darting hither and thither, skimming the surface as lightly as a fluff of thistle down and in courses as erratic as those of the lucky bugs whose gambols it disturbed. Now it sipped the water eagerly, next picked at a floating leaf or darted after some small aquatic insect. Every now and then it would raise the forward part of its body and flap its tiny wings in the manner of an old Duck. The floating sticks and rafts of dirt that covered a large part of the surface did not embarrass its progress in the least, for it crossed them either by running or by a succession of short, quick leaps as nimble as those of a small frog. Poor little waif! It was pathetic to see it start off thus alone and unprotected on its perilous journey of life, rejoicing evidently in its freedom and the novelty of its surroundings, but quite unconscious of the dangers which lay before it. I could only hope that one or the other of the female Whistlers which we started from the water near the nest tree would adopt and care for it, and I was glad to see one of them fly back to the spot after we had departed.

ECOLOGY OF THE MARYLAND YELLOW-THROAT, AND ITS RELATIVES.

BY WILLIAM PALMER.

FOR MANY years I have known that two distinct forms of this common species (*Geothlypis trichas*) occurred in Virginia; a small summer resident and a larger, better colored transient. Within a few years past I have found a third, a large, rich colored summer resident of the cypress and cane swamps of the southeastern part of the State. A study of considerable material and experience has led me to results which may throw more light on the distribution and evolution of the genus.

The genus *Geothlypis* has no characters peculiar to itself; it is differentiated from its near relatives by a combination of characters each of slight importance. It contains about 28 forms, dis-

tributed over most of North and Central America and part of South America, from sea level to about 6000 feet, and exhibits considerable diversity in extent and intensity of color areas, especially in the males. These color values, together with slight structural characters, permit of the forms being arranged in nine natural geographical and evolutional groups. Without violence, the genera *Microligea* (Santo Domingo) and *Teretristis* (Cuba) may both be included in *Geothlypis*. The former, *G. palustris*, is a tropical *G. agilis*, and the latter, *G. fornsi* and *fernandinæ*, are ancestral representatives of *Geothlypis*, and but slightly specialized.

Natural groups of Geothlypis as shown principally in the Males.

1. No black, grayish above, yellow beneath.		*fornsi*, Cuba. *fernandinæ*, Cuba.
2. Head, neck and breast slaty, short wings, long tail, ♀ slightly slaty.		*palustris*, Santo Domingo.
3. Head, neck and breast slaty with slight black areas, long wings, short tail, ♀ nearly similar.		*agilis*[1], British America. *tolmiei*, Western U. S. *philadelphia*, Eastern U. S.
4. Pale slaty, and black face bands, absent in ♀.	*a.* strongly marked, continental.	*brachidactyla*, Northeastern U. S. *trichas*, Eastern U. S. *roscoe*, Southeastern U. S. *occidentalis*, Western U. S. *melanops*, Northeastern Mexico.
	b. less definite, insular.	*rostrata*, New Providence Id., Bahamas. *tanneri*, Abaco Id., Bahamas. *coryi*, Eleuthera Id., Bahamas.
5. Yellow and black head bands, rich coloration, ♀ without black.		*beldingi*, Lower California. *flavovelata*, Southern Mexico. *flaviceps*, Southeastern Mexico.
6. Black face band, broad and short, very rich coloration, ♀ without black.		*cucullata*[2], Southern Mexico. *speciosa*[2], Southern Mexico. *bairdi*, Western Central America. *cheriquensis*, Northern Colombia. *semiflava*, Colombia.
7. Facial black short and narrow, slaty crown patch, rich coloration, ♀ without black.		*æquinoctialis*, Northern S. America. *auricularis*, Peru. *velata*, Brazil.

[1] Subgenus *Oporornis*.

[2] Slight slaty crown patch.

8. Slight facial black, short wings, long tail, pale coloration, grayish dorsum ♀ without black. Subgenus *Chamæthlypis.*	*ralphi*, Northeastern Mexico. *poliocephala*, Mexico. *palpebralis*, Mexico. *caninucha*, Guatemala. *icterotis*, Costa Rica.
9. Short and broad facial black, slight slaty crown band, sexes nearly similar.	*formosa* [1], Southeastern U. S.

