. oocleptica*, the time during which individual birds at any given stage of molt may be found totals about two months. This is shown in figure 40B, which represents the combined data for *oocleptica* and south-coast *californica* between which no difference in molt was evident. (By south-coast *californica* is meant the coastal population from Santa Barbara County northward to the San Francisco Bay region where *oocleptica* occurs.)

It may be estimated from figure 40B that the postjuvinal molt occupies a period



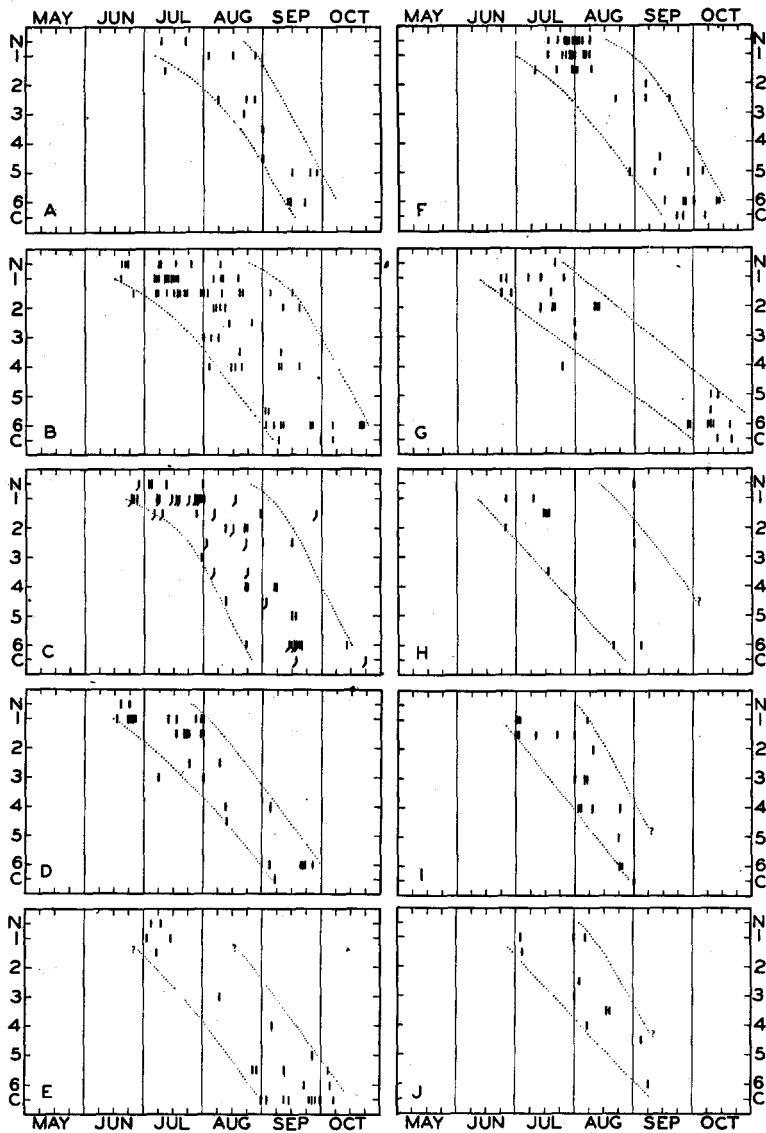


Fig. 40. Period of the postjuvinal molt in different races of *Aphelocoma coerulescens* in western North America. Molt stages are described in table 1; N, no signs of molt; C, molt completed. A, north-coast *californica* (Sonoma and Napa counties north to Del Norte and Curry counties); B, *oocleptica* (San Francisco Bay region) and south-coast *californica* (Santa Barbara County north to San Mateo and Santa Clara counties); C, *obscura* (northern Lower California north to Los Angeles County), each female indicated by a small hook at lower end of vertical line; D, northern *nevadae* (western Utah, Nevada, eastern California); E, southern *nevadae* (southeastern California, Arizona); F, northern *superciliosa* (south-central Oregon, northern California); G, southern *superciliosa* (San Joaquin Valley, adjoining foothills, east slopes of southern Sierra Nevada); H, *insularis*; I, northern *woodhouseii* (Colorado, eastern Utah); J, southern *woodhouseii* (New Mexico, extreme western Texas).

of two and one-half months. This period is shorter than that obtained by observations of two caged birds obtained at the time of departure from the nest. In these the total time was approximately fifteen weeks, or slightly more than three months. The difference is probably to be explained in part at least by the fact that the caged birds suffered irregular loss of scattered remiges or rectrices during the course of the postjuvénal molt; their replacement may have slowed down the whole process. In other respects, however, the molt of the caged birds appeared normal and followed closely the sequence established by study of skins. Part of the data obtained from the study of the caged birds is condensed into figure 39, which serves to show the period during which replacement occurs in the main pterygiae and the order in which molt begins at different, spatially independent points (see beyond). In figure 39, numbers for the stages of the postjuvénal molt are placed in as nearly correct position as possible in relation to the criteria of the individual stages, as given in table 6, and to the chronological evidence provided by the study of caged birds. It would appear that the six arbitrarily defined stages represent more or less equivalent time periods and that the major discrepancies between table 6 and this chart are due to the protraction of the molt process in the caged birds.

Although the plotting of the postjuvénal molt period for *oolectica* and other populations initially involving separation of males and females, no difference was found between them. Thus, in figure 40, all graphs are based on combined data from the two sexes; in one, however, that for the race *obscura* (C), sex of the individual specimens is shown.

*Molt loci*.—Molt begins at a number of different points or loci and spreads from them in a characteristic manner. Inception of molt at these loci is independent of other loci in space, but not in time. The order of activation of these loci in Californian races of *A. coerulescens* is shown in figure 39. Most molt loci in *Aphelocoma*, and this is probably true in passerines generally, are characteristic of all individuals of a particular population or race and, with some exceptions noted below, of the species. From any given locus, molt progresses linearly (that is, in the main axis of the tract) more rapidly than it does laterally. Evidence of asymmetry in progress as well as extent of the postjuvénal molt is negligible and not significant. The following molt loci, based on evidence from study skins as well as from living birds, are recognized for *A. coerulescens*:

(1) Sternal region (see fig. 36).—Molt progresses from here anteriorly and posteriorly, but this progress is not comparable in rate in both directions: Posteriorly, new growth appears along the length of the ventral tract within two weeks of inception of molt on the sternal region. Replacement of the under tail coverts occurs after molt has progressed along the ventral tract to the anal and post-anal areas and begins about two and one-half weeks after that of the sternal region. Anteriorly, replacement progresses slowly for about four weeks; when it is accelerated, simultaneously growth begins at locus 2.

(2) Interramal region.—Growth progresses posteriorly, and within a week replacement along the throat is continuous.

(3) Medial marginal coverts.—Molt begins near the outer margin of the dorsal patagial surface usually at the same time as that of the sternal region, or a few days before the latter. Replacement proceeds medially and distally, but most rapidly posteriorly; it does not proceed ventrally along the anterior margin of the patagium. Subsequently a junction takes place between growth from this locus and that from a more distal one, locus 4.

(4) Distal marginal coverts.—Molt begins on the anteroventral margin of the metacarpal segment and proceeds first distally and dorsally and later proximally. Progress of molt from this locus is slowest proximally. The under wing marginal coverts, except the most proximal ones, are replaced in the course of molt issuing from either locus 3 or locus 4.

(5) Proximal under wing marginal coverts.—Replacement begins on the ventral patagial surface about three weeks after that of marginals at locus 4 has begun. From locus 5, molt spreads over the under wing area and, after slightly more than a week, it proceeds anteriorly and distally toward the alula, where active growth is in progress.

(6) Humeral tract. (7) Femoral tract.—Replacement begins in the mid-regions of these two tracts at approximately the same time and proceeds anteriorly and posteriorly.

(8) Proximal crural tract. (9) Distal crural tract.—Two loci are evident on the crural tract: a proximal one on the anterior face of the crus, and a distal one at the tarsal joint. Molt at the proximal center may begin before that of the distal one; or it may begin at both more or less simultaneously. Growth proceeds distally and proximally, but most rapidly distally. The last feathers to be replaced are those on the proximomedial surface of the shank.

(10) Middle secondary coverts.—Replacement of the middle secondary coverts begins soon after that of the marginals. There is considerable irregularity in this replacement; molt may proceed distally or proximally, or in both directions. In most instances, the majority of the coverts emerge more or less simultaneously.

