THE MOLTS OF YOUNG WILD AND DOMESTIC TURKEYS

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The molts and plumage sequences of many gallinaceous birds have by now been adequately described. Experiments with the domestic fowl have yielded some of our best information on the physiology of molt and feather growth. But the molts of turkeys (*Meleagris gallopavo*) have never been fully worked out, and since the family Meleagrididae is probably phylogenetically more or less isolated from other families in the order Galliformes, it is not surprising to find in turkeys certain peculiarities of molt which are not characteristic of the fowls in general. The main purpose of the present work is to describe the various molts and plumages of the young turkey from the time of hatching to the attainment of sexual maturity in the first winter. Notes on the annual and prenuptial molts of adult turkeys are added, but insufficient material is available to describe these in detail. In addition, within this species some differences in the molting procedures of young Eastern Wild Turkeys (*M. g. silvestris*) and domestic Bronze Turkeys are shown, and evidence as to the nature and origin of these molting differences is presented.

This report is an outgrowth of a study of hybridization between wild and domestic turkeys in the Ozark region of southern Missouri. Data on molting have been collected through two seasons, 1941 and 1942. A considerable part of this material comes from a flock of confined turkeys, raised at Lost Trail Game Farm, Reynolds County, Missouri, for sale as wild stock suitable for releasing. This strain, originating from hybrid parentage (domestic x *M. g. silvestris*), has been carefully selected for color and general appearance over a period of some thirteen generations, and it now closely resembles the native eastern race. The process of selective breeding toward the wild type has been accelerated by annually back-crossing part of the breeding hens to wild living gobblers in the vicinity of a state game refuge, a procedure also followed at the state turkey farms in Pennsylvania (Gerstell and Long, 1939) and Virginia (Mosby, 1941). However, in certain details of morphology and behavior these birds still display evidences of their domestic inheritance, and, as will be shown here, they are intermediate in some aspects of molting behavior between domestic and wild turkeys. Therefore, for present purposes this strain will be referred to as "hybrid," with the understanding that at least in appearance the birds are more closely related to the native eastern race than to their more distant domestic ancestors.

There is a basic sequence of molts and plumages apparently common to all turkeys, and the following accounts of the several molts are generally applicable to the species. The details were worked out largely in the hybrid strain, because it was most available for study. Differences in the extent or procedure of the molts in the wild and domestic strains are touched upon wherever they occur, but these are segregated for more complete discussion later in the paper.

The molting terminology used here follows Dwight (1900*b*) in most respects, but young turkeys pass through three molts before acquiring a stable winter plumage, the third of which is not supplied a suitable name by Dwight, and is here called the "first winter molt."

Altogether, 194 birds were examined, over three-fourths of which were in some stage of active molt. Of these, 144 were hybrids from Lost Trail Game Farm, 32 were domestic bronze turkeys obtained from farmyard flocks in the vicinity of West Plains, Howell County, and 13 were native wild birds from various parts of Missouri. The remaining 5 were miscellaneous skins from other sources. The skin collections of the

author and of the Missouri Cooperative Wildlife Research Unit, which jointly include 64 turkeys, were most valuable as a permanent source of reference. A series of juveniles of known age in these collections, obtained from Lost Trail Farm (hybrid strain), form the basis for the descriptions of the postnatal, postjuvenal and first winter molts. Most of the adult birds, however, were examined alive, and their molting status recorded on prepared record sheets.

POSTNATAL MOLT

The postnatal molt begins with the appearance of the juvenal remiges and their greater coverts. Referring to *M. g. silvestris,* Bent (1932) says: "As with the quail and grouse, the young turkey starts to grow its wings when a small chick." Actually, the process is initiated before hatching, for on day-old chicks the first seven primaries (1 to 7) project from their sheaths 6 to 12 mm., and most of the secondaries are beginning to emerge. At this stage the three distal primaries, 8 to 10, and the two distal secondaries next to the wrist, 1 and 2, have not emerged, but each of these follicles contains a down feather.

Growth of the juvenal remiges is rapid, and at eleven days the longest primaries exceed 50 mm. in length, the secondaries 35 mm., and their greater coverts are growing apace. The four feathers of the alula are evident, and primary 8 and secondary 2 are pushing out of their sheaths. The inner secondaries, 11 to 16, have begun to emerge (see fig. 35 for sequence of appearance of juvenal remiges). At two weeks the feathers of the wing have so developed that the chick is unable to carry the weight of them properly, and a "droopy-winged" appearance is characteristic.

A few days after hatching, the rectrices begin to grow, and by eleven days most of them project from the down. A week later the full juvenal tail of 18 feathers is developing rapidly, the sixth and seventh lateral pairs being the longest, with adjacent feathers in both directions grading down in size. The two central pairs are the first to mature, and they cease growth while still quite minute (approximately 15 mm.), for they are soon replaced by postjuvenal feathers. Maturing of the juvenal rectrices proceeds outward from the center of the tail, and the distal feathers are the last to cease growth (fig. 35).