In groups 4, 5, 6 and 7 there is a sequence of structure and color values, largely geographical and not present in the other groups. Seemingly, group 8 continues the sequence from group 7. The intense, rich coloration of group 6 evidences the values of a moist tropical habitat. The short boreal summer residence of group 3 has hardly effected their color values. The habitats of all the groups except 8 and 9 do not overlap in summer, they rather meet and often intergrade. The ranges of 8 and 9 overlay the general habitats of some of the others, but the local environments are quite different. The differences between the forms do not always indicate a variation from a contiguous form, but rather a specialization from an ancestral generalized type through environmental influences.

In all the forms, except groups 3 and 9, the wings are well rounded, the outer primaries being quite short, the third or fourth being the longest. This is a character common to all non-migrating and especially sedentary tropical species. In *agilis* of group 3, the wing is long and pointed, the outer primary being as long as, or, in fully adult birds, slightly longer than the second. In *tolmiei* and *philadelphia* an intermediate stage is evident, and these are birds of fairly high altitudes with a long migration. As we pass southward and toward sea level in the habitats of these birds, we find that the outer primary decreases in length, thus, *brachidactyla* has a longer and more pointed wing than any of group 4, because it migrates further, it goes further north and south. As the birds of group 3 and 9 and *brachidactyla* of group 4, migrate more extensively than any others of the genus, it is evident that the long, pointed wing with a long outer primary, as compared with the short, well rounded wing and short outer primary of their slightly migrating or sedentary relatives, is an index

[1] Subgenus *Oporornis.*

of the length and character of the migration, *and have been caused by migration.*

While the color values as here given (largely psychological characters) exist strongly in the males, many of the females show a tendency in the same direction. The females of *formosa* especially are very like the males and are thus further advanced in this species, but many of the older females of other species exhibit a tendency toward the marking and coloration of the males of their respective species. This is especially true of the more tropical forms. The strong color differences between the sexes of most of the forms are evidently derived from the superior activity of the male, plus the necessary secretive characteristics of the female. Where, however, the showing off habits of the males are slight, natural selection has permitted the females to acquire an almost similar plumage to the males, as in *formosa*. The subdued character of the song of this species, its secluded habitat and its ground habits have permitted the female to attain nearly similar plumage conditions and has retarded greater specialization of the male.

Judging from all the characters, the *fornsi* and *poliocephala* groups would seem to be the least specialized, while *occidentalis* and *brachidactyla* occupy the other extreme.

Another interesting feature is shown in the comparative lengths of the tails and wings, non-migratory lowland forms having relatively shorter wings and longer tails, while mountainous dwelling and high northern forms have relatively longer wings and shorter tails. These characters, dependent upon altitudinal and northern habitats, are less strong in the immature, but are attained by age and experience.

The white and slaty crown band of the *trichas* group changes in Mexico and lower California to a yellow band, which in Central America is entirely lost, the green of the back becoming greatly intensified and abruptly joining the facial black.

THE TRICHAS GROUP.

Their abundance, and the low bushy-ground nature of their habitat fit these birds to take advantage of general climatic

changes as geological influences have affected the topography, and, therefore, we might expect to find a great variation among the characters most likely to be affected. As these influences have acted gradually through a long series of years upon somewhat different material, it follows that results will be different, according to the distances between the geographical areas examined, because the influences are more dominant at one point than at some other. The forms here recognized and their values and distributions are as follows:

Geothlypis trichas AND SUBSPECIES.

Adult ♂ in spring: Above olivaceous brown, darker on wings and tail; beneath yellowish, stronger and brighter on throat, breast, and under tail-coverts; sides of breast olivaceous; forehead and face black, bordered posteriorly by ashy white; bill blackish, deeper than broad, tapering to a point; wings short and rounded, outer primary shorter than next; tail shorter than wing, well rounded; feet flesh colored; tarsus longer than midtoe, lateral toes nearly equal and as long as midtoe minus claw.

Adult ♀ in spring: Similar to male but smaller, less richly colored and without black; a faint loral stripe; ear-coverts darker than grayish face.

Immature and winter adults: Similar to summer specimens of the same sex, but with the face markings less strongly defined and less extensive; coloration richer with a browner dorsum.

The Subspecies.

Geothlypis trichas trichas. MARYLAND YELLOW-THROAT.

Turdus trichas LINNÆUS, Syst. Nat. ed. 12, 1776, 293. Type locality, Maryland.

Adult ♂ in summer: Smallest; above olivaceous, brownish on pileum; throat, breast and under tail-coverts lemon yellow; sides of breast grayish olive; facial black restricted, narrow on forehead; outer primary shorter than the 6th; wing, 50–54 mm.; tail, 48–52 mm.; culmen, 9–10 mm.; tarsus, 21–23 mm.