(11) Greater secondary coverts.—When the middle secondary coverts are almost fully grown, or approximately ten days after their emergence, replacement of the greater secondary coverts begins. It is more regular than that of the middle coverts. Two loci are recognizable, a distal one and a proximal one, usually at covert 8, from which molt proceeds to 7 and to 9 and 10. This sequence is often, but not always, evident in the complete molt (see beyond) and corresponds to that of the proximal secondaries in the latter molt. The proximal locus may be obscured soon after replacement begins by the rapid replacement of coverts distal to 8. Nine and 10 are replaced at longer intervals; the juvenal tenth may still be present three weeks after replacement of distal coverts has begun. When distal coverts are retained, replacement begins at 8 or 9 and may involve no more than one or the other of these coverts; a variable number of neighboring coverts may be replaced, but when the proximal coverts of any first-year specimen are old and one or more distal ones are replaced, then in almost all such instances adventitious replacement has occurred.

(12) Upper tail coverts.—Replacement of upper tail coverts does not bear a sequence relationship to the spinal tract; such a relationship is observed between the under tail coverts and the ventral tract. In the former instance the oil gland separates coverts from the pelvic region. Molt begins less than a week after that of the under tail coverts, more than two weeks after that of the pelvic region. Replacement proceeds medially, the lateralmost feathers being lost first; this is also true of the under tail coverts.

(13) Middle primary coverts.—Replacement of these feathers is variable as it is in the corresponding secondary coverts; it begins about two weeks after that of the latter.

(14) Lesser under wing coverts.—In one of two caged birds observed through the postjuvénal molt, replacement of this series began along the middle and proximal portions more or less simultaneously, thence proceeding distally. In the other individual, only the outer half of the series was replaced. All other under wing coverts, exclusive of the marginals, were retained.

(15) Postcoronal area.—On the head, molt begins near the midline between the ears, or in what may be termed the postcoronal area. Replacement radiates from this locus, progressing most rapidly anteriorly and most slowly laterally. In the latter direction, molt spreads to the superciliary and supra-auricular regions, thence to the ocular and auricular areas. A subsidiary, postauricular locus was observed on one caged bird; this was soon obliterated by the advance of molt from the top of the head laterally and posteriorly. The advance of molt from the postcoronal locus is met anteriorly by that from the frontal area.

(16) Frontal region.—Within the first week after the beginning of molt on the postcoronal area, replacement begins just behind the upper mandible and proceeds most rapidly posteriorly; it proceeds laterally to the rectal bristles and loreal feathers, by which time the entire side of the head is undergoing active molt.

(17) Malar region.—Replacement begins lateral to the rami of the lower mandible at about the time growth of new feathers spreads laterally both along the midventral line and along the sides of the crown.

(18) Dorsal region. (19) Pelvic region.—Replacement begins at these two loci more or less simultaneously. It proceeds anteriorly and posteriorly from both centers, meeting between these two centers when the anterior line of advance is in the interscapular region. By the time this line of advance reaches the cervical region, it is met by that from the postcoronal area about five weeks after the inception of molt along the spinal tract. The last juvenal feathers to be dropped are those of the lateral neck region, both dorsally and ventrally.

#### GEOGRAPHIC VARIATION IN POSTJUVENAL MOLT

*Molt of greater secondary coverts.*—In all races of *A. coerulescens*, there is at least a partial replacement of greater secondary coverts during the postjuvénal molt (table 2).



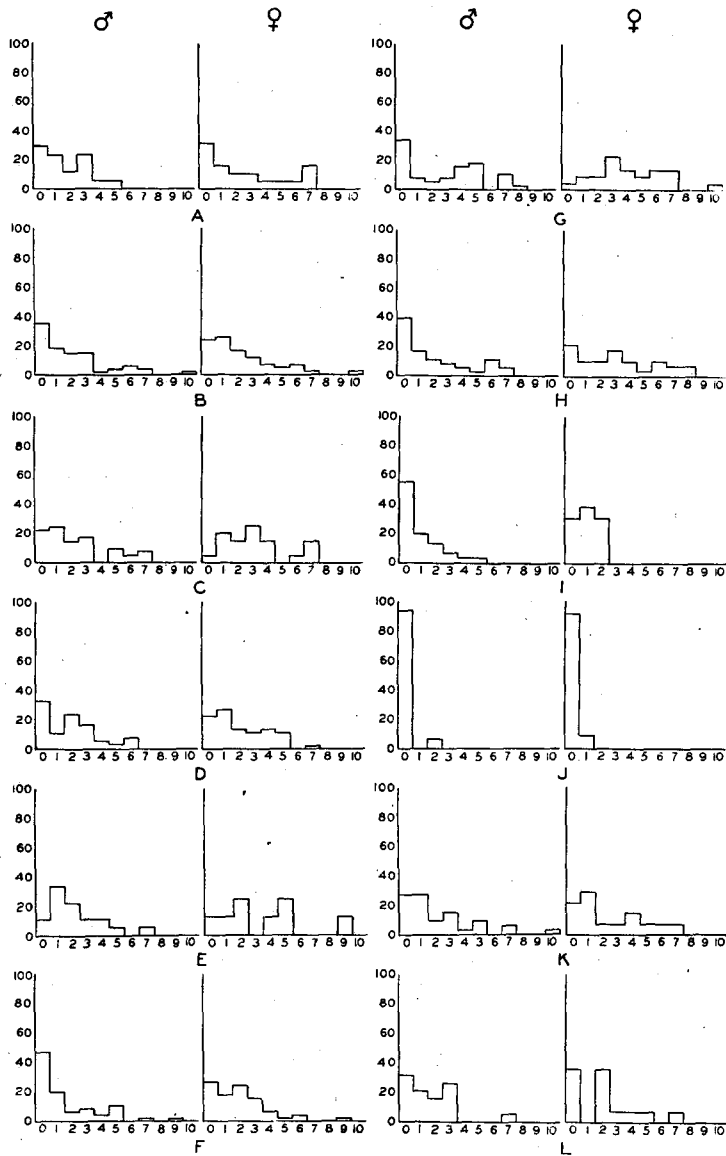


Fig. 41. Geographic variation in the number of juvenal greater secondary coverts retained during the postjuvinal molt of *Aphelocoma coerulescens*. Height of columns indicates percentage of population retaining number of coverts specified at the bases of columns. Data given in table 2. See legend of figure 40 for explanations of geographic groups. A, north-coast *californica*; B, *oocleptica*; C, south-coast *californica*; D, *obscura*; E, northern *nevadae*; F, southern *nevadae*; G, northern *superciliosa*; H, southern *superciliosa*; I, *insularis*; J, *hypoleuca* and *cactophila*; K, northern *woodhouseii*; L, southern *woodhouseii*.

ences are of historical derivation and, at present at least, non-adaptive should not be overlooked.

When the average number of coverts retained is compared between sexes of indi-

vidual populations or races (table 2), it is seen that if a difference exists, females retain the higher number. On the basis of the twelve instances in which a difference exists, the chance that the number retained by females would be higher in all of them in a random distribution may be calculated as less than one in one thousand.

Moreover, there is a tendency for the disparity between the two sexes to be greater when the average number of coverts retained is higher. This can be shown best by calcu-

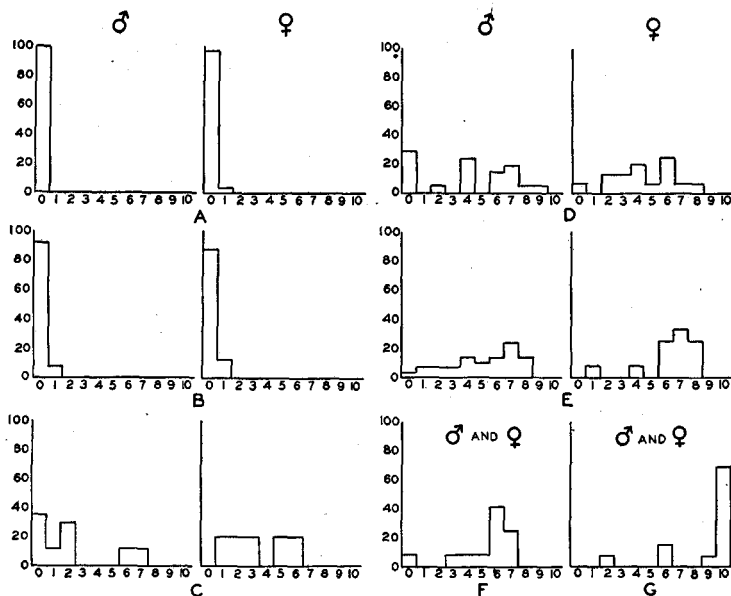


Fig. 42. Geographic variation in the number of juvenal greater secondary coverts retained during the postjuvinal molt of two species of *Aphelocoma*. See legend of figure 41 for explanation. A, *A. coeruleus coeruleus* (Florida); B, *A. c. texana* (west-central Texas); C, *A. c. cyanotis* (northeastern Mexico); D, *A. sordida couchii* and *A. s. sordida*, part (see table 5); E, *A. s. arizonae*; F, *A. s. wollweberi*; G, *A. s. colimae*, *A. s. sieberii*, and *A. s. sordida*, part.

lating the average number retained by males as per cent of the average number retained by females and then plotting these percentages against the respective common average value (male average + female average  $\div$  2). The results of these calculations for each of the first fifteen populations listed in table 2 are plotted in figure 43. This evidence would indicate that when molt of the coverts is usually incomplete in any given race, males replace more coverts than females; furthermore, the less extensive the molt for the race, the greater the difference between the sexes.

