BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XXVI JULY, 1955 No. 3

NOTES ON THE EASTERN PURPLE FINCH

BY CHARLES H. BLAKE

The variation in color of brown-plumaged Eastern Purple Finches *(Carpodacus p. purpureus)* and the distinctions of age and sex have proven so puzzling to banders that it seemed well to undertake a renewed examination of museum specimens. It may be said at the outset that all the questions are not yet answered. However, some clarification of opinions expressed in the literature is possible.

The material critically examined contained 279 birds. Of these, 194 are in the collection of the Museum of Comparative Zoology. This includes 18 specimens from Lexington and Lincoln, Massachusetts, selected for collection from October 1952 to February 1953. The United States National Museum loaned a select series of 79 brownish individuals of *C. p. purpureus* and six examples of *C. p. nesophilus.*

This study has been greatly aided by the kind cooperation of several persons. Mr. and Mrs. Parker C. Reed of Lexington, Massachusetts, have enabled me to see a large number of living finches and to select appropriate specimens for the M.C.Z. collection. Mr. James C. Greenway, Jr., has facilitated in several ways the study of the material in his charge and arranged for the loan of the U.S.N.M. material by its curator, Dr. Herbert Friedman. Dr. John T. Zimmer enabled me to survey the material at the American Museum of Natural History. To all of them I tender hearty thanks.

Even a brief survey of the literature illustrates the dangers resident in too close adherence to one or a few characters for diagnostic purposes and in the easy assumption that the characters of the adults are essentially unchangeable. I have been impressed throughout by the remarkable amount of individual variation and the difficulty of fitting it into a consistent pattern of change.

An ideal statement of the problem is desirable even though we may be somewhat discouraged by the distance we fall short of the solution. We wish to be able to distinguish, in each sex, the following classes:

1. Juvenals, i.e. birds of the year before the postjuvenal molt.
2. First winter birds.
3. First nuptial plumage (at least in males).
4. Fully adult birds in winter plumage (assuming that males become rosy at the first postnuptial molt).
5. Fully adult birds in nuptial plumage.

Even this classification overlooks some possibilities, which have been generally ignored in ornithological literature.

1. Males delayed in assuming adult plumage.
2. Abnormally plumaged birds, such as intersexes or sex-reversed birds.

3. Aged birds (especially females).

We would make measurable progress if we could, with reasonable certainty, distinguish five categories.

1. Juvenals, ignoring sex.
2. First winter birds, ignoring sex.
3. First nuptial plumaged males.
4. Adult females.
5. Adult males.

When we resort to museum specimens we must balance the advantages of leisurely and detailed examination and ready comparison of specimens against certain well-known risks.

1. Sexing of non-breeding birds is not invariably reliable.
2. Specimens are often old and "foxed."
3. Very few individuals can be certainly aged.
4. Molting specimens are usually few or wanting.

With these considerations in mind I selected from the older part of the M.C.Z. series the following as a special subseries of brownish birds whose sexing appeared to be trustworthy.

TABLE I

SELECTED BIRDS, M.C.Z. SERIES

M.C.Z. NO.	DATE	LOCALITY	COLLECTOR
	MALES		
48213	1 Jan. 1896	Cohasset, Mass.	H. B. Bigelow
4728	12 May 1877	Watertown, Mass.	Bangs & Bangs
8355	23 Jan. 1884	Waltham, Mass.	W. Brewster
45873	26 Oct. 1875	Watertown, Mass.	W. Brewster
271892	17 Sept. 1870	Cambridge, Mass.	W. Brewster
8317	29 Mar. 1882	Belmont, Mass.	W. Brewster
2965	28 Feb. 1873	Watertown, Mass.	W. Brewster
4875	3 June 1871	Newtonville, Mass.	C. J. Maynard
40770	28 Apr. 1889	Washington, D. C.	C. W. Richmond
8663	21 Mar. 1884	Washington, D. C.	W. Brewster
12388	30 Nov. 1886	near Charleston, N. C.	A. T. Wayne
	FEMALES		
48215	Aug. 1895	Cohasset, Mass.	H. B. Bigelow
183069	7 Feb. 1931	Newton Centre, Mass.	F. H. Kennard
8360	30 Jan. 1884	Waltham, Mass.	W. Brewster
8356	24 Jan. 1884	Watertown, Mass.	W. Brewster
8345	17 Jan. 1884	Belmont, Mass.	W. Brewster
8346	17 Jan. 1884	Belmont, Mass.	W. Brewster
4903	27 Apr. 1880	Middlesex Cty., Mass.	W. Brewster
45874	28 Oct. 1875	Watertown, Mass.	W. Brewster
10905	30 Sept. 1885	Waltham, Mass.	W. Brewster
40767	28 Apr. 1889	Washington, D. C.	C. W. Richmond
40772	28 Apr. 1889	Washington, D. C.	C. W. Richmond

We are faced, then, with two major problems: age and sex. The overriding difficulty is to solve one problem independently of the other.

Age determination—It would be most helpful to have methods independent of plumage color to aid in distinguishing birds of the year

from older birds. I know of no criterion which does not gradually disappear. My personal investigations are not extensive enough to yield dates for the Purple Finch. In general, six points are worth examining.

1. Feather wear.—In most passerines the quill feathers (rectrices and remiges) are replaced only at postnuptial molts. A bird of the year does not replace them at the postjuvenal molt. (The Song Sparrow is a known exception.) Hence a bird showing symmetrical wing molt is more than a year old. The tail is a less certain indicator since accidentally lost feathers here are not infrequent and are replaced at once. A bird showing noticeable wear of all the quill feathers in very late summer or early autumn is a bird of the year. The difference in wear between old and young birds becomes less with the passage of time, being based only on the difference in age of the feathers. A further difficulty appears in the Purple Finch and will be taken up under the head of season of molt.

2. Underwing feathering. — In adult passerines a triangle on the postventral portion of the propatagium and the ventral faces of the humeral and radioulnar segments of the wing is covered by short, rather downy feathers. The area is concealed from ventral view by the pteryla patagialis corridorii (Lowe, 1942, p. 56)[1] and by the most lateral axillars. These downy feathers are acquired after the rest of the juvenal plumage. Their first appearance may really be with the first winter plumage. This bare area in juvenals is especially conspicuous before the feathers of the pteryla patagialis corridorii have attained full length. A few observations show that the Purple Finch agrees with other passerines.

3. Tibiotarsal feathering. — Juvenal passerines in mid or late summer show a noticeable sparseness of feathering of the tibiotarsus (drumstick). It may prove that the few, short, downy feathers present are part of the juvenal plumage and are replaced by more numerous, normal contour feathers at the postjuvenal molt. I have seen these bare legs on many Purple Finches which gave other evidence of being juvenal.

4. Greater primary coverts. — In passerines generally the juvenal greater primary coverts, like the remiges, form part of the first winter plumage. If, as is true for the Blue Jay, the juvenal coverts differ in color or markings from those of later plumages they may be used for age determination until the birds are a year or so old. In many species only the difference in wear between these feathers and the greater secondary coverts would be determinative. At molt the greater secondary coverts are shed almost simultaneously.

5. Incubation patch.—A discussion of this feature involves both age and sex. Bailey (1952), in an important paper, has summarized the essential points. The major skin changes, hypertrophy and increased vascularization, last from about egg-laying until the young are nearly ready to leave the nest. If these changes are present, they indicate an

[1]I suggest that the function of this pteryla is to contour and give aerodynamic smoothness to the proximoventral portion of the wing. Lowe's view is almost certainly incorrect.

adult, breeding female. The absence of such changes indicates nothing.

The other major item is what Bailey calls by the unfortunate term "defeatherization." Quite aside from its hybrid origin, the word is misleading. What is lost is not feathers in the usual sense but down. For this loss of down from most of the ventral apterium, the first event in the development of the broad patch, I suggest the term "deplumulation" (from plumula, a down). Bailey points out that it may occur a few days before the first egg is laid and the down is only regained as part of the general replacement of all feathering in the postnuptial molt. He closes his discussion with this significant sentence: "During the period between nesting and the fall molt it is difficult to distinguish the site of an old incubation patch from the unfeathered ventral apterium of an immature bird" (p. 127).

We may conclude that only a careful examination of the venter will enable one to say that an incubation patch is present and then only if the condition of the patch is favorable. The best characteristics are of relatively short duration.

6. Season of molt. — We have become used to thinking of the postnuptial molt in passerines as confined to August and the postjuvenal molt as beginning in the same month and running well into September. Magee (1936) brings forward considerable evidence that the postnuptial molt is much more prolonged in the Purple Finch. His observations dealt with the replacement of the remiges, including the tertiaries, and give no data on the postjuvenal molt. The order of molt is normal. (See Dwight, 1900). It appears that the beginning of remex molt may vary between July 5 and August 21, a period of 47 days. The same period separates the completion dates of September 16 and November 2. However, the beginning of remex molt is concentrated in the first half of the range given; about half the birds have started by July 15 and most of the rest by July 31. Magee estimated the average time required for this part of the molt as 72 days. He gave individual cases with estimated times from 55 to 98 days. Our observations suggest a duration of about 8 weeks for the postjuvenal molt.