The greater tail coverts, tertiaries, and some of the lesser wing coverts emerge in the second week. Growth of the juvenal body plumage becomes evident in the third week, in the anterolateral parts of the breast (fig. 36, C), and in the interscapular region of the back. The long feathers of the femoral tract soon appear. Molt spreads rapidly over the sternal and dorsal regions, thence posteriorly to the abdominal and pelvic regions. By the sixth week the full juvenal plumage has developed except on head and neck (fig. 36, F). The anterior spread of the molt is much slower, particularly on the ventral side. At five weeks the head and neck still retain the natal down, but since the bird has increased considerably in size (body weight has increased approximately six times), the plumage of these areas looks thinned and skin shows between the feathers. In the sixth week juvenal feathers begin to appear in the ear tuft and middorsal cervical region, and thereafter molt progresses slowly over the top of the head to the crown and forehead, up the throat to the chin, and lastly takes in the cheeks, lores and area around the eye. The postnatal molt of the head is not completed until the tenth or eleventh week, by which time the postjuvenal molt is more than half completed on the body and wings.

POSTJUVENAL MOLT

The postjuvenal molt is initiated early in the fourth week by replacement of the central pair of rectrices. Molt in the tail then spreads in a centrifugal manner, rapidly

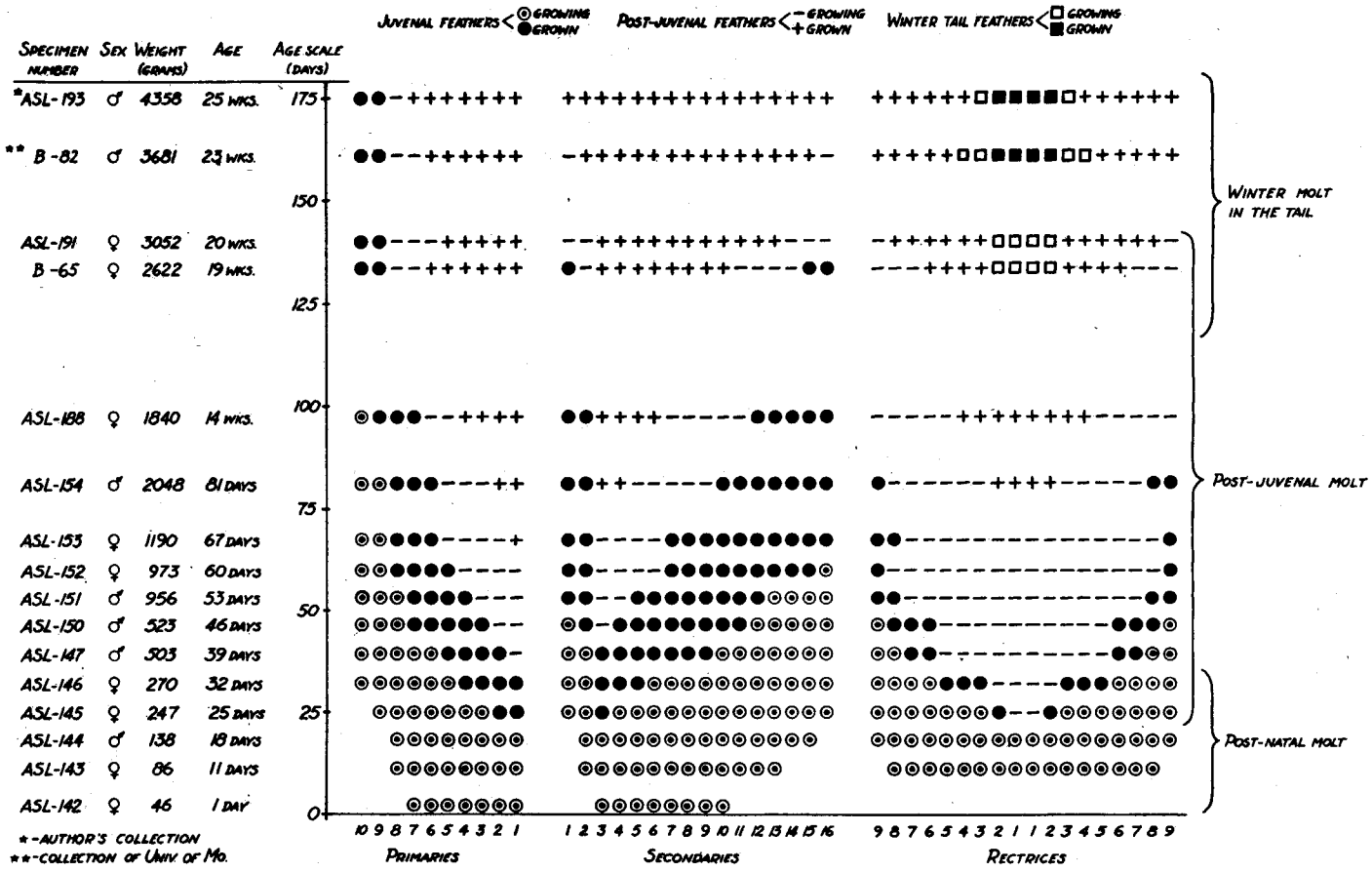
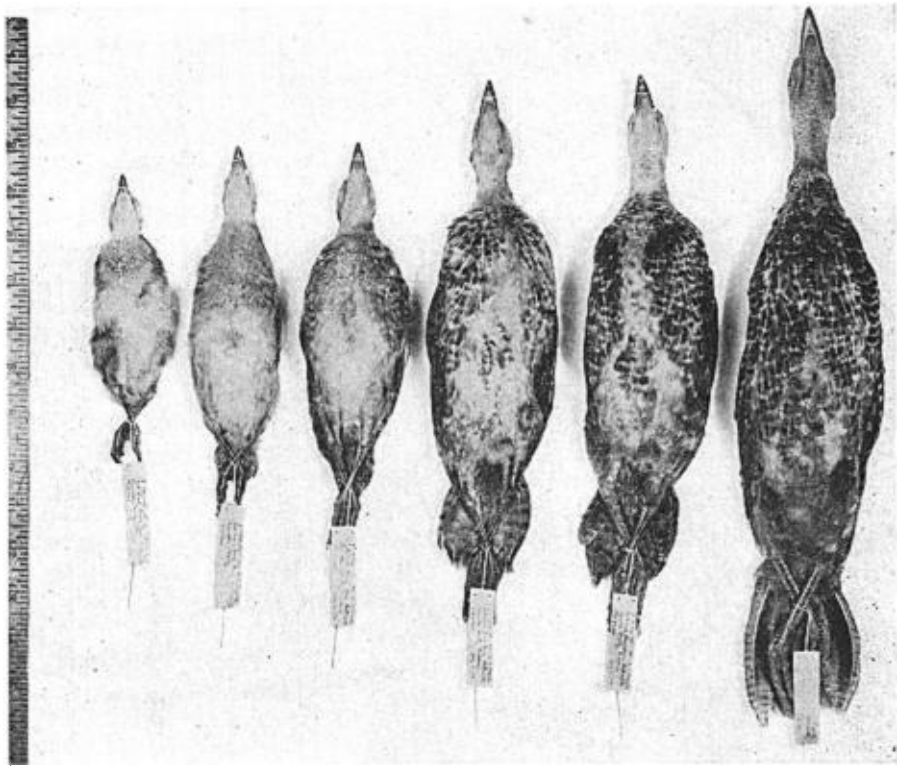