Occurrence of asymmetry in replacement of greater secondary coverts not due to adventitious molt is rare. Practically all true instances involve a difference of one in the totals of coverts replaced on the two sides. This asymmetry was not seen in more than one or two per cent of the total number of individuals studied (table 2). The number recorded for all these individuals was arbitrarily the higher one.

*Molt of rectrices and wing feathers other than greater secondary coverts.*—Although other feathers normally retained through the postjuvinal molt may be replaced, such replacement is clearly adventitious as evidence of it is rare, scattered, and frequently

limited to one or several feathers. This is true of all races except *hypoleuca* and *cactophila*, in which the postjuvinal molt may involve the proximal four secondaries, the alula, greater primary coverts, and remiges (table 3). Molt of any of these series may be partial or complete. Molt of the secondaries is comparable to that of adults: the order of replacement is 8-9-10 and 7; when replacement is partial, the replaced feathers still

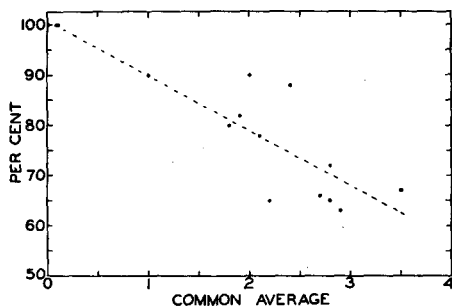


Fig. 43. Comparison between males and females of average numbers of greater secondary coverts retained during the postjuvinal molt. Dots represent number retained by males expressed as per cent of number retained by females in each of fifteen populations of *Aphelocoma coerulescens* (see text, page 242; also table 2).

fit this order. There is no evidence of correlation in the degree to which inner secondaries, alula, and greater primary coverts are replaced, except that in those individuals which show at least partial replacement of greater primary coverts, the alula is completely replaced. The degree to which replacement of any of these feathers occurs in races other than *cactophila* and *hypoleuca* never exceeds four per cent and usually falls below two per cent of all individuals. In the latter instances, there is no evidence that the replacement is anything but adventitious.

Table 3

Replacement of Certain Alar Feathers and Rectrices in 41 First-year Specimens of  
*A. c. hypoleuca* and *A. c. cactophila*

	Complete replacement	Partial replacement	Total	Per cent
Secondaries 7-10	8	4	12	29
Greater primary coverts	1	3	4	10
Alula	7	4	11	27
Rectrices	3	4	7	18

*Period of molt.*—Comparison of the period of postjuvinal molt in different populations may be made by study of figure 40. The beginning of the molt period of south-coast *californica* and *oocleptica* (B) is comparable to that of *obscura* (C), but molt would appear to be completed sooner in the latter race. In north-coast *californica* (A), molt is later, and this is probably true even though the number of specimens involved is not great. A comparable difference is observed inland between northern and southern divisions of *superciliosa* (F, G, respectively); in the former, the molt is not only later, but proceeds more rapidly. In *insularis* (H), the few specimens are scattered rather widely on the time chart; as the data are limited, this is not necessarily to be interpreted as an indication of considerable variability in breeding period, since the late records might represent young of first-year, late-breeding birds. Differences between southern and northern divisions of *nevadae* (D, E) and *woodhouseii* (I, J) are obscure. There

is some evidence that molt proceeds more rapidly in *woodhouseii*. It would appear that in these last four instances, the similarity of the molt period (and, presumably, of the breeding period as well) is related to the marked seasonal periodicity of the climate (Great Basin and Rocky Mountain areas) which is particularly noteworthy for the ranges of these races when the latter are compared with birds of more coastal or southern distribution.

Data on races other than those considered above are limited. In *A. c. coerulescens*, *texana*, and *cyanotis*, molt apparently begins in June or July and is completed in late September or early October. In *hypoleuca* and *cactophila*, it begins earlier, in May or June, and proceeds slowly (see fig. 46A), probably occupying a period of at least four months. In *remota* and *sumichrasti*, the molt period is again long, beginning in June or July and ending in October or November, or, in some instances, even later. One specimen of the latter race (BS-144739) taken in Oaxaca on December 8, 1894, was not midway through the molt yet when collected!

*Other evidence of geographic variation.*—In *texana*, *woodhouseii*, *nevadae*, *hypoleuca*, and *cactophila*, the frontal molt locus may become active at the same time as, or sooner than, the postcoronal locus; in a few individuals of *woodhouseii* and *nevadae*, molt begins over the entire coronal area and spreads without evidence of two separate loci. In the Guerreran race *remota*, head molt is apparently retarded over that of the remaining parts of the body; in each of three specimens undergoing postjuvenile molt, the only ones available to me, the head is one full stage behind the body and wings in advance of molt. In two specimens of *sumichrasti* from Oaxaca and Puebla, respectively, however, this is not the case.

*Discussion.*—Parallel evidence of geographic variation in the postjuvenile molt of another passerine is provided by Miller's work (1931) on *Lanius* and adds significance to the findings reported here. In more northern populations of two or three races of *Lanius ludovicianus* ranging into southern Canada, replacement of coverts is partial; it is complete, or almost so, in remaining races (Miller, 1931:138). In *Lanius excubitor*, a northern species, replacement of greater secondary coverts is considerably less extensive than in any race of *L. ludovicianus*. Miller (*loc. cit.*) found partial replacement of greater primary coverts to occur in the Lower Californian race *grinnelli*, but not in any other. This was found true of the Lower Californian races of jays, *cactophila* and *hypoleuca*. In only these two races of jays does replacement of any remiges occur during the postjuvenile molt. Again in *L. l. grinnelli*, replacement of secondaries and primaries is more extensive than in other races of shrikes. The period of molt in *L. l. grinnelli* and another Lower Californian race, *nelsoni*, is more extended than in more northern races; the same is true of *A. c. cactophila* and *hypoleuca*.

#### COMPLETE MOLT

The second and all subsequent fall molts of corvids are typically complete molts. For purposes of comparison, eight arbitrary stages, based on Californian mainland races, have been defined (table 4). The first two involve initial steps in the replacement of remiges and rectrices, stages which are absent in the postjuvenile molt. The remaining six stages, in most respects, are comparable to those of the postjuvenile molt. In table 4, greater primary coverts are not mentioned; their replacement closely follows that of the primaries. Middle primary coverts are hidden on study skins by other, larger feathers, chiefly those of the alula.

Primaries 1-3 and their greater coverts are dropped in sequence and replacing feathers are at least partially grown before loss of any other feathers occurs. After molt of the primaries has begun, that of the coverts progresses more rapidly; the latter are all replaced with at least partially grown



Table 4

Arbitrary Stages of the Complete Molt in *Aphelocoma coerulescens*

Stage number	1	2	3	4
Primaries	1, 2 dropped; or breaking sheaths	1-2-3 full grown or almost so; 5-10 old	1-4 fully grown; 6- or 7-10 old	7- or 8-10 old
Secondaries		Old feathers intact; or 8 dropped	8 fully grown; 9, 7 breaking sheaths; 1 dropped; 10 old	7 half grown; 3-6 old; 1-2 partly grown
Greater secondary coverts		Dropped or breaking sheaths	Well grown	Growth complete
Middle secondary coverts		Old	Breaking sheaths	Partly grown
Alula				Old or dropped
Rectrices	Old	1-1 pin feathers to $\frac{1}{3}$ grown	1-1 half grown; 2-2 dropped; others old	1-1 fully grown; 6-6 old; 2-2, 3-3 partly grown
Capital tract, dorsally		Old	Old	Feathers breaking sheaths on frontal and postcoronal areas
Spinal tract		Old	Feathers breaking sheaths	Superficial feathers old; many breaking sheaths or partly grown
Tail coverts		Old	New laterally, old medially	Half grown
Ventral tract		Old	Feathers breaking sheaths on sternal region	Sternal region refeathered; old feathers on throat