It is clear that the postnuptial molt of the Purple Finch is a long process. The whole molt may well require more time than is given above. In passerines it seldom begins or ends in the remiges. There is much need of exact data on the occurrence and duration of molt in all our small birds. For the Purple Finch there is probably no period in summer or fall when the mere presence of molt defines an individual as adult or juvenal.

We conclude that age (as between juvenals and postjuvenals) may be determined independently for a few months during the summer and fall. It is more certainly done on a live bird seen more than once over a period of time.

Wing length—While there appears to be an average difference in wing length between male and female, the value of this character as an indicator of sex is rather small. The variation is large and so also the overlap of male and female dimensions. Other metrical characters were not studied because they are too difficult for banders to secure accurately.

The problem may be approached by finding the mean and standard deviation of a fairly sizable series of rosy males and from this computing the extremes of a series of 100 males. I measured the wing lengths (chord) of 84 rosy males. The extremes were 75 and 87 mm. with an average of 82 mm. The standard deviation was 2.4 mm. Eight selected young males (two of them pinkish) averaged 80 mm. and 9 selected females 79 mm.

Let us assume a Gaussian distribution with σ equalling 2.4 mm. Then, a series of 100 adult males corresponding to my average of 82 mm. should range from 75 to 88 mm. in wing length or 2.75 each side of the mean. A similar series of females would range from 72 to 85 mm. with an average of 79 mm. This enables us to forecast the long run experience. Four and a half per cent of females and 10 per cent of rosy males could be sexed by wing length. If the series of brown males is only taken to show that their wing length approaches that of the females, a still smaller proportion of all birds would be sexable.

If we take Ridgway's (1901, p. 128) figures only 21 per cent of my rosy male series exceed his longest female while on Groskin's (1950) basis only 8 per cent could be sexed by wing length. None of the selected brown males could be sexed by either criterion and of the females all would be sexable (against rosy males, not brown males) by Ridgway's figures but only one-third would be by Groskin's

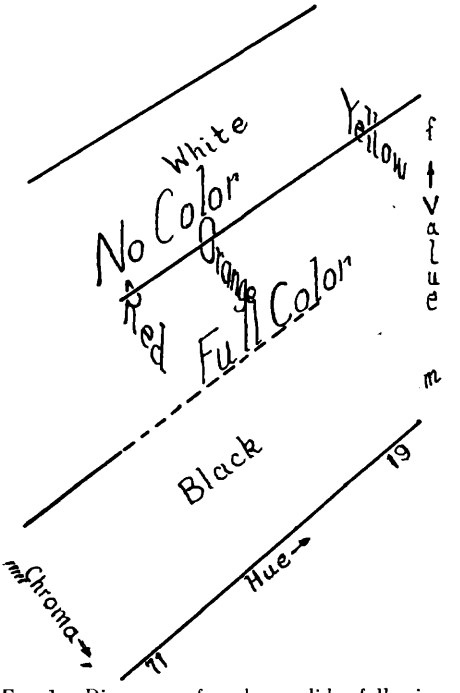

FIG. 1. Diagram of color solid, following Ridgway (1912).

criterion. It is safe to conclude that less than 15 per cent of all birds may be sexed by wing length. For some similar measurements see Weatherbee (1934). For another discussion leading to a similar conclusion see Blake (1954).

General color of the back—At the risk of retelling what many readers know I preface a discussion of the back and rump color with some fundamental points. All colors have three dimensions: hue, chroma, and value. Hue refers to the spectral position of the color, as red, yellow, etc. Chroma is a measure of the "coloredness" of the color. In terms of light we may think of a bright red light as having strong chroma which can be reduced by dimming the light. With pigments an admixture of black does nearly the same thing. Value is a measure of the depth of color without regard to chroma. Higher values represent a greater admixture of white light than do low values. In Ridgway's system hue is represented by numbers beginning with 1 for Red. The circle of hues is continuous. Red is adjoined by the reddest violet (really purple). Chroma is shown by primes; more primes, lower chroma. Finally, value is shown by lower case letters proceeding both ways from a middle value, first toward high values and then toward low values. Any color may be uniquely designated by this system and it has the merit of giving similar designations to similar colors and at the same time exhibiting the direction of passage from one color to another and the distance between them. Other numerical and literal systems will do the same thing but are less familiar to biologists. Fig. 1 shows a diagram of Ridgway's color solid in the arrangement here described. Capitalized color names are from Ridgway (1912).

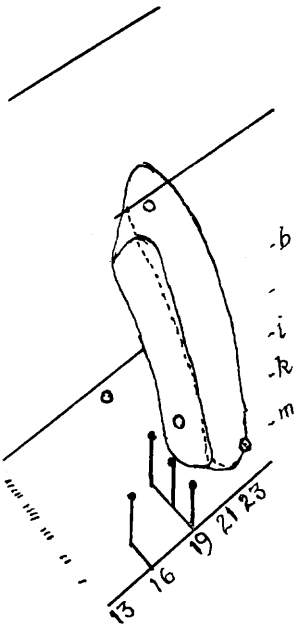

FIG. 2. Dorsal colors of olivaceous, brown birds and of juvenals of *purpureus*. In this figure and in Figs. 3, 7, and 10 the color and other data for the solid dots are given for each vertical line in order from left to right and from top to bottom on each vertical. 1st vertical — 16′m — juvenals; 2nd— 19″m; 3rd—19′m; 4th—19m— olivaceous, brown birds. Top open dot — 23″ ″ ′b — Olive Gray; left lower open dot — 17″ ′k — Olive Brown; center lower open dot—21″m—Olive; right lower open dot — 23m — Olive Green. The outlined solid includes most olive hues.

In the Purple Finch there are some surprizing similarities revealed between very different looking colors.

Ridgway (1901, p. 128) may be as much responsible as anyone for the idea that the non-red individuals are "olivaceous." He says of the adult female: "Above olive or olive grayish (more olivaceous in winter), streaked with dusky and, to a lesser extent, with whitish."

There are, in fact, a few individuals which may be called olivaceous and they are striking enough to be singled out quite readily. However, it is by no means easy to assess the average coloration of an area of streaked and variegated feathers. I have tried to do this for the most olive specimens in the M.C.Z. series. The sexes are as labelled. The specimens are mostly from April, one February and two May birds being included.

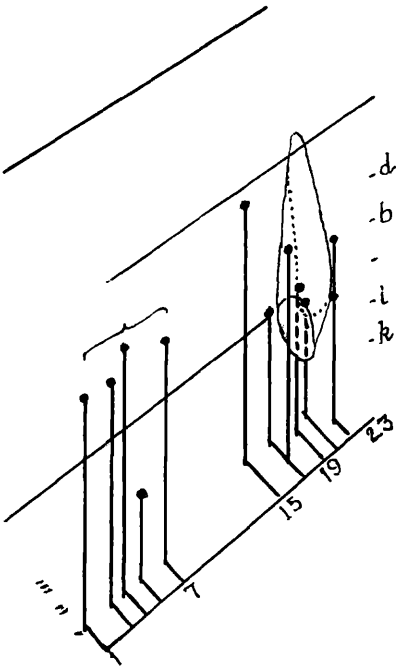

FIG. 3. Rump colors. 1st vertical—1′b—adult ♂ *nesophilus;* 2nd—3′b—adult ♂ *purpureus* and *mexicanus frontalis;* 3rd—4′c—somewhat rosy ♂ *purpureus;* 4th—5′k—pink ♂ *purpureus;* 5th—7′b—adult ♂ *purpureus,* Ft. McMurray; 6th—15″d—juvenal *mexicanus frontalis;* 7th—17″i—juvenal *purpureus;* 8th—17′b—adult ♀ *purpureus,* M.C.Z. 279357 (p. 96); 9th—19′/19″i—brown *nesophilus;* 10th—20″j—average brown *purpureus;* 11th—21′—particolored ♂ *purpureus,* M.C.Z. 724, 21′i—adult ♂ *purpureus,* M.C.Z. 44435 (p. 102). The outlined solid contains 90 per cent of brown *purpureus.* The bracket spans the range of red males of *purpureus.*

Two birds (♂ and ♀) are Medal Bronze (19m), one male is Saccardo's Olive (19′m) and five (one ♂) are Brownish Olive (19′′m). All the colors are yellowish orange-yellow of rather high chroma and very low value. In no case would I regard olive or olive-grayish as fair descriptions of the average color even though they might be for the feather edges. The actual colors are more orange (browner) and darker than Olive (hue 21), also of much higher chroma than any grayish-olive (21′′′′) or Olive-gray (23′′′′′). (Fig. 2).