Fig. 35. Development and replacement of remiges and rectrices in a series of young hybrid turkeys from Lost Trail Game Farm.

at first, but slowing down as the outer pairs are reached (fig. 35). By the seventh week all save the outer two pairs of rectrices are replaced, but it is usually the fourteenth week before both of these have dropped. A deeply rounded shape to the tail results (fig. 37), until the outer feathers have caught up in growth, restoring the more nearly square shape. The greater tail coverts also molt in centrifugal order, following the



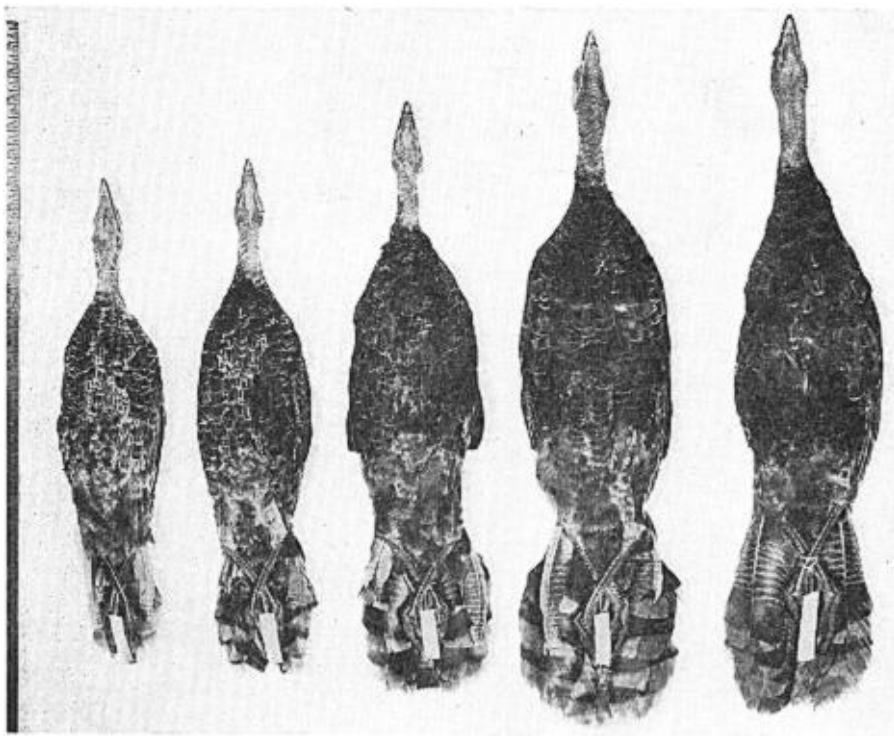
A B C D E F

Fig. 36. Young hybrids illustrating stages in the postnatal molt of the body plumage. A, ♀, 1 day old; B, ♀, 11 days; C, ♂, 18 days; D, ♀, 25 days; E, ♀, 32 days; F, ♂, 46 days.

rectrices. In the Rock Ptarmigan (*Lagopus mutus*) the postjuvenal molt of the tail is centripetal, proceeding from the outer feathers inward (Salomonsen, 1939:37).