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Stage number	5	6	7	8
Primaries	10 old	10 new, short		
Secondaries	7, 9 fully grown; 4-6 old; 10 well grown	6 old, or breaking sheath; 10 fully grown	6 partly grown	6 fully grown
Middle secondary coverts	Well grown	Growth complete		
Alula	Breaking sheaths	Partly grown	Well grown	Growth complete
Rectrices	3 pairs fully grown	6 6 half grown	6-6 fully grown	
Capital tract, dorsally	Frontal and postcoronal areas refeathered	Entire crown refeathered		
Capital tract, laterally	Old feathers on auricular area and sides of neck	Feathers of auricular area old mixed with new, partly grown ones	Active growth over entire auricular area	Some feathers not fully grown
Spinal tract	Scattered old feathers still present	Well grown	Some feathers not fully grown	Growth complete
Tail coverts	Well grown	Growth complete		
Ventral tract	Breast and belly refeathered; old feathers on lower throat	Old feathers on sides of lower throat	Feathers of sides of lower throat partly grown	Few feathers on sides of lower throat not fully grown

feathers by the time primary 8 is breaking its sheath. At about the time primary 4 is dropped replacement begins at secondary 8 and rectrices 1-1. With the replacement of secondary 8, most of the distal greater secondary coverts emerge. Proximal coverts usually emerge last, but occasionally the order is reversed, or distal and proximal loci may be evident, as in the postjuvenile molt. When replacement of the remiges has progressed to primary 5 and secondaries 9 and 7, and that of the rectrices has progressed to 2-2, body molt starts, as does also the replacement of secondary 1. Thus, replacement of remiges proceeds from two loci, secondary 8 and the carpal joint, in the following sequences: primaries

1-10, secondaries 8-10, 7 being replaced at the same time as 9 or shortly after, and secondaries 1-6. I have found no exceptions to this order in any species of *Aphelocoma*. Secondary 6 is usually only partly grown when growth of the distal primaries is completed. Middle secondary coverts (and probably middle primary coverts) together with marginal coverts are molted after most of the greater secondary coverts are well grown and when primary 5 is dropped. Molt of the middle secondary coverts occurs after that of the marginals has begun. When primary 6 or 7 is dropped, alular feathers are also dropped. Growth of new alular feathers is not completed until after the distal primaries are fully grown.

Body molt begins on the sternal region, or also on the dorsal and pelvic regions more or less simultaneously; soon after, that of the humeral, femoral, and crural tracts begins. When primary 6 or 7 is dropped, molt of head feathers begins. Replacement of upper tail coverts usually begins laterally and before that of the under tail coverts. As in the postjuvinal molt, the last old feathers to be dropped are those of the lateral cervical regions of spinal and ventral tracts. In both molts, the last feathers to complete their growth are those of the auricular, lateral occipital, and/or lateral throat areas; most frequently, final growth occurs in the auricular region.

The complete molt of *Aphelocoma* differs from the postjuvinal molt in the following ways: (1) Additional molt loci account, of course, for replacement of feathers normally retained by first-year birds; these are as follows: primary 1 together with greater primary covert 1; secondary 8; secondary 1; greater secondary coverts; middle coverts; and rectrices 1-1. (2) The sequence of replacement of the covert series is reversed: whereas in the postjuvinal molt, middle secondary coverts are replaced before greater coverts, the reverse is true in the complete molt; whereas in the former, molt of marginals may begin even before any other feathers are lost, in the latter, these are molted with the middle secondary coverts. In both molts, growth of new marginals begins at the time new feathers emerge on the sternal region. (3) Inception of molt on the sternal region always precedes that on the spinal tract in the postjuvinal molt; in the complete molt this occurs only occasionally, and then the time difference is only slight.

*Period of molt.*—In general, molt in *A. coerulescens* begins some time in June or July and is completed in September or October. In *oocleptica* (fig. 44B), the molt period lasts three months. The complete molt occupies a slightly longer period of time than the postjuvinal molt.

*First complete molt.*—The first complete molt of birds one year of age is initiated, sometimes, before that of older individuals of a given population and usually within the first half of the molt period of the population. Thus, of twenty-eight individuals of *A. coerulescens* and *A. sordida* undergoing that molt, seven (25 per cent) began to molt earlier than older individuals, 19 (68 per cent) began to molt with the first 50 per cent of older individuals, and two (7 per cent) with the last 50 per cent. In *A. coerulescens*, with rare exceptions, it is not possible to identify an individual in the first complete molt after stage 5 has been reached; in *A. sordida*, however, individuals in late stages of the first complete molt can be identified if the bill has a considerable area of yellow coloration (see page 256).

Irregularities in sequence of molt apparently occur more frequently in the first complete molt than in either the postjuvinal or later complete molts. The irregularities are almost always minor, however; for example, molt may begin on the loci of the capital tract sooner than normal in relation to other body loci; the body molt as a whole may be somewhat ahead of wing molt. Other examples are discussed for *A. unicolor* and *A. sordida* below. The irregularities of the first complete molt may well be related to the fact that some first-year birds do not breed.

#### GEOGRAPHIC VARIATION IN THE COMPLETE MOLT

*Period of molt.*—In races of *A. coerulescens* distributed over the western United States, as is evident from figure 44, molt generally does not begin later than July 31,

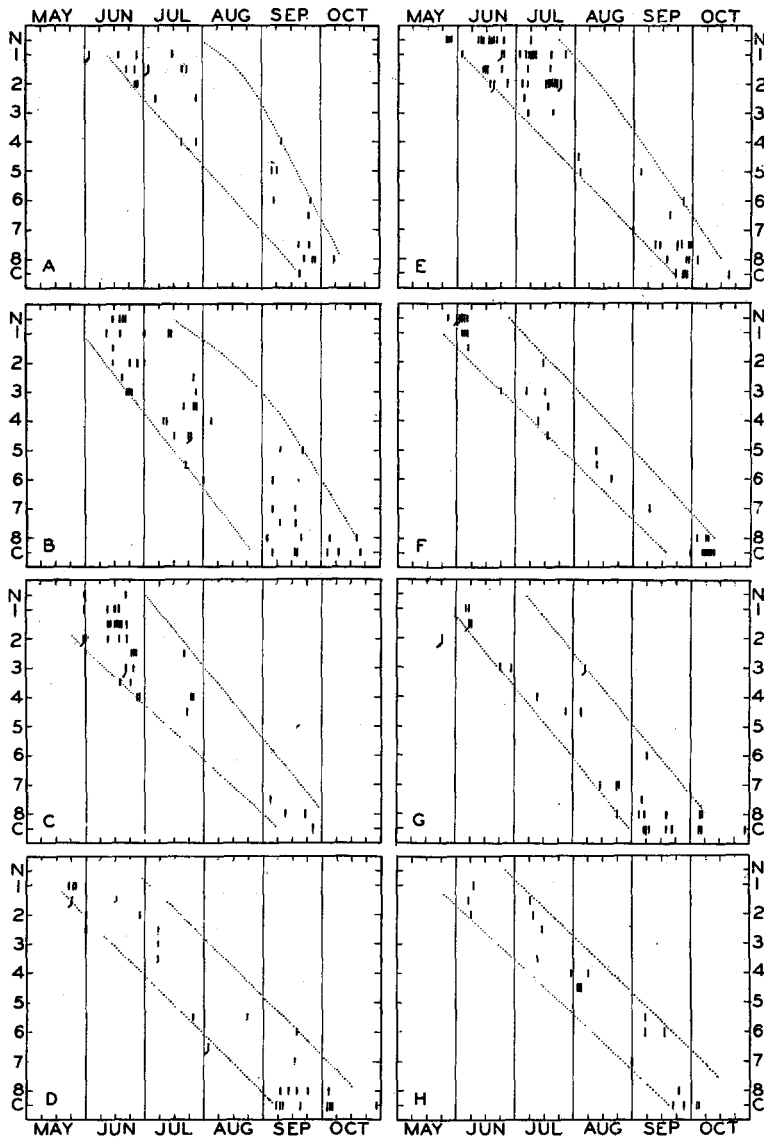


Fig. 44. Period of complete molt in different races of *Aphelocoma coerulescens* in western North America. Molt stages described in table 4; N, no signs of molt; C, molt completed. Individuals undergoing first complete molt indicated by a hook at lower end of vertical line. See legend of figure 40 for explanation of geographic groups. A, north-coast *californica*; B, *oocleptica* and south-coast *californica*; C, northern *nevadae*; D, southern *nevadae*; E, northern *superciliosa*; F, southern *superciliosa*; G, northern *woodhouseii*; H, southern *woodhouseii*.

nor is it completed sooner than September 1. In coastal California (fig. 44A, B), the molt period lasts three months. Along the north coast, the rate of replacement appears to be higher than to the south. There is a difference of about fifteen days between the

lines representing the onset of molt of north-coast *californica* and of south-coast *californica* and *oocleptica*. A comparable difference occurs between interior populations of *superciliosa* (fig. 44E, F), but the molt period of the latter is longer than that of the coastal populations. These observations confirm those made earlier of the postjuvinal molt.