The dorsal color of the juvenal plumage (see below) may be designated 16′m. This has the same chroma and value as the most olive birds but the hue is nearer orange. The usual brown bird would fall somewhere between the juvenal plumage and the selected olivaceous examples. Fresh specimens are darker than old museum specimens.

It is of interest to notice that immatures and females of *C. p. californicus* are noticeably greener dorsally than *C. p. purpureus*.

The rump—Except in the juvenal plumage, the rump is rather distinct from the back in color. This difference is mainly caused by broader light edgings and somewhat lighter central streaks to the feathers. In brown birds these edgings are usually more yellow than true Olive and paler than the average color of the back. The distribution of the colors is shown in Fig. 3. There is no evident sexual difference and in the figure all brown (M.C.Z. non-juvenals) birds are lumped together. The average color is half-way between Isabella (19′′i) and Buffy Olive (21′′k). Even the rump colors run a little browner than the truly olivaceous tints but there is a considerable overlap.

The important tendency in the rump color is toward browner colors which lead finally to the red of the adult male. Two somewhat rosy males in the M.C.Z. series show orange-red tints. No. 8317 from Belmont, Mass., 29 March 1882, is Light Coral Red (5′b) and no. 4875 from Newtonville, Mass., 3 June 1871, shows Jasper Pink (3′d). Probably these birds are males well over a year old. The shift seems to involve all three color dimensions and yields redder colors of higher value and chroma than the rump colors of juvenals and females.

The more or less reddened males may be placed in three groups. Immature but pinkish males show rump edgings of hues 5 and 7. Fully rosy males have these edgings of hues 1 and 3 and much lighter than the pinkish males. Some adult males (M.C.Z. #279191 and 279194) are not distinguishable in color from some immature males. The third group includes a few unusual birds such as a parti-colored male and an odd bird from Ft. McMurray described below (pp. 102, 108).

It appears probable that adult females fall into two groups. The first of these is of the same hue (20) as the average brown bird but is lighter. On the other hand some adult females are quite buffy yellow in general tone. One of these (M.C.Z. 279357 from Lincoln, Mass.) has the rump edgings Antimony Yellow (17′b). Further comment on this bird appears below (p. 106).

The juvenal rump color is close to Tawny-Olive (17''i).

There appears to be a very marked variation in the rump color of some individuals from year to year. The best record of this variation is in C. L. Whittle (1933, 1934), Whittle and Whittle (1927), and H. G. Whittle (1928). The comments on five birds, all supposed to be females, may be summarized.

Band No. 66868	20 July	1924	not very olive yellow
		1925	strong olive yellow
		1926	not very olive yellow
		1927	reddish brown
66881	5 July	1924	strong olive yellow
	31 May	1925	reddish brown
	15 May	1926	not very olive yellow
	9 May	1927	same
83998	15 June	1924	strong olive yellow
		1925	same
		1926	same
	14 May	1927	dull rosy with central patch of rich olive yellow
	9 May	1928	yellow with patches of rich reddish brown in upper tail coverts
A18034	5 May	1925	rosy
	29 May	1926	similar
	13 May	1928	crimson but duller than in old males
B69309	5 May	1931	yellowish olive
	18 Apr.	1932	more rosy
	1 Oct.	1932	pale rosy
	5 Apr.	1933	bright yellow
	16 Aug.	1934	rich, dark rosy

In the last bird the postnuptial molt of rump feathers in 1932 seems to have occurred after 1 October.

Throat markings—The portion of the throat between the malar stripes shows great variation in the amount of dark marking. The juvenals show uniform heavy marking. At the other extreme are a few brown birds with practically no dark markings in the area. The differences are not due to wear. As the rosy males lack dark throat marks we may suggest that the differences are in some part a matter of age.

Although there seems to be great individual variation, the general statement above is borne out by averages based on the scale of markings given in Fig. 4.

TABLE II. GRADES OF THROAT MARKINGS

Juvenals	4	M.C.Z. series
Imm. females	3	12 from Washington series
Imm. males	2	12 from Washington series
Adult females	3½	7 from Washington series
Rosy males	0	M.C.Z. series

Seven immature males from the Lexington series average 2½. The immature males and females overlap almost completely. None of the females are Grade 1 but a few males are Grade 4. The group of adult females undoubtedly includes some in first nuptial plumage. Repeated estimates by banders handling known old birds will give us a better grade figure. One adult female (M.C.Z. 279357), a very yellow bird,

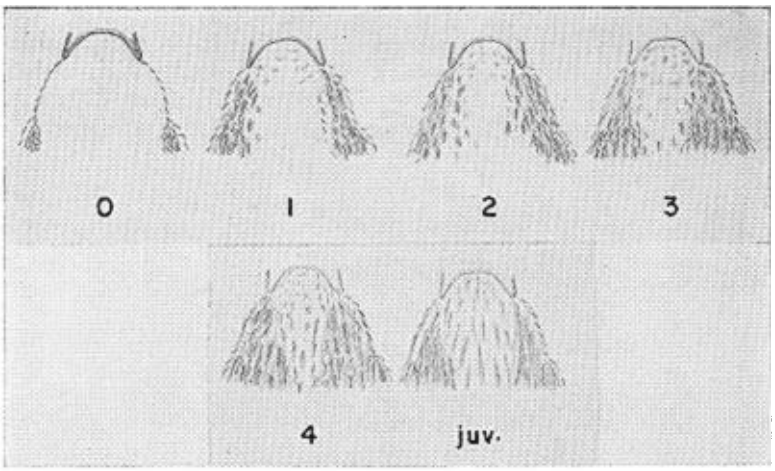

FIG. 4. Scheme for numerical grading of throat markings.

has the throat of type 1 and a similar bird (Amer. Mus. Nat. Hist. 365491) taken Jan. 1, 1892, at Bridgeport, Conn., is type 2.

Breast, sides, and flanks—These portions of the underparts show two points of interest, the variation in the streaking and their buffiness. A third point, pink tinting, will be taken up later.

Because the streaks on the ventral feathers differ considerably according to location, I have placed the chief reliance on the side of the bird about opposite the tips of the greater primary coverts and two to four streaks lateral to the edge of the unmarked central area. As a possible aid in describing the streaking I propose the arbitrary, numbered scale of Fig. 5. The drawings are diagrams not precisely showing any individual feather. It will be seen that the streaks are either somewhat linear or are subtriangular (deltoid). There is some difference in the upper (i.e. proximal) angle of the deltoid streaks. Over the chest the streaks tend to be more deltoid than on the sides. In a few cases these broad streaks carry down onto the sides so that their streaking might be rated 4½. The extreme of dark marking of the underparts is shown by a bird (A.M.N.H. 25510) marked ♀ and taken in New Jersey in November 1848 which has the sides and a band across the upper breast almost solid brown.

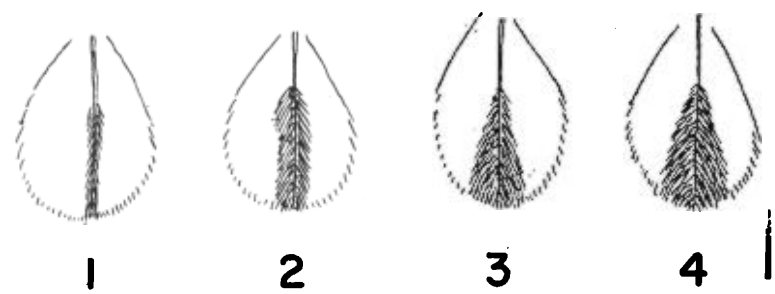

FIG. 5. Scheme for numerical grading of side streaking.

Taking the birds of the M.C.Z., Lexington, and part of U.S.N.M. series whose age and sex both seemed certain, we may draw some rather tentative conclusions. The juvenal streaking is about midway between 2 and 3. It is certainly narrower than that of the first winter plumage. The streaking of the brown first winter plumage is the broadest found in any plumage but quite variable and averages nearly 3½. It may well prove that it is slightly broader in females than in males (3½:3) but a wide overlap is evident. There are only three specimens that seem to be clearly adult females and they average just over 2½ or a little narrower than in first winter plumage. One of these is the yellowish bird (M.C.Z. 279357) which is type 2. On the other hand a similar looking bird (A.M.N.H. 365491) has its sides type 3.

The males offer a more involved problem. Two pinkish males in first winter plumage are both 3 which is about what one would expect. Two similar looking *adult* males are both 2. Two quite rosy adult males still show some streaks on the sides and average just under two. The normal rosy male shows no streaking. It appears that the narrowest streaks occur on the most highly colored males. The question that remains is what is the effect of increasing age on the streaking of females? Only bird-banders who save samples of side feathers or carefully record the grade of the streaking can clarify and extend the above conclusions.