The first (proximal) primary drops early in the sixth week. Replacement proceeds in a uniform fashion from the wrist outward, one new primary appearing every week until the fifth is reached, after which both replacement and the rate of feather growth slow down. The juvenal greater upper primary coverts, which are retained for a year in many gallinaceous birds, are replaced in turkeys, each covert falling just ahead of its corresponding primary. The molt of the primaries is never complete, the two distal, juvenal feathers (9 and 10) being retained through the first winter in *M. g. silvestris* (Bent, 1932; Petrides, 1942), but only the distal member in the domestic strain. The hybrids are divided between these two categories, as noted later. The retention of at least one of the distinctively pointed juvenal outer primaries is the best index for differentiating young turkeys from adults.

Several days after the primary molt has started, the greater upper secondary coverts begin to molt, starting with no. 3, the sequence of replacement proceeding proximally. The first postjuvenal coverts are dull blackish brown, tipped with buff, but as the molt proceeds, subsequent feathers in the series become progressively larger, with a purplish iridescence and a subterminal black band similar to that of the coverts of the adult female. In the seventh week the third secondary drops, and replacement of the second-



G H I J K

Fig. 37. Hybrids illustrating stages in the postjuvenal molt. G, ♂, 53 days old; H, ♀, 60 days; I, ♀, 67 days; J, ♂, 81 days; K, ♀, 98 days.

aries follows that of the coverts in a proximal direction (fig. 35). It is in the fourteenth or fifteenth week, when the molt of the other secondaries is largely completed, that the second and first greater secondary coverts are replaced, followed shortly by the two secondaries in that order. These late coverts become the largest of the series. This sequence of secondary replacement in the postjuvenal molt has been described by Warren and Gordon (1935) in the domestic turkey, domestic chickens and guineas. It is apparently characteristic of most, if not all, gallinaceous birds, since it also occurs in the Hungarian Partridge and Rock Ptarmigan (Salomonsen, 1939), and in Ruffed Grouse (personal observation).

The body plumage begins to molt in the seventh week, again in the interscapular region of the back and the anterolateral parts of the breast where the postnatal molt began (fig. 37). The first postjuvenal body feathers are blackish brown, narrowly tipped with cinnamon buff, and may have faint cinnamon subterminal vermiculations,

or even a cinnamon band. The tips are bluntly rounded, not narrowly pointed as are those of the juvenal body feathers, and the white or buffy shaft streaks characteristic of the latter are absent. Replacement of the body plumage progresses in much the same manner as in the postnatal molt, that is, across the breast, then posteriorly down back and belly, and lastly forward up the neck. As with the secondary coverts, there is a progressive change in form and color of the body feathers, which, as the molt proceeds, increase in size and tend to approach the appearance of adult female feathers.

It has been noted that the postnatal molt of the head was not completed until the tenth or eleventh week. As a consequence, postjuvenal replacement is delayed, but in the fourteenth week new feathers appear in the dorsal cervical region, and on crown, forehead and chin, later in loral and cheek regions. Whereas the juvenal head feathers were small (3-7 mm.) and buff colored, bearing widely spaced barbs to the tip of the rachis, the new feathers are usually black or dark brown, up to 16 mm. long, and barbs are borne no more than a third of the way up the rachis, the tips being hair-like. This gives an appearance of dark pubescence to the heads of young turkeys, most noticeable in *M. g. silvestris,* least so in domestic strains. The postjuvenal head plumage is retained through the first winter. In subsequent molts the heavy pubescence is lost, the feathers of the head being reduced both in size and number. In the native range of *silvestris* the legend of the little "moss-head" turkeys, supposedly a distinct strain, may have arisen from failure to recognize the age classes, "moss-heads" actually being immature individuals.