The molt periods of *insularis* and *obscura* (fig. 45A, D) are comparable to those of *californica*. Between northern and southern divisions of *woodhouseii* (fig. 44C, D)

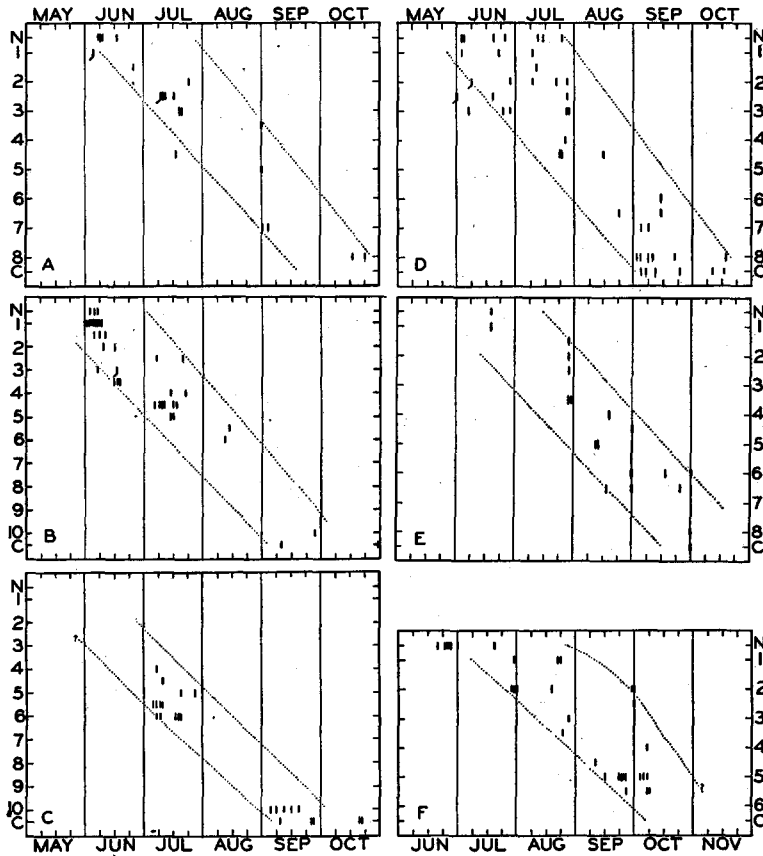


Fig. 45. Period of complete molt in different species and races of *Aphelocoma*. See tables 1, 4, and 6 for description of molt stages; N, no signs of molt; C, molt completed. A, *A. coerulescens insularis*; B, *A. sordida couchii* and *A. s. sordida* north of San Luis Potosi; C, *A. s. colimae*; D, *A. coerulescens obscura*; E, *A. c. cyanotis*; F, postjuvinal molt of *A. sordida arizonae*.

and of *nevadae* (G, H), no differences are evident, although there is a suggestion of a slightly higher rate of molt in the northern populations. In *texana*, molt period is comparable to that of southern *woodhouseii*. In *cyanotis* (fig. 45E), molt proceeds at the same rate as in those races just to the north but it occurs slightly later.

In all races considered thus far, except those along the Californian coast, molt occupies a period of three and one-half to four months. In *hypoleuca* and *cactophila*, this

period is at least four months and probably longer. Because the number of molting specimens of these two races was small, the evidence for longer molt period, as shown in figure 46A, is augmented by comparable evidence from specimens undergoing the postjuvinal molt. The nine available molting specimens of *sumichrasti* and *remota* indicate that in these races, also, the complete molt lasts at least four months.

*Differences in local inception of molt.*—In *woodhouseii* and *texana* (and probably *nevadae*, *cactophila*, and *hypoleuca*, as in the postjuvinal molt), replacement on the capital tract may begin at the frontal locus before, or at the same time as, that of the

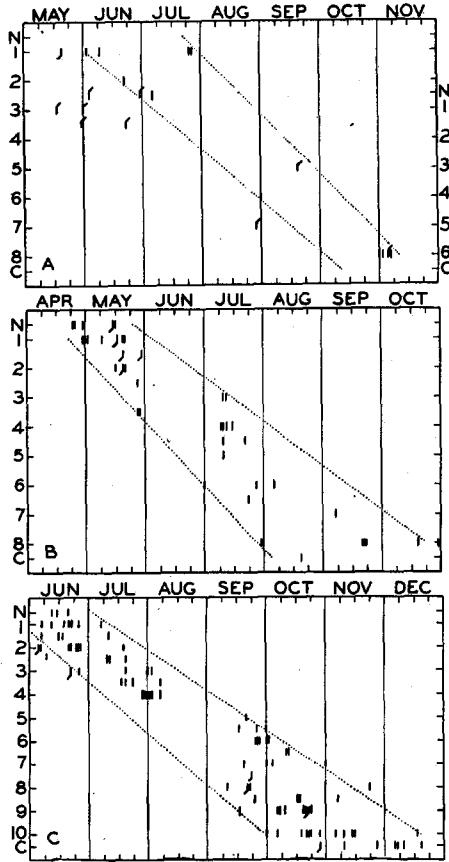


Fig. 46. Period of complete molt of *A. coerulescens hypoleuca* and *A. c. cactophila*, shown in A (individuals in postjuvinal molt indicated by hook at upper end of vertical line); of *A. unicolor*, all races, B; and of *A. sordida arizonae*, C. See legend of figure 44 for explanations.

postcoronal locus. The same is true of *sumichrasti* and *remota*; in these races, furthermore, molt of the ventral tract begins on the upper abdominal region and not on the sternal region, although it soon spreads on to the latter. This last departure from other races of *A. coerulescens* is not evident in the postjuvinal molt of these races.

In *cyanotis*, molt sequence is comparable to that of more northern races (ten specimens in stages 1-8); or the wing and tail molt may begin to lag at stage 2 so that by the time stage 6 is reached, delay in molt of these parts may amount to two full stages

(six specimens in stages 2-6 of body molt). This peculiarity of *cyanotis* may be related to the fact that although its molt proceeds at a rate comparable to that of more northern birds, replacement of its longer remiges, in some individuals at least, occupies a longer period of time. Average wing length of adult males is 139.7 mm., that of typical *woodhouseii*, 130.9, of *californica*, 123.0.

In *insularis*, replacement of the proximal four secondaries lags one stage behind the molt of other parts of the alar tract; growth of these feathers is completed at about the same time as that of the distal primaries.

#### MOLT IN APHELÖCOMA UNICOLOR

*Postjuvénal molt.*—Although only six specimens of this species in the postjuvénal molt were available to me, several noteworthy observations can be recorded from them. Molt occurs in June, July, and August and apparently may be completed by early September. It probably begins in late May or in June. Unlike the postjuvénal molt of *A. coerulescens*, molt along the ventral tract begins on the upper abdominal region, not on the sternal region, but proceeds anteriorly rapidly so that the advance of the abdominal over the sternal region is usually only slight. Molt of the capital tract is similar to that of inland and Mexican races of *A. coerulescens*; it may begin at either frontal or postcoronal loci or at both more or less simultaneously. Molt of the alar tract is less extensive than that of *A. coerulescens*. All greater secondary coverts are often retained (table 5). In fifteen first-year specimens, nine or 60 per cent retained all coverts; of the remaining 40 per cent, none shows replacement of more than three proximal feathers. Further, a variable number of middle secondary coverts is often retained. This, to my knowledge, is never true of *A. coerulescens*.

*Complete molt.*—An adequate number of specimens undergoing complete molt was available for tabulation of arbitrary molt stages, which correspond to those of *A. coerulescens* fairly closely (fig. 46B). As was true of the postjuvénal molt, replacement along the ventral tract begins on the upper abdominal region. Comparable or greater variation in head molt occurs in adults; in some instances, head molt may begin on the frontal and malar loci and proceed posteriorly and laterally before any replacement at the postcoronal locus begins. It is possible that a postcoronal locus is lacking in at least some individuals.

Perhaps the chief contrast in the molts of *A. coerulescens* and *A. unicolor* is the comparatively great variation in *unicolor* in time at which certain molt loci become active. The consequence of this is a partial breakdown of the characteristic time sequence of inception of molt at different loci, as determined for *A. coerulescens*. So far as can be determined from study skins of *A. unicolor*, molt loci—the specific areas as well as the manner of spread of molt from them—are comparable in the two species (with exceptions noted above). But the sequence of molt in *A. unicolor* may be similar to that of *A. coerulescens* (table 4); this is true of available specimens from Honduras and Guatemala and of some from other regions. Or activity of spinal- and ventral-tract loci may become evident when the wing and tail are at stage 2; of five specimens from Chiapas in early stages of molt, this is true of all. Or delay may occur at these loci and molt on the body as well as the head begin at about the same time, when wings and tail are at or near stage 4; among eight specimens from Vera Cruz, this is true of four, three conform to the sequence given in table 4, and the last, at stage 4, has the central pair of rectrices only one-half grown. One specimen from Guerrero (BS-185538) is similar to those from Chiapas; seven others are in the earliest or latest stage and thus provide no evidence of variation in molt sequence. But in two Guerreran specimens

(BS-185542, 185544) of four undergoing the first complete molt, body molt has begun even before that of the tail. The molts of wings and tail, here as in *A. coerulescens*, are correlated quite closely, they extend over a long period of time, and they constitute the chief basis for estimating molt stage. Thus, the greater variation in body molt of *A. unicolor* does not in any way invalidate the method of using arbitrarily defined molt stages for timing molt; as a matter of fact, it has added the value of providing good basis for detecting and evaluating just such differences as are described above. Too few specimens of *A. unicolor* are available to establish interracial and intraracial differences on the same basis as in *A. coerulescens*, but it is evident from the data given above that in this southernmost species of *Aphelocoma*, inter- as well as intra-racial variation is greater than in *A. coerulescens*. As will be shown below, interracial, but apparently not intraracial, variation of a similar order occurs in *A. sordida*.