The buffy tone of the underparts of some Purple Finches is well known. When fully developed it is found as an outer zone on all the streaked feathers (Fig. 6.) of the underparts except the undertail coverts. Its color is best studied on the breast feathers. For this purpose I have used the Lexington series, where three tints were found: Pale Ochraceous Buff (15′f), Light Ochraceous Buff (15′d), and Warm Buff (17′d). The average (7 birds) is practically Light Ochraceous Buff. Since the four pinkish birds in the same series show three similar tints they may be mentioned here and the whole set of colors shown in one diagram. These pinkish tints on the breast feathers are also buffy: Pale Flesh Color (7′f), Salmon Color (9′d), and Apricot Buff (11′b). Finally, the rosy males have edgings which are from Eugenia Red (1′-) to Jasper Pink (3′d). It is noteworthy that all these colors are of the same chroma (′) and that increasing maleness of plumage correlates with increasing redness. (Fig. 7.).

FIG. 6. Fresh (Sept.) breast feather of a brown bird.

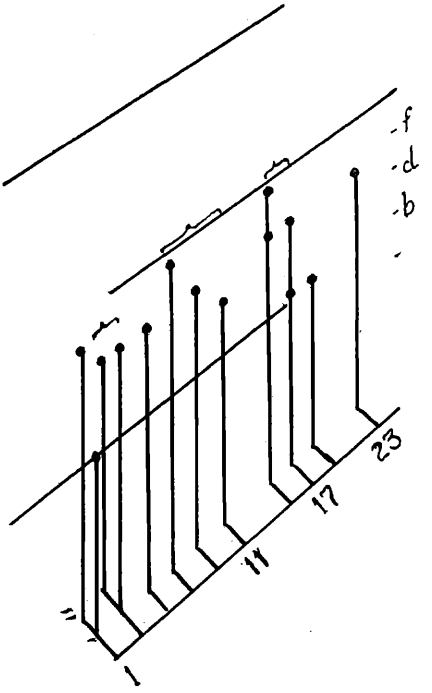

FIG. 7. Breast colors. 1st vertical—1′d/1″d — adult ♂ *nesophilus;* 2nd — 1′ — adult ♂ *purpureus;* 3rd — 3″b — adult ♂ *purpureus,* M.C.Z. 276012 (p. 102); 4th—3′d—adult ♂ *purpureus;* 5th — 7′f — pink ♂ *purpureus;* 6th—9′d—pink ♂ *purpureus;* 7th—11′b—pink ♂ *purpureus;* 8th—15′f, 15′d—brown *purpureus;* 9th — 17′d — brown *purpureus;* 17′ — brown ♂ *purpureus;* 10th — 19′ — adult ♂ *purpureus,* M.C.Z. 40764 (p. 102); 11th—23′d—adult particolored ♂ *purpureus,* M.C.Z. 724. Left bracket spans breast colors of normal adult ♂ *purpureus;* center one, pink ♂ *purpureus;* right one, brown *purpureus.*

Buffiness of the ventral feathering is evidently a character of the fresh winter plumage but does not occur on fully rosy males. The loss of the character is, in part, due to fading. Starting with brown birds (M.C.Z. series) in July, we find a late July bird very buffy and almost wholly in fresh plumage. Three others are largely unmolted and only one shows some buffy. One bird of early August is mostly in juvenal plumage and shows only a trace of buff. The other two August birds, all 11 from September and all 8 from October are very buffy and in fresh plumage. The amount of buffiness is less in November and December but more than shown by any later birds. Two out of nine January birds show a trace but none is shown by 10 February and four March birds. Two out of 16 April and one out of 17 May

birds show a trace. C. L. Whittle (1928) came to the same general conclusion. The occasional persistence of buff in the spring may be confined to extreme buffy females.

Mesial streakings of undertail coverts—Ridgway (1901) remarks that the longer undertail coverts are rarely marked with narrow, mesial streaks of dusky. I found such streaks on 8 per cent of the rosy males and on 10 per cent of the brown birds of the M.C.Z. series. One out of the three M.C.Z. juvenals showed them. It is highly unlikely that so rare a character can have any diagnostic value as to age or sex.

Mr. Parker C. Reed is of opinion that this streaking occurs on a much larger proportion of birds than stated above. His records of 48 birds handled in November and December, 1952, validate this opinion since exactly half of them show streaking. In a few cases the shorter coverts are streaked as well as the longer ones.

Red or yellow feathers on brown birds—The occasional presence of red feathers on the heads of brown birds has long been known. Whittle and Whittle (1927) hold that such feathers may occur on females. A more rare condition is to find an occasional greenish yellow feather. The present series shows five birds with red and four with yellow feathers. Only one of these nine birds is considered to be a female. It is worthy of remark that most of the birds with yellow feathers were taken from New Jersey southward and all those with red feathers from the same latitude northward. However, no summer birds are involved, so it is not clear that a difference in breeding populations is shown.

While one would expect such red feathers to occur only where red occurs on the adult males (and such is the case), it is strange that no isolated feathers are on the rump. This latter area shows some tendency to vary as a whole rather than piecemeal.

The view that scattered red feathers are a peculiarity of males is lent some support by the fact (very generally true) that a feather lost between molts is replaced by a feather of the type that would be produced at the next regular molt. However, this supposition does not explain the yellow feathers mentioned above. Yellow is known on males but appears to be very rare. One immature male, from Lexington, Mass., (M.C.Z. 279197) has a Cinnamon Rufous feather in the left superciliary area.

Pink tinting of underparts—Four fresh specimens taken at Lexington, Mass., in October, 1952, show pink tinting of the underparts. Two (M.C.Z. 279191 and 279194) appeared to be adult males and the other two (M.C.Z. 279190 and 279193) are considered first winter males. The colors of the edgings of the breast feathers and of the rump feathers were assessed as shown in Table III.

All of these birds show some additional reddening in the way of scattered feathers in the dark areas of the head or reddish tinting of the back or shoulders. Nos. 279190 and 279191 both have definitely pink throat feathers. Fig. 7 shows the colors of the breast edgings in relation to the colors found on ordinary first winter birds and rosy males. Another immature male (279195) shows several deep pink

TABLE III. SELECTED MALES FROM LEXINGTON

M.C.Z. NO.	BREAST	RUMP	STREAKING OF SIDES
Adult			
279191	near Apricot Buff (11'b)	Brick Red (5'k)	2
279194	Pale Flesh Color (7'f)	near Brick Red	2
Immature			
279190	Salmon Color (9'd)	Morocco Red (5k)	3
279193	Salmon Color	Brick Red	3

throat feathers and a rump near Hay's Russet (7'k). The color of the edges of the breast feathers is not determinable. It seems reasonable to conclude that pink tinting of the underparts is a mark of males but that it does not bear any well-defined relation to age. However, the pinkness of the underparts does vary with the general reddening of the plumage. The transition from buff to pink or light red is a gradual one and we may regard the colors given above as mixtures of buff and light red.

Particolored birds—The section above on red or yellow feathers on brown birds describes the initial manifestations of particoloring. Here I describe some M.C.Z. specimens which exhibit patches of color rather than just isolated feathers. The first is a brown male, No. 48213, from Cohasset, Mass., Jan. 1, 1896, which shows a small patch of yellowish in the malar stripe and another on the opposite side of the breast. These two patches are not quite identical in color but both are near Yellow Ochre (17'-). The color is similar to but of lower value than the buffy colors of the edgings of the breast feathers.

No. 18811 from Wellesley, Mass., May 3, 1885, has part of the right side of the upper tail coverts with Old Gold (19'i) edgings. It is a quite normal adult male otherwise except that the crown is bluer (Pomegranate Purple) than the others measured. Two other adult males show yellowish areas. One, from Cambridge, Mass., Jan. 25, 1892, (No. 44435), has the edgings of most of the rump and upper tail coverts Olive Lake (21'i). The other, No. 40764, Minneapolis, Minn., Apr. 14, 1888, shows a small patch of Primuline Yellow (19'-) on the left side of the breast.

C. L. Whittle (1928) describes an "olivaceous" bird (band no. A28-748) as having a primrose yellow patch on abdomen and flank and buffy under tail coverts. The variability of such particoloring is pointed out by H. G. Whittle (1928) who describes a probable female (band no. 83998) which on May 14, 1927, had the rump dull rosy with a central patch of rich olive yellow and on May 9, 1928, had a yellow rump with patches of rich, reddish brown in upper tail coverts, and a few crimson feathers in the crown.

The final example (M.C.Z. 724, Watertown, Mass., Feb. 28, 1873) is a remarkable harlequin male. It has yellowish areas in the following places: most of crown but not nape, forehead, most of superciliaries, front of cheeks, sides of chin, an irregular horseshoe across the middle of the breast and down the centers of the sides, edgings of greater secondary coverts, most of scapulars and across the middle of the back, upper part of rump and a little of the right upper tail coverts. Except

for a few breast feathers there is no intergrading of yellowish and rosy. The almost complete symmetry of the pattern is quite striking. The crown color is Antimony Yellow (17′b), the rump Wax Yellow (21′-) and the breast Barium Yellow (23′d). The red portions are of normal color.