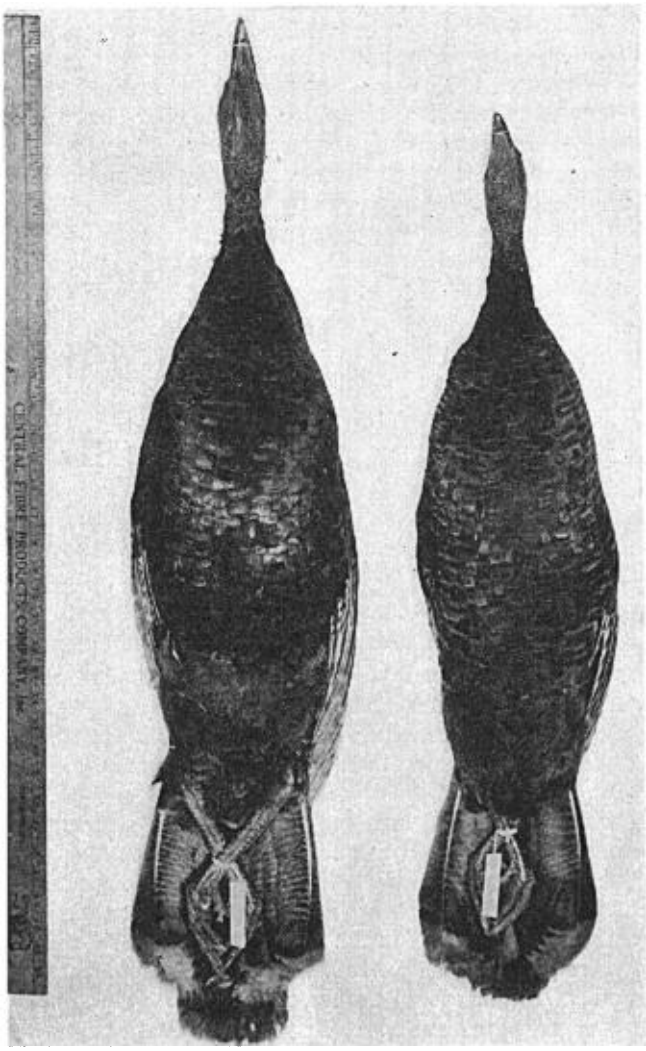
FIRST WINTER MOLT

Most gallinaceous birds wear their postjuvenal plumage through the first winter, but the ptarmigan undergoes an extensive winter molt which has been described in detail by Salomonsen (1939). The turkey also undergoes a partial first winter molt, which hitherto has not been described.

At about fourteen weeks the postjuvenal plumage is approaching full development in all regions except the head. The two central pairs of tail feathers have attained full growth, and vary in length from 210 to 240 mm., with an average width of 35 mm. Adjacent rectrices have grown considerably larger in both dimensions, and these central feathers, which were the bulwark of the tail at eight weeks, now look proportionately small. Usually in the fifteenth week these two pairs drop, as a rule together (fig. 35), and are replaced by new feathers which sometimes attain a length considerably greater than the rest of the tail (fig. 38, L). In *M. g. silvestris* and some of the hybrids the winter molt of the rectrices goes no farther, the other seven pairs of postjuvenal feathers being retained. However, in domestic turkeys this molt continues in a centrifugal progression and may take in five or more pairs of rectrices, often extending to complete the replacement of the whole tail. Most of the hybrids undergo varying degrees of tail molt beyond replacing the two central pairs, as later discussed.

On the body, winter molt starts once more on the sides of the breast, interscapular region of the back, and in the femoral tract, and spreads in the manner described for the previous two molts. The new winter body feathers show for the first time the sexual dimorphism described by Mosby (1941), namely, slightly rounded, cinnamon-tipped contour feathers in the female, in contrast to square, black-tipped feathers in the male (faintly visible in fig. 38). The new female body plumage closely resembles that of an adult hen, but the plumage of the young male still lacks the brilliant iridescence of the old gobbler.

The lesser and middle wing coverts are replaced, as well as the tail coverts. But the remiges, greater primary coverts, alula, variable portions of the tail, and the feathers of the head are exempt from this additional molt. The greater secondary coverts are



L M

Fig. 38. Male (L) and female (M) hybrid turkeys 25 weeks of age, after completion of the first winter molt in the body plumage. The partial replacement in the rectrices is nearing completion, and in the case of the male, the new feathers may be seen projecting beyond the rest of the tail.

retained in *M. g. silvestris* but are replaced in domestic turkeys. As far as I am able to determine, the body molt is complete, but due to the close resemblance of the late postjuvenal body feathers to the first new winter feathers, it is exceedingly difficult to tell from a series of skins the true extent of this body molt. If not complete, it is at least very extensive. There is no trace of typical postjuvenal body plumage in the late winter birds after molting has ceased.

The opinion has often been expressed that the white plumage of the ptarmigan,

which is assumed in the winter molt, is an adaptation to the arctic-alpine environment, either as a form of protective coloration or as a measure of conserving body heat. Salomonsen (1939) regards it as a mechanism of thermo-regulation. But the winter molt in turkeys involves no fundamental change in plumage color or texture, and it is not repeated after the first year. I am inclined to think that this additional molt is occasioned by the great increase in the size of the turkey during the first year's growth. The postjuvenal body plumage starts to grow when the juvenile is five to six weeks old and weighs around 500 grams, and it would seem physiologically impossible for so small a bird to produce a plumage adequate to cover a 5,500-gram gobbler during the winter. The proportionate increase in the size of the turkey, from chick to adult, is considerably greater than in smaller gallinaceous birds, as indicated by the following comparison with the Hungarian Partridge (weights of *Perdix* supplied by Robert McCabe in a personal letter):

Species	Average weight of day-old chick	Average midwinter weight of young male	Per cent increase in body weight
Hungarian Partridge	9 gm.	390 gm.	4300
Hybrid turkey (Lost Trail Game Farm)	42 gm.	5430 gm.	12900

In the turkey the increase in body weight during the first six months is three times greater than in the partridge. In this fact may lie the evolutionary necessity for adoption of a third molt among young turkeys in the period of most rapid growth.