The molt period of *A. unicolor*, estimated from a plotting of all available molting specimens of the species as a whole (fig. 46B), apparently lasts from three and one-half months to five months. In general, molt begins in May and is completed in August (Guatemala, three specimens), September (Chiapas, four specimens), or October (Guerrero and Oaxaca, two specimens).

Although specimens taken in other months of the year were examined for evidence of molt, none was found except in a series from Honduras. Of 32 specimens taken there in January and February, five or 16 per cent were at or near stage 6 of the complete molt. These were collected between January 25 and February 10, 1936, at Alto Cantoral. The remaining, non-molting specimens consist of 22 adults and three first-year birds. Of the five undergoing molt, four show some yellow coloration near the inner end of the lower mandible; the fifth shows but a vague suggestion of color. Bill coloration would suggest that these individuals may have been passing through the first complete molt (see page 256). But they probably do not represent more than one or two broods; two additional specimens in adult plumage taken at the same locality on February 10, 1936, although showing some yellow color on the lower mandible, are not in any stage of molt.

#### MOLT IN APHELOCOMA SORDIDA

*Postjuvinal molt.*—In *A. s. arizonae*, this molt is similar to that of *A. coerulescens*. For the most part this applies to other races of *A. sordida*, but to varying degrees. Thus, on certain specimens of *sordida* from southern Tamaulipas and in *wollweberi* from northern Jalisco, the head molt, in terms of stages given in table 1, is ahead of that of body and wings. This difference in molt sequence is striking in specimens of *sordida* from Hidalgo; from these it is evident that in this race, middorsal loci of the capital and spinal tracts may become active at about the same time as that on upper abdominal and sternal regions. Replacement of middle and greater secondary coverts is delayed one stage or proceeds more slowly. Too few specimens are available to state how generally this is true of the Hidalgo population. At any rate, these observations are evidence for marked geographic differences and, within some races, individual differences in the postjuvinal molt of *A. sordida*. In character of interracial differences, *A. sordida* compares with *A. unicolor* but contrasts with *A. coerulescens* in which evidence for differences of such magnitude was limited to the Guerreran race *remota*.

In *arizonae*, the postjuvinal molt begins in July or August and is completed in October or, probably, early November (fig. 45F). Compared with the southern division of *A. coerulescens nevadae* (mainly Arizona), molt occurs about one month later.

In other races of *A. sordida*, postjuvinal molt apparently begins earlier. Thus, of eight molting specimens of *couchii*, the average date of two from Texas and Nuevo Leon

in stage 1 (table 1) is June 15; the average date of two from Texas in stage 6 is October 12. Of eleven specimens of *wollweberi*, the date of two from Durango in stage 1 is July 22; the date of one from Sinaloa in stage 6 is September 26. In both the preceding instances, molt stages and dates of remaining specimens fall between the given extremes. The molt of four specimens of *sordida* from San Luis Potosí in middle or late stages, all collected in late August and September, can be estimated to reach completion by October 15. On one specimen from Michoacan (FM-119200), collected on July 15, 1940, the molt is advanced (stage 5). Thus, the available specimens suggest that molt in *arizonae* lags behind that of populations of *A. sordida* to the east and south.

Table 5

Number of Greater Secondary Coverts Retained through the Postjuvenile Molt in Different Populations of *Aphelocoma sordida* and in *Aphelocoma unicolor*

	Sex	Number of coverts										Total	Avge.	
		0	1	2	3	4	5	6	7	8	9			10
<i>Aphelocoma sordida</i>														
New Mexico, Arizona, northern Sonora, northwestern Chihuahua														
	M	0	2	2	2	4	3	4	7	4	0	0	29	5.1
	F	0	1	0	0	1	0	3	4	3	0	0	12	6.2
Texas, states of Coahuila, Nuevo Leon, and Tamaulipas														
	M	6	0	1	0	5	0	3	4	1	1	0	21	4.0
	F	1	0	2	2	3	1	4	1	1	0	0	15	4.4
Durango, Sinaloa, Zacatecas, northern Jalisco (= <i>wollweberi</i> )														
	Both	1	0	0	1	1	1	5	3	0	0	0	12	
Jalisco, Colima, Michoacan, Morelos, Vera Cruz, Hidalgo (= <i>colimae</i> , <i>sieberii</i> , and <i>sordida</i> , part)														
	Both	0	0	1	0	0	0	2	0	0	1	9	13	
<i>Aphelocoma unicolor</i>														
	Both	0	0	0	0	0	0	0	2	3	1	9	15	

Extent of molt of wing coverts varies from complete replacement of greater and middle secondary coverts to retention of all these. Most extensive data are available for *arizonae* and *couchii* (table 5, fig. 42). In these races the number of coverts retained is higher than in any race of *A. coerulescens* for which data are adequate. Among races of *A. sordida*, most extensive replacement occurs in *couchii*, while greatest number of coverts is retained in the southern races (table 5). In the latter, as in *A. unicolor*, variation occurs in the extent of replacement of middle secondary coverts, and all may be retained. A sexual difference in number of coverts retained is shown in table 5 for *couchii* and *arizonae*; in this respect, *A. sordida* is apparently similar to *A. coerulescens* (see also fig. 42). Finally, it may be noted that in extent of postjuvenile molt of the wing, *A. sordida* varies more than either *A. unicolor* or *A. coerulescens* and is, as a matter of fact, more or less intermediate between them.

But one instance of replacement of proximal secondaries during the postjuvenile molt was found in *A. sordida*. In the Michoacan specimen mentioned above, secondaries 8 and 9 and the center pair of rectrices have been replaced.

*Complete molt.*—The study of the complete molt of *A. sordida* was based on the race *arizonae* which was represented by the largest number of specimens. Soon after this was begun, it became evident that the molt process occupied a longer period of time than in *A. coerulescens* and that molt of the body tracts in particular was protracted. This necessitated the formulation of another series of arbitrary stages, and



ten were defined. From the tabulation of these stages (table 6), it can be seen that molt sequence in *A. sordida* is similar to that of *A. coerulescens*, and this applies as well

Table 6  
Arbitrary Stages of the Complete Molt in *Aphelocoma sordida*

Stage number	1	2	3	4	5
Primaries	1-2 dropped; or 1 breaking sheath to half grown	1-2 one-third grown; 3 breaking sheath; 5-10 old	6-10 old	7-10 old	9-10 old
Secondaries		8 breaking sheath; 1-7, 9-10 old	8 half grown; 9 breaking sheath; 10 old	8-9 well grown; 7 dropped or old; 10 old; 1 partly grown	8-9 fully grown; 3-6 old; 10 old
Greater secondary coverts		Breaking sheaths along entire series	Majority well grown	Growth complete	
Middle secondary coverts		Old	Dropped	Partly grown	Growth complete
Alula					Old
Rectrices	Old	1-1 breaking sheaths	1-1 half grown	1-1 fully grown	3 pairs fully grown
Capital tract, dorsally			Old	Pin feathers over crown area	Half refeathered; old feathers on back of neck
Capital tract, laterally				Old feathers	Old or some breaking sheaths
Spinal tract			Old	Some new feathers evident superficially	Refeathered; some old feathers evident superficially
Ventral tract		Old	Feathers breaking sheaths on sternal area	Sternal area refeathered; feathers breaking sheaths on interramal area	Superficial feathers of lower throat old; new feathers breaking sheaths below

Stage number	6	7	8	9	10
Primaries	10 old	10 old	10 breaking sheath		
Secondaries	7-9 fully grown; 4-6 old	4 partly grown; 5-6 old	6 old or breaking sheath	6 not fully grown	
Alula	Breaking sheaths	Half grown	Well grown	Growth complete	
Rectrices	3 pairs fully grown	4 pairs fully grown	Outer pair half grown	Growth complete	
Capital tract, dorsally	Refeathered	Most feathers not fully grown	Some feathers not fully grown	Growth complete	
Capital tract, laterally	Partly grown and old feathers mixed	Most feathers not fully grown; a few old feathers still present	Growth incomplete	Growth incomplete	A few feathers not fully grown, chiefly on auricular area
Spinal tract	Most feathers not fully grown	Growth incomplete	Growth incomplete	A few feathers not fully grown	Growth complete
Ventral tract	Old feathers on sides of throat only	Growth incomplete on throat, breast, and belly	Growth incomplete	A few feathers not fully grown on throat, breast and belly	Growth complete

to molt of pterygiae not mentioned in table 6. Molt loci, so far as can be determined from study of dried skins, are also comparable.