Although it seems not unreasonable that females with reddish areas may be relatively old, it is not yet clear what yellow patches on males mean beyond local peculiarities of the carotinoid metabolism. From the tendency of the patches to involve whole feathers I would conclude that the site of the change is in and closely adjacent to the feather follicle. The phenomenon can hardly have an environmental or dietary origin in the cases described. The House Finches from Molokai Island noticed below may owe their abnormal color to some extrinsic cause. In this connection I cite the fact that caged Purple Finches have the red replaced by golden yellow. One such bird marked as a caged ♂, second molt is A.M.N.H. 83078. Since the specimen came from the Sennett collection it may be *C. p. californicus*. Another specimen (A.M.N.H. 365714) taken Apr. 8, 1911 at Witch Creek, San Diego County, California, is very similar.

The yellow colors noted in the descriptions above have hues within the general range of olive but are of slightly higher chroma than the usual rump color of females or young. This would appear to be nothing more than a greater replacement of melanin in the barbs by carotinoids as is generally true of the feather edgings in males. I have handled one rosy male with a patch of olivaceous on the right side of the rump. The red rump feathers lacked, as usual, the dark central streak but this was fully developed in the olivaceous feathers.

Precise chemical knowledge of the carotinoid pigments in this species and other related finches is clearly a desideratum for our understanding of the color sequences.

Note. At this point we may insert a description of an immature female (M.C.Z. 279356) taken at Lexington, Mass., 14 January 1953. At first sight the specimen is normal. A closer look shows that the wing quills are marked with a white stripe resembling that found in other cardueline finches. In the right wing the fourth to second secondaries are white for about half their length from the bases. The white does not extend so far out the fifth secondary. The first secondary shows no white! The first four primaries have the white areas extending about 2/3 their length. From the fifth to the eighth primary the feather bases are dark, gradually reducing the length of the white patches. On most feathers the distal end of the patch is some 19 or 20 mm. from the end of the feather. Its extreme outward extension is to about 15 mm. from the ends of the sixth and seventh primaries. The left wing is similar but the first secondary is like its neighbors and a little of the outer edge of each vane of the fifth and sixth secondaries is whitened. While each vane of the feathers is whitened there is a dark shaft streak and each white area terminates by a diagonal and vague line, blending into the normal dark color.

If these wing stripes are not of the same genetic origin as those in other finches, then they are a remarkably good imitation. That they

might be the latter case is, perhaps, hinted at by the all dark right first secondary. In any event I am inclined to regard this feather as of a different feather coat from the rest of the remiges. We are certainly not dealing with either traumatic or genetic white spotting. We may conclude that it has nothing to do with age or sex and, further, that the marks are not an extension of the normal light edges of the quill feathers, since these are not white in any plumage.

The colors and the color changes due to wear—No attempt will be made to discuss all aspects of feather color in this section. The intention is to show the physical mode of production of some rosy, olive, and yellowish colors and the close relation that exists between them. The matter has already been touched on by Dwight (1900), Whittle and Whittle (1927), and C. L. Whittle (1928). There is general agreement that wear leads to a brightening of the red and yellow colors in spring. There seems to be only a rather minor prenuptial molt, confined to the front of the head and occurring around mid-April.

Red or yellow colors involve the replacement of brownish or blackish melanin by red or yellow carotinoids in the barbules and ultimately in barbs and even feather shafts. In general this replacement is centripetal. After the feather is fully formed color change results from the effects of wear and fading. The former is again centripetal while the latter affects all the exposed portion of the feather but is most conspicuous in the less deeply colored parts. The various olive tints come from the apposition of yellow barbules and blackish barbs.

All of the brown, olivaceous, and buffy feathers show one general pattern: (Fig. 8.) a dark central streak and a more or less wide light margin which is usually still lighter toward the edges of the feathers. Abraded plumage (Fig. 9.) tends to be darker and browner than fresh plumage. The effect of fading is to increase the contrast between the light and dark portions of each feather. The over-all result is narrower and lighter edgings than in fresh plumage. On balance the general tone may become slightly browner and the streaking a little more evident.

C. L. Whittle (1928) points out that yellow feathers have both barbs and barbules yellow. There may be some confusion here between carotinoid yellow and melanin yellow. He says further that olive-yellow and rosy feathers have such color only in the barbs while the

FIG. 8. Fresh (Sept.) back feather of a brown bird.

FIG. 9. Worn (late May) back feather of a brown bird.

barbules are pale gray to smoky. This accords with the usual situation in birds. It further agrees with Dwight's (1900) statement that reddening in spring is due to wearing away of whitish barbs. Whittle and Whittle (1927) confirm this and also find some yellowish rump colors to vary from the same cause. They describe other specific colors:

1. Pale brown—pinkish brown barbs and unworn very dark gray barbules;
2. Brown—reddish brown barbs and partly worn dark gray barbules;
3. Reddish brown—a. reddish brown barbs without barbules,
   b. rosy barbs and partly worn dark barbules.

The role of fading is more difficult to assess exactly since one would rarely know with certainty the initial color of the feather. The loss of ventral buffiness in the first winter plumage arises both from a rather extensive loss of the feather margins involving as much as half the length of some barbs.

Wearing away of the less heavily pigmented parts of the barbs may play a much larger part in color change than has been generally recognized. Dwight (1900) pointed out the power of heavily pigmented parts of feathers to withstand abrasion. In brown birds the light margins referred to above are much abraded by May. The change is even clearer on the back feathers of rosy males. In fresh plumage each feather has a dark center then a rosy zone and finally a nearly white margin. Such birds have a "frosted" appearance. By May this white margin is almost abraded away but the rosy zone has suffered but little damage.

Finally, it must not be supposed that the visual difference between yellow and red is indicative of any far-reaching chemical differences. No data exists on which to base a specific statement. The gross colors of carotinoid samples depend on concentration as well as on chemical composition and stereoisomeric state of the individual components.

Juvenal plumage—The eleven birds (4 males, 7 females) in juvenal plumage range in date from 20 June to 16 October. The juvenal plumage may be known by its general fluffiness and by the short and decomposed undertail coverts. These characters hold of passerines generally. More specifically, the underparts are heavily and rather finely streaked except on the center of the belly and the undertail coverts. The general impression is that the underparts are grayer in tone than in later plumages. This is not borne out by examination of single feathers. The grayness arises from the dark gray down showing through the terminal portions of the feathers. There is scarcely a trace of ventral buffiness.

The upper parts, particularly crown and nape, are a more uniform dark brown (close to Prout's Brown or Mummy Brown) than in later plumages. This means that there is little distinction between the central streak and the feather margin.

The greater secondary coverts are conspicuously tipped with buffy brown and the outer vanes of remiges and rectrices show distinct yellowish olive margins. These margins wear sufficiently rapidly to become obscure or wanting in the first winter plumage.

I do not find myself in agreement with the inference of Whittle and

Whittle (1927) when they speak of juvenals as quite buffy. There is no evidence of difference between the sexes in juvenal plumage. We may sum up the first plumage as the darkest and plainest of the plumages.

First winter plumage—As has been already pointed out there seem to be two extremes of the first winter plumage grading into one another. The normal brown plumage passes by way of birds with scattered red (or yellow) feathers to quite pinkish male plumages described in the section on pink tinting of the underparts.

In the normal plumage the general color of upperparts, wings, and tail is brownish with a light superciliary stripe extending well behind the eye and another along the malar region dorsal to the dark lateral throat stripe. In a few cases the upperparts have a somewhat olive cast. Individually the dorsal contour feathers have very dark central streaks, Blackish Brown (1) (1′′′′m) to Fuscous Black (13′′′′m), a lighter midzone and still lighter edges (Fig. 8). Museum specimens show the greatest foxing in the darkest parts of the dorsal feathers. The wing and tail feathers are generally dark with narrow olivaceous edgings. The underparts are whitish with subdeltoid streaks, except the belly, and with the buffy margins already discussed. There is no clear cut indication of sex in this plumage but it is probable that those with the narrowest ventral stripes are male and those with the widest, female.

Since the adult female plumage is very similar it would be unexpected to detect any evident transitions. Males do show transitions. As already noted, and contrary to Whittle and Whittle (1927), the presence of scattered red feathers, at least in first winter plumage is almost confined to males. Any more extensive reddening or a pink wash on the underparts is also chiefly a male character but not necessarily an indicator of first winter plumage. This pinkish wash correlates with a slight lightening of the ventral streaks.

The adult female—So far as is now apparent one might, without much risk of error, adopt the second paragraph of the preceding section as a description of the adult female.

There remains to be considered the possibility that old females may become somewhat masculine in plumage. Some cases have already been noted in the sections on rump color and on particolored birds. The particular birds are Band Nos. 83998 and A 18034. In both the rump acquired a reddish tint at ages of at least three or four years. I have handled one female, Band No. 49-21170, which when at least three years old showed a reddish cast at the rear of the crown. It is possible that occasional red feathers on the head are also a mark of very old females as they appear to be of young males.