NOTES ON THE ANNUAL AND PRENUPTIAL MOLTS OF ADULTS

Adult turkeys undergo two molts each year. The complete annual molt occurs during the summer and early autumn, following the breeding season. A partial prenuptial molt takes place in late winter. Insufficient material is available to describe fully these two molts, but enough is known of the annual molt in the hybrid strain to include the following notes.

The time at which the annual molt begins varies widely among individual birds, depending apparently on their sex, age and reproductive relationships. First to start molting are the young gobblers, whose mating duties, even though they do considerable strutting and gobbling, are probably light (not true of domestic turkeys). One specimen of the hybrid strain, collected while in the act of gobbling at Deer Run State Refuge, Reynolds County, May 22, 1942 (no. 180, coll. A. S. Leopold), was already growing three primaries and two secondaries. Another, obtained from the game farm on May 28, 1942, had shed four primaries and three secondaries. The last to start molting are hens with late nests. One hen at Lost Trail that persisted in stealing a nest had not started to molt on August 29, 1941. Of the wild turkeys in Missouri, most males probably start their annual molt in early June, most females in July. Domestic turkeys, whose mating season is somewhat advanced, start to molt a little earlier. The complete annual molt of an adult gobbler takes approximately four months. Salomonsen (1939) records the average period of annual or "autumn" molt in the male Rock Ptarmigan as not exceeding two months.

The annual molt is initiated by the dropping of the first primary. As in the postjuvenal molt, the sequence of replacement is progressive from the wrist outward toward the tip, but in this case the molt is complete, all primaries being replaced. Each greater upper covert is molted with, or just ahead of, its corresponding primary.

The secondary molt starts again with the third feather in the series, usually about the time the second primary is growing. In the annual molt, however, replacement of the secondaries is more complicated. After the third secondary is dropped, molt proceeds in a proximal direction, usually two or three new feathers growing at once. As

before, the two distal members of the series are dropped later, usually concurrent with replacement of the sixth and seventh feathers, respectively. But also, at about the time the second and sixth feathers drop, a new focus of molt begins in the eleventh secondary and spreads in a proximal direction, completing the replacement of the inner secondaries, numbers 11 to 16. Thus for a short period, molt in the secondaries is proceeding in three places simultaneously. This complicated pattern of secondary replacement in the annual molt is similar to the procedure in *Gallus, Perdix* and *Lagopus* (Salomonsen, 1939).

Usually after three or four primaries are shed the body molt starts on the sides of the breast and on the thighs (but not, as previously, in the interscapular region) and proceeds over the breast and down the legs and belly, thence to the rump and up the back. The dorsal cervical region is last to complete the molt. At the peak of the body molt almost half of the body feathers are growing at once.

Replacement in the tail is irregular, both as to time of starting and sequence. The first tail feathers may drop almost with the first primary, or as late as the sixth primary. Both the postjuvenal and first winter tail molts are centrifugal, originating in the center as already described, but in the annual molt, replacement is centripetal. There are nine pairs of rectrices in the turkey's tail, and molt starts in the eighth lateral pair, and proceeds inward from each side. One female specimen (no. 148, coll. A. S. Leopold) seems to have dropped the eighth, seventh, and sixth pairs simultaneously, for all these feathers have grown in to the same extent, but normally the replacement proceeds one pair at a time. The ninth, or outer pair, is retained until molt has almost reached the center of the tail, whereupon it is replaced concurrently with the central feathers. This curious reversal of the replacement order in the rectrices has no counterpart in other gallinaceous birds, as far as I know.

The prenuptial molt is represented in only two available specimens, and I am unable to describe it here. This molt appears to start among confined hybrid birds in February and to involve replacement of a considerable part of the plumage.

DIFFERENCES IN THE EXTENT OF POSTJUVENAL AND FIRST WINTER MOLTS

The degree of completeness of the postjuvenal molt is highly variable in many groups of birds, particularly in passerine forms, as Dwight (1900*a*), Miller (1931 and 1933), and Sutton (1935) have shown. In gallinaceous birds, however, postjuvenal molt usually follows a rather constant pattern and is subject to relatively little variation. The normal habit of retaining the two distal juvenal primaries is common to the whole order (Dwight, 1900*b*). Some of the families customarily also retain the juvenal greater upper primary coverts (van Rossem, 1925; Leopold, 1939; Petrides, 1942). Otherwise the molt is complete.

In all races of wild turkeys, the two distal, juvenal primaries are retained through the first winter (Bent, 1932; Petrides, 1942). In the domestic turkey, however, only the one distal primary, no. 10, is retained. A total of 56 turkeys of all strains have been examined in their first winter plumage. Without exception, all specimens of the native race, *M. g. silvestris,* possessed juvenal primaries 9 and 10, and all specimens of the domestic bronze strain had replaced 9, retaining only no. 10. Approximately half of the hybrids fell in each class. The data are summarized in part A of table 1.