The molt period of *arizonae* is, so far as is known now, longer than that of any other race or species of *Aphelocoma*. Molt begins usually in June, but may begin in late May (fig. 46C); it is completed in October, November, or December. Thus, molt

may occupy a period of from over four months to almost six months.

The chief geographic difference in complete molt noted was an advance, in terms of stages given in table 6, of the body-molt over the wing and tail in more southern races. In fourteen of sixteen specimens from Zacatecas and northern Jalisco, chiefly in middle stages of molt, body molt is advanced one or two stages. The same is true in ten of thirteen specimens from Michoacan, and in two of thirteen from southern Jalisco and Colima.

Comparison of length of molt period can be made among several geographic groups of *A. sordida* by study of figure 45B and C, and figure 46C. In *couchii*, the molt period is about three and one-half months. In *colimae*, it is at least three and one-half months, and probably longer; the individuals plotted in figure 45C were all collected in 1905 at a few localities in the Sierra Nevada de Colima. In other races, molt occupies a longer period. Data from 24 molting specimens from Vera Cruz, Puebla, Mexico, and Michoacan indicate that molt occurs between May 15 and September 15, a period of four months. Eleven molting specimens from San Luis Potosí and Hidalgo were taken within the period June 1-October 1 (four months). Twenty-six molting specimens from northern Jalisco and Zacatecas were taken within the period June 15-October 31 (four and one-half months). Thus, the shortest and longest molt periods in *A. sordida* are found in populations at the two northern apices, eastern and western, respectively, of a roughly U-shaped geographic range. This conclusion is a puzzling one inasmuch as in *A. coerulescens*, southern races (Lower California and Mexico) show longer periods. It is my opinion that this evidence has historical significance, but an interpretation of it is not warranted without evidence from other sources.

Perhaps the most puzzling specimen in molt examined in this study is that of a male *A. sordida* (BS-144653) taken at Patzcuaro, Michoacan, on July 24, 1892. All coverts except the greater primary series are recently replaced. Although some of the remiges are missing, there is no sign of normal replacement! Two pairs of new rectrices are fully grown; some old feathers are still retained laterally. Body molt is beginning on dorsal, frontal, and sternal regions, but is most advanced on the interramal region! On the basis of the character of the remiges and old rectrices, the dull greater primary coverts, and the yellow coloration of the lower mandible, the specimen is judged to be a first-year bird, probably non-breeding, undergoing the first complete molt. Irregularities in the first complete molt have been noted in *A. coerulescens* and *A. unicolor*, but none of these was so striking as that described here.

#### AGE DETERMINATION

*Plumage characters.*—It is clear from the differences between postjuvinal and complete molts discussed above that if the retained juvenal feathers are distinguishable from corresponding ones of adults, basis is provided for segregating first-year individuals from adults. A number of distinguishing characters involving rectrices, remiges, and wing coverts are available. These apply to all species of *Aphelocoma*. Comparable differences have been described for *Corvus* by Emlen (1936:99). The existence of some of these differences in *Aphelocoma* has been noted in the past (Swarth, 1904:32; Dickey and van Rossem, 1938:409), but no attempt has yet been made to describe them precisely.

1. The rectrices of the first-year bird are rounded or bluntly pointed; those of adults are usually truncate (fig. 47A, B).

2. The same difference, although not so marked, is observed between outer primaries of the two groups (fig. 47D, E).

3. The retained juvenal alular feathers, greater primary coverts, and, if any, greater

secondary coverts are of a duller coloration than greater or middle secondary coverts acquired during the postjuvencal molt. The contrast is especially evident if the series of greater secondary coverts has undergone only partial replacement. If not worn, the

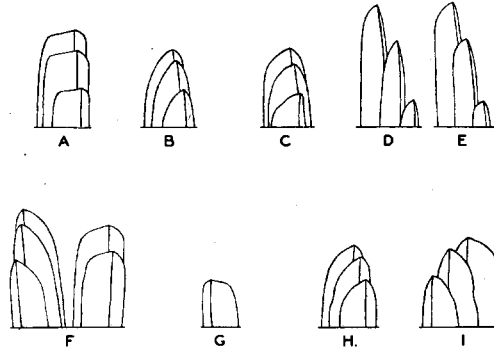


Fig. 47. Shape of lateral rectrices (A-C, F-I) and outer primaries (D, E) in adult and first-year specimens of *Aphelocoma coerulescens*. A, adult male, Monterey County, California, October 10, 1914 (FM-142456); B, juvenal male, San Benito County, California, July 12, 1918 (MVZ-29180); C, adult, female?, Monterey County, California, January 29, 1919 (MVZ-30356); D, same as B; E, adult male, San Luis Obispo County, California, October 4, 1918 (MVZ-29744); F, juvenal male, Mendocino County, California, August 22, 1909 (MVZ-10498), two rectrices of adult form apparently acquired early in the postjuvencal molt; G, first-year specimen, female?, Cedar Keys, Florida, January 23, 1874 (LCS-8321), tail completely replaced; H, first-year female, Marin County, California, November 18, 1915 (FM-70600), tail undergoing complete replacement when specimen was collected; I, first-year male, Elko County, Nevada, December 26, 1927 (RE-4599), only three rectrices shown replaced.

juvencal coverts are tipped with dull grayish brown; the adult coverts are blue throughout. If evidence from other characters listed here is questionable, coverts will almost always serve to classify the specimen satisfactorily. Emlen (1936:100) does not mention covert characters, but the differences are as clear in *Corvus* as in *Aphelocoma*.

4. Rectrices and remiges of first-year birds are typically more worn than those of adults. This, however, is not a reliable means of distinguishing the two age classes; but specimens with excessively worn flight feathers are almost always first-year birds. I have used this character in spotting first-year birds in the field in spring, when, in the vicinity of Berkeley, the wear shown by adults is moderate or negligible.

5. The tail of first-year birds is not so rounded as that of adults. This may be shown by differences in length between the longest rectrices and those next to the outermost (Emlen, 1936:101) summarized in table 7.

Table 7  
Differences between Length of Rectrices of Adult and First-year Birds

		Number	Males		Number	Females	
			Range	Mean		Range	Mean
<i>A. c. californica</i>	Adult	17	10-20 mm.	15.8 mm.	12	8-16 mm.	12.0 mm.
	First-year	19	7-15	10.9	10	8-10	9.3
<i>A. s. arizonae</i>	Adult	18	8-14	11.4	10	5-10	8.8
	First-year	7	3- 8	5.3	8	2- 5	4.1
<i>A. u. guerrerensis</i>	Adult	12	21-27	23.8	9	19-25	22.0
	First-year	0			2	13-16	14.5

In juvenal or first-year individuals, the longest rectrices are 2-2; 1-1 are five to ten millimeters shorter than 2-2. In adults, with rare exceptions, when the difference between 1-1 and 2-2 is very small, the longest rectrices are the center pair.

As pointed out by Emlen (1936:102), the characters serving to distinguish first-year from adult birds are not to be used individually, but in combination, one supplementing the others. Reliance upon the obvious character of rectrix shape should especially be avoided inasmuch as adventitious replacement may produce rectrices of adult form (fig. 47F, G), although in some instances of fall or winter replacement during the first year, the new feathers are of juvenal form (fig. 47H, I). On the other hand, adult rectrices are not necessarily truncate and, indeed, may be strongly suggestive of juvenal feathers (fig. 47C); in the latter, comparatively rare instances, the character of the greater coverts together with the sturdier structure and more intense coloration of the flight feathers indicate that the specimens in question are adults.

First-year birds also differ from adult birds statistically in size and color characters. A discussion of these differences is not in order here; rather these are differences whose sound determination depends on the separation of age classes in terms of the characters described above. An example will serve to illustrate the magnitude of difference in selected size characters. Thus, in wing and tail length, age classes of the two sexes differ in north-coast *californica* as shown in table 8.

Table 8  
Sex and Age Differences in Lengths of Wing and Tail

		Number	Wing Range	Mean	Number	Tail Range	Mean
Males	Adult	38	119.7-128.2 mm.	123.0 mm.	36	131.0-145.7 mm.	136.8 mm.
	First-year	25	117.0-125.1	121.8	25	125.0-144.1	133.8
Females	Adult	29	114.6-122.5	119.0	28	125.0-137.7	131.1
	First-year	32	113.0-122.2	116.8	31	120.0-131.7	125.7

From my use of data of this type in studies of the genus *Aphelocoma*, I have concluded that separation of age classes is absolutely essential if correct interpretations of variation and racial differences are to be made. Any work on the systematics of corvids in which first-year specimens are not distinguished from adults is at once suspect.