Any series of apparently adult females is almost certain to contain a fair proportion of birds in first nuptial plumage. It is not surprising that the seven adult females in the Washington series (5 of them spring birds) show throat markings averaging over 3 and side streaking averaging nearly 4. Only the bird banders can tell us much about fully adult females.

The buffy yellow adult female already referred to (M.C.Z. 279357)

has the rump edgings Antimony Yellow (17′b) which is near the orange limit of the rump colors of brown birds and between the yellowish and the reddish groups in the male series of colors. This same bird has an Ochraceous Buff (15′b) breast which falls in the orange half of the series of buffy breast colors. The yellowish colors of this adult female are about midway between those of the first winter plumage and the pinkish males.

Adult male—The fully plumaged male has the pileum, malar stripes, throat, breast, sides, and most of rump and upper tail coverts reddish. The remaining contour feathers of the head, dorsum, and wing coverts have reddish margins, which on the dorsum and greater and middle secondary coverts are more or less edged with white in fresh plumage. The outer vanes of the remiges and rectrices are narrowly margined with some shade of red or orange. The underparts are usually unstreaked, the belly white, and the under tail coverts white or, occasionally, buffy pink. The auriculars are a rather violet brown. The

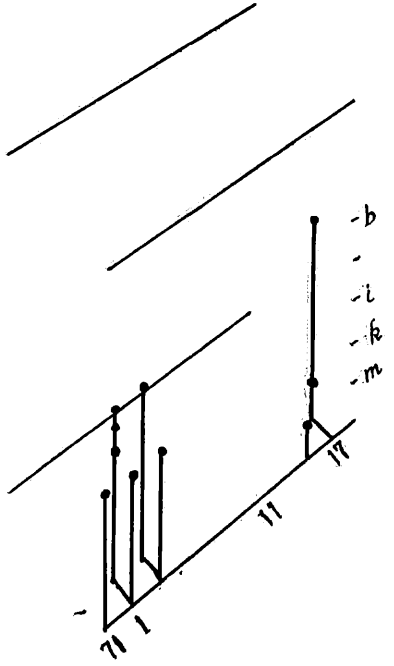

FIG. 10. Crown and forehead colors. 1st vertical — 7li — adult ♂ *purpureus* and *nesophilus;* 2nd—1′—adult ♂ *purpureus,* 1′h — average adult ♂ *purpureus,* 1′i — adult ♂ *purpureus;* 3rd — 1i — adult ♂ *purpureus;* 4th—3′—adult ♂ *purpureus,* Ft. McMurray; 5th—3i—adult ♂ *mexicanus frontalis,* 6th—15m—juvenal *purpureus;* 7th—17′b—particolored adult ♂ *purpureus,* M.C.Z. 724, 17′m — juvenal *purpureus.*

centers of the red margined dorsal contour feathers and the quills are dark brown. Contrary to Ridgway (1901) I find streaking of the underparts, except under tail coverts, to be very rare (less than 2% of M.C.Z. series).

Ridgway refers to the color of the crown as "deep wine purple (more crimson in summer)" and to the rump and underparts as pinkish wine purple. (Fig. 10). These colors, based on the 1886 edition of his color standards (see Ridgway, 1912, p. 41), are about 70′k or between Rosolane Purple and Indian Lake. These colors are bluer than those I found except the crown of one bird. I took seven clean adult males at random from the M.C.Z. series with the following results.

TABLE IV. ADULT MALES, M.C.Z. SERIES

NO.	LOCALITY	DATE	CROWN	RUMP	BREAST
14083	Milton, Mass.	May 10, 1887	Acajou Red	Old Rose	Alizarin Pink
9316	Shelbourne, N. H.	July 10, 1884	Carmine	Old Rose	Jasper Red
18579	Oden, Mich.	May 20, 1888	Acajou Red	Lt. Jasper Red	Alizarin Pink
18811	Wellesley, Mass.	May 3, 1885	Pomegranate Purple	Old Rose	Jasper Pink
11865	Middlesex Co., Mass.	Oct. 4, 1886	Eugenia Red	Jasper Pink	Alizarin Pink
66061	Lexington, Mass.	Nov. 20, 1914	Eugenia Red	Lt. Jasper Red	Lt. Jasper Red
723	Watertown, Mass.	Mar. 2, 1875	Acajou Red	Lt. Jasper Red	Old Rose

The average colors of this group are: crown (1′h) between Acajou Red and Eugenia Red, rump (3′b) Light Jasper Red, and breast (2′d) between Alizarin Pink and Jasper Pink.

The extent of variation is shown by a specimen (M.C.Z. 231531) from Ft. McMurray, Alta., which was examined because the center of the lower breast and the sides were nearly white. Its red colors proved to be more orange than those already listed: crown, Jasper Red (3′-); rump, Carrot Red (7′b); and breast, Coral Pink (5′d). It will be noted that the value and chroma of these colors are sensibly identical with the average colors.

There do not appear to be any reliable statistics on the age at which the adult male rosy plumage is assumed. We may agree with Magee (1926) who says, "The crimson plumage is not acquired until the bird is at least a year old, and in many not until at least two years old." Earlier (Magee, 1924) he had expressed the opinion that the very brightest were four years old. In the light of the Lexington series I conclude that some males become pinkish at the postjuvenal molt and some not until at least the first postnuptial molt. These are cases of a gradual transition but I have evidence from my banding data that in other cases the change is abrupt from brown to quite fully rosy.

The two pinkish adult males in the Lexington series are M.C.Z. nos. 279191 and 279194. Both are finishing the fall molt. The first bird has the edgings of the chest feathers near Apricot Buff and those of the rump Brick Red. The head and throat are much reddened with

some of the throat feathers close to Eugenia or Acajou Red. The other bird shows Pale Flesh Color on the chest and rump edgings near Brick Red; the pale superciliary and malar lines are pinkish and there is one red feather each in the forehead, crown, and chin. These birds are different from the pinkish immature males already described in being somewhat more generally reddened and having narrower streaks on the sides.

H. G. Whittle (1928) describes a bird which may be a xanthochroic male. The crown was bright olive yellow with similar feathers on the sides of head and the underparts. Rump and upper tail coverts were nearly as yellow as the crown. Apparently no red was present. This suggests a more extreme color variant along the same direction as M.C.Z. no. 724.

The sex ratio—It is possible to form some notion of the proportion of brownish and rosy birds to be expected in a large population. No calculation of this sort is very good unless an adequate life table is available. This is not the case for our species. Using the table given by Magee (1940) for survival of older birds, we may estimate that the whole population of Purple Finches from mid-winter to late spring contains about 80 per cent of birds not over one year old. These will all be brownish birds.

Magee (1938, 1940) and Groskin (1950) have both deduced the sex ratio of adults from return data. This method appears to be entirely satisfactory. Magee (1940) includes the data from his earlier paper and secures a ratio of 100 males: 74 females. The departure from equality seems surprising but Groskin (1950) gets 100 males: 71 females. When the two figures are weighted for sample size we are led to take Magee's 100: 74. Applying this ratio to the remaining 20 per cent, i.e. birds over one year old, we find a further 8½ per cent should be brownish. The over-all result is 88½ brownish birds to 11½ rosy males.

This calculation assumes certain things which may not be true. As hinted above it assumes a certain type of life table. It also assumes that the sex ratio is established so early that it does not differ in populations with differing age composition. Lastly it refers to the total population and not to samples seen by banders. The composition of these samples certainly is not always that of the population as a whole.

Newfoundland Purple Finch—Burleigh and Peters (1948, p. 122-123) described a new subspecies, *C. p. nesophilus*, as follows. "Similar to *Carpodacus purpureus purpureus*, of the northeastern United States and eastern Canada, but upperparts in both sexes decidedly darker. Pileum of adult males deep, maroon purple, in contrast to the deep wine purple of *purpureus*. Underparts duller and lacking the pinkish tinge of the nominate race. Females and subadult males less olive above, with the whitish streaks of the back broader and more numerous. In size, both sexes average slightly larger than *purpureus*." The dimensions can be tabulated as:

	WING	TAIL	EXPOSED CULMEN
3 breeding males	84.3mm.	57 mm.	11.8mm.
2 subadult males	70	55.2	10.8
4 breeding females	80.7	57.5	10.7

Peters and Burleigh (1951, p. 372-373, pl. 28) add nothing and confuse the matter by calling the male "rose-red," which would be roughly descriptive of the Eastern Purple Finch. *Nesophilus* is not certainly known outside Newfoundland.