The number of specimens of *silvestris* is lamentably small, but as previously mentioned, both Bent (1932) and Petrides (1942) have established the retention of the two juvenal feathers in the wing of young winter specimens, and neither of these authors mentions having found any exceptions. It appears, therefore, that a constant difference of one feather exists in the extent of the postjuvenal primary molt between wild and

domestic turkeys living in the same geographic area, and their hybrids are more or less equally divided between the two classes. A very few of the hybrid birds replaced the ninth primary on one wing and retained it on the other.

In two other respects the molts of *silvestris* and the domestic turkey are at variance; both concern the extent of the first winter molt. In *silvestris*, the postjuvenal greater upper secondary coverts are all retained through the winter, along with the secondaries. But in the domestic birds, part or all of this series of coverts is replaced in the first winter molt with showy, purplish-iridescent adult feathers. Generally the whole series is replaced, but in one group of eight young birds (Matt Adams farm, West Plains, Missouri), from four to six coverts only had been renewed in each wing, replacement always starting with no. 3 and proceeding proximally. Of 12 hybrids at Lost Trail Game Farm, five retained all postjuvenal coverts, four replaced from one to three coverts on each wing, and three replaced from four to six coverts (table 1, part B). As in the case of primary replacement, the tendency in the domestic bird is toward more extensive molt than that undergone by *silvestris*, and the hybrids show a diverse but more or less intermediate condition.

TABLE 1

Differences in extent of postjuvenal and first winter molts in wild, domestic and hybrid turkeys

	M. g. silvestris	Hybrid	Domestic
A. Retention of distal, juvenal primaries through first winter			
Retained primaries 9 and 10	5	15	—
Retained only primary 10	—	17	19
B. Replacement of postjuvenal greater upper secondary coverts in first winter molt			
No replacement	5	5	—
Replaced 1 to 3 coverts	—	4	—
Replaced 4 to 6 coverts	—	3	8
Replaced 7 or more coverts	—	—	11
C. Replacement of rectrices in first winter molt			
Replaced 2 central pairs	5	4	—
Replaced 3 to 5 pairs	—	18	7
Replaced 6 to 9 pairs	—	1	12

Similarly, in the first winter molt of the rectrices, only the center two pairs are customarily replaced in *silvestris*, whereas from four to nine pairs (whole tail) of new winter feathers are grown in the domestic turkey (table 1, part C). The hybrids are again intermediate, the great majority replacing three to five pairs (see specimens ASL-193 and B-82 in fig. 35). Although this tail molt normally proceeds in a uniform centrifugal manner, as previously stated, lateral pairs of rectrices dropping together, frequent irregularities occur, the most usual one being somewhat more rapid molt on one side of the tail than on the other. This is further complicated in some birds by the occurrence of supernumerary rectrices, an unpaired nineteenth feather being rather common in both the domestic and hybrid strains. But despite this individual variation, a clear difference is evident between the various strains in the extent of winter molt in the tail, the domestic birds again tending toward most extensive replacement, as was the case in the secondary coverts and distal primaries.

Before suggesting an explanation of this variability in the extent of the first year molts in turkeys, it may be well briefly to consider some of the known facts of molt in other species. That feather replacement is a direct response of the follicle to stimulation by thyroidal hormones seems to be well shown by a considerable amount of experimental evidence, which will not be reviewed here, but is adequately summarized by Salomonsen (1939:388-393). In explaining the variable timing and extent of the molts in widely separated populations of Rock Ptarmigan, Salomonsen found a close correlation between

seasonal temperatures and the molting habits of various groups of birds, and concluded that environmental temperature was the external stimulus, which, through direct effects on thyroidal secretion, indirectly controlled both the initiation of molt and its extent. In Scotland the winter molt of the ptarmigan was found to be incomplete, whereas in Greenland and several other localities of severe winter climate, the total white dress was always assumed through a virtually complete winter molt. The variable extent of the winter molt was laid to a temperature control. The time of inception and the duration of the molting cycles were also shown to be correlated with temperature cycles.

Salomonsen's concept of the complete external control of molt by temperature has recently been upset, however, by the work of Host (1942), who proved very conclusively that under experimental conditions the periodicity of light, rather than temperature, was the environmental factor which controlled the initiation of molt in the Willow Ptarmigan. The summer molt was induced in mid-winter by exposure of birds in outdoor pens to increasing periods of artificial light. Nonetheless, Salomonsen's temperature correlations are too complete to be ignored, and it seems highly probable to this author that temperature may have stimulating or inhibiting effects on both the rate and the extent of molt through direct effects on thyroid activity, although a light stimulus is apparently concerned with initiating the molt, possibly through stimulation of thyrotropic hormone production in the hypophysis. Such was the conclusion of Bissonnette (1935:160) from his experiments on the influence of light on sexual and molting cycles in the ferret. He states that "these hair cycles are conditioned to a considerable extent by cycles of activity of the anterior hypophysis induced by light cycles, rather than by temperature cycles alone. Variation of temperatures may, however, constitute a modifying factor, though of less importance than light changes."