*Bill color.*—In *A. unicolor* and *A. sordida*, but not in *A. coerulescens*, the bills, especially the lower mandibles, of birds which have passed through the postjuvinal molt are colored yellow to a varying degree. Although various shades of yellow on dried specimens, the bill in life, at least in *A. sordida*, is presumably more flesh colored (Ridgway, 1904:338); in *A. unicolor griscomi*, the color is greenish yellow (Dickey and van Rossem, 1938:410). Although the majority of specimens with partly colored bills, excluding juveniles, are first-year birds, a segregation of age groups using bill color as a criterion (Swarth, 1904:31; Dickey and van Rossem, *loc. cit.*) cannot be made.

Changes in bill color are clearly evident from a large series of specimens of *A. s. arizonae* which I have examined. The bill of the young nestling is largely or entirely yellow. As the time for departure from the nest approaches, the outer half of the upper mandible and the outer lateral areas of the lower mandible begin to darken. During the fledgling period and before the postjuvinal molt, the base of the upper mandible and most of the lower mandible are usually yellow. This amount of light coloration, arbitrarily defined as stage 1 in the process of darkening of the bill (table 9), may be retained through the postjuvinal molt and into the first year as late as May. During the first year, the area of yellow is gradually reduced: the base of the upper mandible darkens, the last parts to lose the yellow color usually being the proximolateral edges; at the same time, the distal half of the lower mandible darkens, later the inner half and rami. By the time darkening occurs over the rami, the upper mandible is usually entirely dark; the last area to lose the yellow color is, in most instances, that around the inner

end of the gonys. In table 9, extent of light coloration of the bill in first-year and adult specimens is shown in relation to sex and season of year. These data clearly indicate the progressive darkening of the bill.

Considerable variation occurs in the time taken by the process of darkening (table 9). The bill may become black before the individual has reached the age of one year.

Table 9  
Extent of Light Coloration on Bills of Specimens of *Aphelocoma sordida arizonae*  
in Relation to Age, Sex, and Season of Year

Stages of increasing area of black	Males					Females					Both sexes, black	Total specimens
	1	2	3	4	5	1	2	3	4	5		
First-year specimens:												
Sept.-Nov.	4	4	3	4		3	1					19
Dec.-Feb.	1		2			3	1		2			9
March-May	2	2	7	3	2		2		3			21
June-Aug.				3	2			1	4			10
Adult specimens:												
Sept.-Nov.		1	1	15	8		1	2	6	6	12	52
Dec.-Feb.				6	5				6	1	14	32
March-May				4	10				8	6	58	86
June-Aug.				1	7				3	8	27	46
Total specimens examined												275

This is shown by two April-taken and two June-taken first-year specimens, the bills of which are practically all black. These four specimens represent seven per cent of the total of 59 first-year specimens examined.

On the other hand, on many specimens which have passed through the first, and possibly the second, complete molt, irregular areas or streaks of light color are present on the proximal ventral surface of the lower mandible (table 9). These individuals were at least one year old when collected; but it is not possible to segregate them as second-year individuals, as others of the same age have black bills. Of a total of 216 specimens which are more than one year old, 105, or 49 per cent, have some yellow on the lower mandible. The latter include nine specimens taken in July or August which earlier have passed through at least one molt and probably not more than the first complete molt. It is evident, then, that yellow color of the bill may disappear from the ages of slightly less than one year to more than two years.

The data of table 9 also indicate that there is a tendency for males to acquire black bills before females. Thus, among first-year specimens, 10 per cent of the males, but none of the females, are in stage 5. Among adults showing some yellow coloration, 55 per cent of the males are in stage 5, but only 45 per cent of the females.

In other races of *A. sordida*, bill color behaves in a similar manner except in *A. s. couchii* (Van Tyne and Sutton, 1937:61) and of *A. s. sordida* exclusive of southern Hidalgo. In these races the bill darkens rapidly during nestling life and becomes black before or during the postjuvinal molt. The same is true of *A. coerulescens*.

With slight variations, the darkening of the bill in *A. unicolor* proceeds in the same manner as in *A. sordida arizonae*. The yellow areas of the bill of *A. unicolor* are brighter in dried specimens; apparently in life, the color contrast of a partly black bill is more striking than in *A. s. arizonae*. It appears that the darkening may proceed most rapidly in northern forms of this species. In four specimens from Honduras and Guatemala which have passed at least through the first complete molt, the lower mandible, although largely black, still has conspicuous areas of yellow. Among specimens from Vera Cruz

and Guerrero, however, all those which have passed through one complete molt have dark bills. Furthermore, of three specimens from Vera Cruz in stages of the first complete molt, two have black bills and one has a small light spot on the lateral surface of one ramus. The bill of one first-year specimen from Guerrero (BS-185545) taken on May 16, 1903, is almost black. On two adults from Chiapas, taken in September and March, respectively, there are one or two small light streaks or spots on the lower mandible of each; otherwise, bills of adult specimens from this state are also entirely black.

#### SUMMARY

The feather-tract pattern of American jays of the genus *Aphelocoma* is figured in detail and compared with *Lanius* (Miller, 1931). Distinctive features of *Aphelocoma* are absence of frontal and rectal apteria, reduced temporal apterium, presence of only ten upper and ten under tail coverts, and posteriorly undivided sternal region of the ventral tract. *Aphelocoma* lacks a middorsal apterium present in some corvids; also, the dorsal region of the spinal tract is not acute-angled as in some corvids. Twenty remiges are present in *Aphelocoma* and in most other corvids.

Sequence and extent of molts, and the nature and extent of intra- and inter-specific differences in molt of *A. coerulescens*, *A. sordida*, and *A. unicolor* have been studied using 1910 study skins. Two caged individuals of *A. c. oocleptica* were observed through the postjuvénal molt.

Prior to the postjuvénal molt of *A. coerulescens*, marginal feathers of the wing of a blue color brighter than that of greater and middle upper wing coverts emerge at or near the time of departure from the nest. Dark feathers of head, neck, and collar areas replaced adventitiously before the postjuvénal molt are also blue, not brown, in color. Under wing coverts emerge after departure from the nest. The postjuvénal molt begins about five weeks after departure from the nest; it is a partial molt and does not involve, in general, the feathers of the alula, greater primary coverts, remiges, rectrices, a variable number of greater secondary coverts, and a variable number of under wing coverts. Normal replacement of some or part of these feather series occurs only in the races *hypoleuca* and *cactophila*.

In the postjuvénal molt, northern races tend to retain more greater secondary coverts than southern races; females tend to retain more of these coverts than males. As the average number of coverts retained increases from one population to another, the disparity between males and females in number of coverts retained tends to increase.

The molt locus is defined as a small area on any feather tract on which molt begins independently of that in other areas in space, but not in time; specific loci as well as manner of spread of molt from them are identifiable in *Aphelocoma* as racial, specific, or generic characters. Nineteen loci are recognized in the postjuvénal molt of *A. coerulescens*; six additional ones are recognized in the complete molt. Interracial differences in molt loci are few in *A. coerulescens*; more pronounced differences occur in *A. sordida* and *A. unicolor*.

In *A. c. oocleptica*, the period of the postjuvénal molt is about two and one-half months; that of the complete molt is about three months. In interior and southern races of the same species, it is longer.

The postjuvénal molt of *A. unicolor* is less extensive on the wing than that of *A. coerulescens*. The period of the postjuvénal molt is at least three months; that of the complete molt is from three and one-half to five months. Greater intraracial variation in sequence of molt occurs in *A. unicolor* than in the other two species.

In *A. sordida*, molt occurs later and occupies a longer period of time in *A. s. arizonae*

than in races of that species to the south and east. The complete molt of *arizonae* lasts from more than four months to almost six months. Postjuvinal molt of the wing is more variable in *A. sordida* than in the other two species; in extent, it is more or less intermediate between them.

In *A. coerulescens* and *A. sordida*, the first complete molt begins, on the average, before that of birds undergoing later molts; irregularities occur in the first complete molt of all three species more frequently than in either the postjuvinal or subsequent complete molts.

First-year specimens of *Aphelocoma* can be distinguished from adults primarily by differences in shape of rectrices and remiges and in color of retained versus replaced greater wing coverts. Light coloration of the bill in young individuals of *A. sordida* and *A. unicolor* which have passed through the postjuvinal molt does not serve as a criterion in separating age classes. In the former species, light color on the bill may disappear from the ages of slightly less than one year to more than two years. There is a tendency for males to acquire black bills before females. Northeastern populations of *A. sordida*, primarily the race *couchii*, differ from others of the same species in that light coloration of the bill is lost before the postjuvinal molt is completed.

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