Since a name properly rests on the published description and not on specimens, it is appropriate to begin with an analysis of the description. The pileum of the nominate race is called deep wine purple. So far as this color (evidently quoted from Ridgway, 1901) can be identified from Ridgway (1912) as 70′h. I find it too blue. It is, of course, partly a matter of literary style whether one uses "contrast" or "distinction" in referring to the color in *nesophilus*. "Deep, maroon purple" can only be identified as 72′i (between Indian Lake and Acajou Red). It would be more helpful to have the color according to Ridgway (1912). In any event, the difference is a rather small one especially when compared with my average *purpureus* color, 1′h, which is on the opposite side from Ridgway but even nearer to *nesophilus*. It is quite problematical what color is to be deduced from the description quoted above for the underparts of the adult male. The statements on the female and subadult male are, in my opinion, inconclusive, considering the variation both in color tone and white streaking that I have seen. A calculation similar to that in the section on wing length indicates that only 2¼% of adults of either race could be distinguished by wing length. I suppose "70" under subadult male to be a misprint for "80." One is forced to the conclusion that *nesophilus* cannot be distinguished from the nominate race on the basis of the original description of the former except in the unlikely situation that the lengths of tail and exposed culmen are significantly different.

The only fully adult male at hand (Biol. Surv. no. 394071) was collected 22 May 1947. The crown is Pomegranate Purple (71i), the rump Old Rose (1′b), the throat Hydrangea Red (1′′i) and the sides of the breast between Alizarin Pink (1′d) and Vinaceous (1′′d). (Fig. 3, 7, 10).

As noted above, M.C.Z. no. 18811 also has the crown Pomegranate Purple but the rest of its red coloring is that of *purpureus*.

In *purpureus* we have already seen that the rump averages 3′b or Light Jasper Red in color but three of the seven specimens on p. 108 showed Old Rose (1′b). The present example of *nesophilus* matches a considerable proportion of *purpureus*.

If the specimen has underparts typical of *nesophilus*, we may interpret "duller" in the original as meaning "of lower chroma." On the other hand "lacking the pinkish tinge" is hardly a fair statement unless the describers define pink on a far narrower basis than does Ridgway. The hue is certainly a pink as is the value. The chroma approaches the limit of Ridgway's named pinks. Summing up, the adult male of *nesophilus* at hand has the breast of very slightly lower chroma but of the same hue and value as does *purpureus*. The tendency of the

throat feathers in specimens to be suberect renders it an unpropitious region to discuss.

The upperparts of the specimen of *nesophilus* show, for me, no trustworthy distinctions from *purpureus*.

Before leaving the adult male, attention may be drawn to an adult male (M.C.Z. no. 276012). This rather large bird (wing 86 mm.) was collected at Lexington, Mass., 6 December 1952. It was banded at Lewiston, Me., 27 Apr. 1951, retaken 12 May, as an immature. The crown is Acajou Red (1′i), the throat Deep Vinaceous (1′′b), the breast near Light Corinthian Red (3′′b) and the rump Old Rose (1′b). The crown is the same as in *purpureus*. The throat is close to *nesophilus*. The rump proves nothing. The sides of the breast are still further toward the orange and away from *nesophilus* than is the average of *purpureus* but both the male *nesophilus* and the present male are within the hue and value range of *purpureus*. However, the chroma of the breast is a trace further from *purpureus* than is even the *nesophilus* specimen. On the basis of the available evidence the specimen could fairly be called *nesophilus*. It seems unlikely that a bander with live bird in hand would be justified in making the distinction.

Turning to the brownish specimens of *nesophilus*, we look first at the rump edgings. Two of the females are Olive Lake (21′i), one is Buffy Citrine (19′k) and one Old Gold (19′′i). These colors are all within the range of *purpureus*. The general color and markings of the back are not, in my opinion, distinguishable from fresh, brown examples of *purpureus*, taken in October, 1952. The remaining specimen is a male without trace of redness, taken 24 June 1945. It differs from the preceding only by having the rump near Cream Buff (19′′d). Only one example of *purpureus* shows a higher value than this.

I conclude that no clear distinction is present to separate *nesophilus* from *purpureus*. The Newfoundland birds may be the distal element of a cline. An adequate breeding series from Nova Scotia and New Brunswick might be instructive. The only adult male I have seen from the Gulf of St. Lawrence area (M.C.Z. 5488) was taken at Fox Bay, Anticosti Island, 9 July 1881. Its coloring is within the usual range of *purpureus*. In view of the above it is not strange that the race has not been recognized away from its breeding range. For the time being I prefer not to recognize the purple finches of Newfoundland as meriting a separate trinomial.

Distinctions from the House Finch—Since the House Finch *(C. mexicanus frontalis)* appears to be locally established in the northeastern United States (Elliott and Arbib, 1953), I summarize the distinctions between it and the Eastern Purple Finch.

The one general difference is that the tail is deeply emarginate in the Purple Finch and slightly, if at all, in the House Finch. Further, *frontalis* shows some average metrical differences from other races of *mexicanus:* wing over 70½ mm. (♀) but not exceeding 84½ mm. (♂) and depth of bill at base not over 10 2/3 mm. (Ridgway, 1901).

In adult, rosy males the Eastern Purple Finch has the greater secondary coverts edged with reddish; the top of the head is near Acajou

Red or Eugenia Red, the edgings of the rump feathers are Light Jasper Red and similar coloring extends well down the upper tail coverts and up the back; the throat is about Eugenia Red which in similar but paler shades extends over the breast and upper belly; the sides and belly are mostly unstreaked. The outer vanes of the quills are pinkish.

The adult male House Finch has the greater secondary coverts edged with pale grayish; the forehead is Nopal Red and similar color extends along the superciliary line but not over the crown; the edgings of the rump feathers are Jasper Red, not extending to upper tail coverts and back, although the interscapulars may be edged with reddish; the throat is Light Jasper Red which extends in paler shades over the chest; the lower sides and belly are mostly streaked. The outer vanes of the quills are grayish, as in *Carpodacus cassini.*

Females and immature males (first winter plumage) of the Eastern Purple Finch have the upper parts conspicuously streaked with dusky or the general color tends toward slightly olive brown.

In the House Finch these forms have the upperparts brownish gray obsoletely streaked with darker (Ridgway, 1901). The difference seems to be that, in this species, the central and intermediate zones are occupied by the same color, especially on the head, giving a scaly effect.

The juvenal plumage of the Eastern Purple Finch has the upper parts quite dark (see above) and apearing nearly unstreaked. The light edgings of the rump feathers are about Light Brownish Olive. The edgings of the wing feathers are Tawny Olive. The underparts are moderately coarsely streaked.

The same plumage in the House Finch is generally lighter in tone, particularly the upperparts. The edgings of the rump feathers are about Cinnamon Buff. The wing edgings are Tilleul Buff, a grayer and lighter color than in the Purple Finch. The underparts are finely streaked.

It also appears that in all plumages the undertail coverts are streaked in the House Finch but this is a less frequent character in the Purple Finch.

Although the colors given in this section do not represent the complete range of tints, they do show adequately the nature of the differences between the two species. The House Finch is clearly a paler and grayer bird in all the plumages compared, except the red portions of adult males. These red portions will average (except the rump) slightly paler and more orange in the House Finch. A series of House Finches from Molokai I. (T.H.) show a quite complete conversion of red to yellow and some particolored (red and yellow) males are present from the normal range of the form.

A standard set of observations on brown Purple Finches—As a final point I suggest a standard set of notations to be made on each brown Purple Finch each time it is handled.

a) The state of molt and estimate of whether the molt is postjuvenal or postnuptial.

b) Presence or absence of juvenal plumage.

c) Gape color.

d) Number, location, and color of any red, orange, or yellowish feathers.

e) Sites of reddish or pinkish tinging, especially on the crown, wing coverts, rump or underparts.

f) Grade of throat and side streaking.

g) Streaking of undertail coverts.

h) Wing length.

i) Color of outer vanes of wing and tail quills.

j) Any unusual features not noted above.

Summary and conclusions—We should first consider how the case stands with regard to the five categories listed on pp. 89-90. Juvenal birds may be told by color, markings, and feather structure without much risk of error. Until early fall some, and perhaps most, juvenals retain identifiable amounts of juvenal plumage so that the postjuvenal molt may usually be known as such. No external distinctions of sex have been found in juvenals.

Except as the postjuvenal molt may determine, it does not seem to be possible to make an unequivocal discrimination between the first winter and the subsequent brown plumages, barring a few cases of precocious transition to extreme plumages. Some points have not been adequately explored: 1) distinctions of structure and color in the wing and tail quills; 2) similar distinctions in the greater primary coverts; 3) streaking of the underparts; 4) scattered red feathers. Useful results may be got from these items. No universal means of telling sex is available. In a small proportion of the males the first winter plumage has a general pink cast.