Miller (1933) found a marked difference in the extent of the postjuvenal molt in *Phainopepla nitens lepida* in two climatic regions of California, birds of the Colorado Desert undergoing more complete replacement of remiges and rectrices than birds in the cooler coastal belt to the north and west. This difference was attributed to the later nesting of the coastal population, which allowed a considerably shorter period for the young Phainopeplas to mature and to molt prior to migration than that available to the non-migratory desert birds. Similarly, in *Lanius ludovicianus* Miller (1931) found differences in the completeness of postjuvenal molt in various races, particularly in the variable number of primaries replaced. But while the migratory populations (more northerly breeders) generally showed less replacement than the non-migratory forms, the correlation with migratory habit and latitude of breeding range was not complete, and Miller suggests the existence of "inherent average tendencies in some subspecies to undergo a more complete primary molt than that occurring in other races. These supposed heritable tendencies correspond to subspecific variation in purely structural features."

In the present case, variations in light, temperature or migratory habit cannot explain the molting differences in the several strains of turkeys, since all are resident in the same locality. Domestic turkeys do enter the breeding season several weeks earlier than the native birds, and most of their young, like the desert Phainopeplas, have a somewhat extended period in which to mature and complete their molts before winter; but one group of domestic birds hatching in late June, after the peak of hatch in wild birds, still followed the pattern of molt typical of the domestic strain, namely, invariable molting of the ninth juvenal primary and replacement of most of the postjuvenal secondary coverts and rectrices. Other environmental influences, such as food and confinement, have been considered as possibly affecting the molts, but rejected for a number of reasons, one of which is the fact that wild-living birds of the hybrid strain

seem to undergo the same degree of postjuvenal and first winter molt as the confined birds on the game farm. I therefore see no option but to conclude that the tendency toward more extensive first year molts in the domestic turkey is an inherited pattern, genetically controlled. It would follow that the intermediate expression of the differential molt in the hybrid birds is a function of their heterozygous genetic make-up. This view conforms with Miller's interpretation of the situation in *Lanius*. The native and domestic turkeys can therefore be considered distinct physiological strains in regard to their molting response to identical environmental stimuli.

It is recognized that all domestic turkeys were derived from *M. g. gallopavo*, the native race of central Mexico. The origin of these distinct molting patterns in the turkey might lie in the separate geographic and phylogenetic origins of *M. g. silvestris* and the domestic strain, or in the very domesticity of the latter. A single specimen of the native Mexican turkey is available that offers a clue in this regard (no. 197, coll. A. S. Leopold; taken January 8, 1938, in the northern Sierra Madre, Chihuahua, Mexico; classified as *M. g. gallopavo* until the taxonomic status of the turkeys of northern Mexico is further clarified). This bird is probably closely related to the wild progenitors of the domestic turkey and is in the mixed plumage of its first winter. All of the greater secondary coverts and all of the rectrices have been replaced with new feathers in the winter molt, which follows the pattern found in the domestic turkey, and suggests an early ancestral origin of this procedure. But the two distal juvenal primaries are retained as in *silvestris*, which, according to Petrides (1942) is normal in "all native subspecies" of turkeys. The habit of consistently dropping the ninth primary in the domestic strain may be the result of some physiological change which has occurred in the turkey subsequent to its domestication. Interestingly enough, the domestic chicken also retains only the tenth primary through the postjuvenal molt. It would be premature to draw any conclusions as to the origin of these molting differences on the basis of a single specimen, but it seems reasonable that an inherent molting pattern in *M. g. gallopavo*, distinct from that of *M. g. silvestris*, might have been further modified during the process of domestication.

The existence of distinctive characters in the molting habits of *M. g. silvestris* and the domestic turkey, and the intermediate expression of these differences in the hybrids, may have some practical use in helping to recognize the true relationships of birds of questionable origin. Particularly on game farms, where the purest possible strains of the Eastern Wild Turkey are being sought, recognition of the typical molts of *silvestris* may be helpful in selective breeding. It is not inconceivable that the molting habits of an individual turkey may be more closely associated with the physiological condition known as "wildness," than plumage color or general external appearance.

SUMMARY

Young turkeys undergo three molts before acquiring a stable winter plumage.

The postnatal molt is complete. The postjuvenal molt is complete except for the retention of one or two distal juvenal primaries in each wing. The first winter molt involves replacement of the body plumage, the lesser and middle wing coverts, parts of the tail, and sometimes the greater upper secondary coverts. A mixed winter plumage results, made up of some juvenal, some postjuvenal and some winter feathers.

Adult turkeys undergo two molts each year, namely, a complete annual molt in summer and fall, and a partial prenuptial molt in late winter.

In at least three feather tracts, the first year molts in young domestic turkeys are more extensive than in *M. g. silvestris*. Hybrids are intermediate in the extent of these replacements. Such differences in molting procedure are probably due to inherent tendencies in the various strains.

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