Since the first spring (nuptial) plumage of males is derived by wear and fading from the first winter plumage, it is not uniquely distinguished from the latter nor from most female plumages. When there is precocious reddening in the first winter plumage it overlaps certain retarded older male plumages. The possibility that some added reddening about the head may be acquired by a partial prenuptial molt should be kept in mind. (Fig. 11)

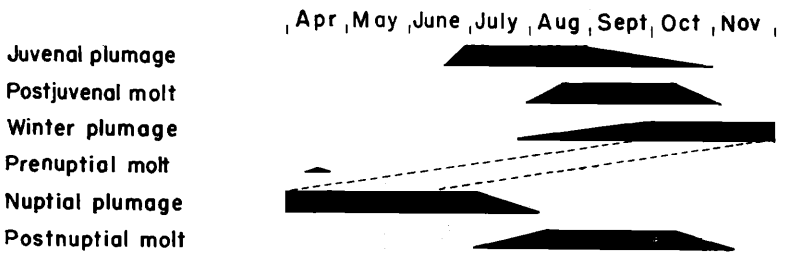

FIG. 11. Diagram of plumages and molts. The winter and nuptial plumages are essentially the same plumage.

TABLE V. SYNOPSIS OF CHARACTERS

	UNDER WING FEATHERING TIBIOTARSAL FEATHERING	GREATER SECONDARY COVERTS	UNDERTAIL COVERTS	MAIN COLOR OF UNDERPARTS	RUMP COLOR	THROAT MARKINGS	EDGING COLOR OF BREAST	STREAKING OF SIDES	SCATTERED RED FEATHERS
JUVENALS	—	Shed together in postjuv. molt	Short, fluffy	Grayish	Brown	4	Whitish	2½	—
FIRST WINTER MALE	+		Fully formed	White	Brownish-olive to Brick red	2	Buffy to salmon	3	±
FIRST WINTER FEMALE					Brownish-olive	3	Buffy	3½	—
FIRST NUPTIAL MALE		Shed together in postnuptial molts		White to pinkish	Brownish-olive to Brick red	2	White to salmon	3	±
FIRST NUPTIAL FEMALE				White	Brownish-olive	3	White	3½	—
OLDER MALES				Pinkish to rosy	Brick red to rosy	1-0	Salmon to rosy	2-0	+ to all rosy
OLDER FEMALES				White to Buffy-yellow	Olivaceous to reddish brown	2-3½	White to Buffy-yellow	2-3½	±

As to the adult female, I conclude that this stage cannot certainly be told from the usual brown first winter birds, except for the yellowish-buff females. The streaking of throat and sides may yield criteria adequate to identify old females.

Finally, the adult male is, with very few exceptions, readily known by the redness of crown, throat, and rump. The few retarded birds may probably be distinguished from similar males in first winter or first nuptial plumage by narrower streaking on the sides. The above points are summarized in Table V.

A still broader statement may be made on coloration. The over-all change is an increase, proceding centripetally from the feather edges, in the amount of carotinoids with a corresponding recession of the melanins. This recession takes place on the underparts even in default of any visible deposit of carotinoids. These changes are carried further in males than in females. It is not certain whether red and yellow in this species differ qualitatively or only quantitatively.

The winter and nuptial plumages differ almost wholly through wear and fading. The nuptial plumages will tend to lack whitish or pale edges on the dorsal feathers and wings and tail quills. The feather centers, when pigmented with melanin, will be lighter. The buff on the underparts is largely lost in brownish birds.

Plumage and wing length are usable in determining sex in extreme cases. The incubation patch when certainly present is diagnostic for females but available for only a few weeks. Cloacal examination will be useful for a somewhat longer period (probably April to July).

The sex ratio is rather far from unity (100 males: 74 females). About 11½ per cent of all individuals should be rosy males.

The amount of dark marking of the throat appears to change with age. Records of this change are very desirable.

There is still some doubt of the frequency of streaked undertail coverts and its relation, in adult males, to the pinkness of the area.

The occurrence of red and yellowish feathers on the head and throat is still of uncertain meaning. Are they a feature of males alone? Not entirely, but how frequent are they in females? Do they occur as replacement feathers for those lost accidentally? Do they yield any evidence of a very minor prenuptial molt?

Males can produce yellow feathers in areas that should be rosy but there is no indication of the mechanism of such a variation of color. This variation may well not be the same as the occasional appearance on males of patches of female type plumage.

The proposed Newfoundland subspecies *(C. p. nesophilus)* is tentatively rejected.

The House Finch *(C. mexicanus frontalis)* is distinguishable in the hand in all plumages.

Banders can greatly advance our understanding of the Purple Finch by a careful record of each individual handled and its changes with age.

BIBLIOGRAPHY

BAILEY, R. E., 1952—The incubation patch of passerine birds. *Condor*, **54**: 121-136, 4 figs.

BLAKE, C. H., 1954—Notes on the wing length of the Eastern Purple Finch *(Carpodacus p. purpureus)*. *Bird-Banding*, **25**: 97-101.

BURLEIGH, T. D., and PETERS, H. S., 1948—Geographic variation in Newfoundland birds. *Proc. Biol. Soc. Wash.*, **61**: 111-126.
DWIGHT, JONATHAN, JR., 1900—The sequence of plumages and moults of the passerine birds of New York. *Ann. N. Y. Acad. Sci.*, **13**: 73-360, 7 pl.
ELLIOTT, J. J., and ARBIB, R. S., JR., 1953—Origin and status of the House Finch in the eastern United States. *Auk*, **70**: 31-37.
GROSKIN, HORACE, 1950—Banding 4,469 Purple Finches at Ardmore, Pa. *Bird-Banding*, **21**: 93-99.
LOWE, P. R., 1942—The anatomy of Gould's manakin *(Manacus vitellinus)* in relation to its display, with special reference to an undescribed pterylar tract and the attachments of the flexor carpi ulnaris and flexor sublimis digitorum muscles to the secondary wing-feathers. *Ibis*, **84**: 50-80, 10 fig.
MAGEE, M. J., 1924—Notes on the Purple Finch *(Carpodacus purpureus purpureus)*. *Auk*, **41**: 606-610.
——1926—Summary of trapping and banding operations in northern Michigan. *Wilson Bull.*, **38**: 162-167.
——1927—Notes on Purple Finches. *Bull. Northeast. Bird-Banding Assoc.*, **3**: 102-104.
——1936—The wing molt in Purple Finches. *Bird-Banding*, **7**: 73-76.
——1938—Estimated sex ratio of the Eastern Purple Finch *(Carpodacus p. purpureus)*, based exclusively on returns at Sault Sainte Marie, Michigan. *Bird-Banding*, **9**: 199.
——1940—Notes on returns of the Eastern Purple Finch *(Carpodacus purpureus purpureus)*, and their sex ratio. *Bird-Banding*, **11**: 110-111.
PETERS, H. S., and BURLEIGH, T. D., 1951—The Birds of Newfoundland. Boston xix+ 431 pp., 32 pl., 40 fig.
RIDGWAY, ROBERT, 1901—The birds of North and Middle America. Part 1. *Bull. U. S. Nat. Mus.*, no. 50: [xxxi] + 715 pp., 20 pl.
——1912—Color Standards and Color Nomenclature. Washington, [iv] + 44 pp., 53 pl.
WEATHERBEE, OLIVE K., 1934—Some measurements and weights of live birds. *Bird-Banding*, **5**: 55-64.
WHITTLE, C. L., 1928—Xanthochrism in the Purple Finch. *Bull. Northeast. Bird-Banding Assoc.*, **4**: 25-27.
——1933—Color variability of the rump plumage of the Eastern Purple Finch. *Bird-Banding*, **4**: 161-162.
——1934—Additional plumage-color changes of an Eastern Purple Finch, B69309. *Bird-Banding*, **5**: 194.
WHITTLE, C. L., and WHITTLE, HELEN G., 1927—Plumage variation and plumage changes among Eastern Purple Finches. *Bull. Northeast. Bird-Banding Assoc.*, **3**: 62-68.
WHITTLE, HELEN G., 1928—Color phases of the Purple Finch. *Bull. Northeast. Bird-Banding Assoc.*, **4**: 102-104.
Massachusetts Institute of Technology, Cambridge, Massachusetts.

GENERAL NOTES

A Supposed Bird Banding Record in the Great Basin in 1846.—Some time ago I came across an alleged banding record in the literature which if valid would not only be one of the first instances of banding known but also an extreme longevity record. This item of ornithological interest was first noted in J. Cecil Alter's History of Utah (p. 473, vol. 3) having been taken from The Millennial Star (June 25, 1894, Vol. 56: 416), which is a magazine of the Church of Jesus Christ of Latter Day Saints. The story had in turn been taken from Territorial papers but with no indication as to the particular one or the date.

The account is as follows: "A wild goose has been captured west of the Utah line. Attached to the bird's leg was a very thin piece of brass, an inch long and half as wide. On this is punched with a pointed instrument, 'Fremont Party, September, 1846, B.B.J.' It is presumed that the initials are those of Colonel B. B. Jackson, who was a member of Fremont's exploring expedition when it passed through that region nearly fifty years ago. The venerable colonel is living somewhere in Sonoma County, California, and has been informed of the capture.