Adult ♀: Smaller than ♂, relatively stouter bill; yellow of throat paler, restricted, sometimes absent.

Geothlypis trichas roscoe. SOUTHERN YELLOW-THROAT.

Sylvia roscoe AUDUBON, Orn. Biog. I, 1831, 124, xxix. Type locality, Mississippi.

Geothlypis trichas roscoe HASBROUCK, Auk, VI, 1889, 167.

Geothlypis trichas ignota CHAPMAN, Auk, VII, 1890, 11. Type locality, Tarpon Springs, Florida.

Adult ♂ : Large, brownish above; breast strongly tinged with ochraceous; under tail-coverts ochraceous yellow; facial black broad, especially on forehead; outer primary shorter than the 8th; wing, 53–55 mm.; tail, 50–54 mm.; culmen, 10–12 mm.; tarsus, 21–22 mm.

Adult ♀ : Smaller, slightly larger bill, less strongly colored.

Geothlypis trichas brachidactyla. NORTHERN YELLOW-THROAT.

Trichas brachidactylus SWINSON,[1] Animals in Menagerie, Jan. 1, 1838, 295. Type locality, "Northern provinces of the United States."

Adult ♂ in summer: Similar to *trichas* but larger, with stouter bill and longer and more pointed wings; outer primary longer than the 6th; wing, 51–57 mm.; tail, 48–51 mm.; culmen, 11–12 mm.; tarsus 19–21 mm.

Adult ♀ : Similar to ♀ *trichas* but larger, with more pointed wing and longer outer primary.

Geothlypis trichas occidentalis. WESTERN YELLOW-THROAT.

Geothlypis trichas occidentalis BREWSTER, Bull. Nutt. Orn. C. 1883, 159.

Adult ♂ in summer : Largest; above pale olivaceous; throat, breast and under tail-coverts bright lemon yellow; facial black with a broad whitish crown band; forehead black, narrow; outer primary longer than the 6th; wing, 54–61; tail, 53–56; culmen, 10–11; tarsus, 19–21.

Adult ♀ : Smaller; less richly colored, especially on the throat and breast; sides of face pale grayish, pale eyering, grayish tinge across breast.

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[1] "47. *Trichas brachidactylus.*

"Above, olive green; beneath, yellow: a black fillet enveloping the front, eyes, and ears, bordered above by cinereous white. Lateral toes nearly equal, and shorter than the hinder one.

"Inhabits plentifully, the Northern provinces of the United States."

Geothlypis trichas melanops. MEXICAN YELLOW-THROAT.

Geothlypis melanops BAIRD, Review Am. Birds, Smithsonian Miss. Colls. (181), 1865, 222. Type locality, Jalapa, Mexico.

Adult ♂, in summer: Large; above yellow olivaceous; beneath uniform rich yellow, ochraceous on the flanks; facial black with a broad whitish crown band, posteriorly margined with yellow; tail as long as or longer than the wing; wing, 62 mm.; tail, 61.5 mm.; exposed culmen, 12 mm.; tarsus, 22 mm. (type).

Adult ♀: Less strongly colored than the ♂; lores less ashy white; face and underbody pale yellow, whiter on the abdomen; sides of neck and breast pale reddish brown.

Distribution in Summer.

Florida and the seaward edge of the Coastal Plain from Chesapeake Bay into Texas; inhabits the cypress, cane and palmetto regions. Floridian . . . . . *roscoe.*

The Coastal Plain and Piedmont Plateau regions from southern New England to Chesapeake Bay, thence including the bases of the mountains into Georgia and the Mississippi Valley from near sea level to about 1000 feet. Carolinian . . . . . *trichas.*

New England, northward and eastward into Newfoundland, and near Hudson Bay. Transition and Canadian . . . . *brachidactyla.*

Western United States from about the 97th meridian to the Pacific, and from northern Mexico into British America. Generally between 2000 and 6000 feet. Sonoran and transition . . . . . *occidentalis.*

Eastern Mexico, probably below the eastern edge of the plateau. *melanops.*

Distribution in Winter.

Practically resident, except at its more northern habitat . . . *roscoe.*

Southern Atlantic slope birds, wintering largely if not entirely in the southern States; the more northern and the intermediates migrating to the Bahamas and the West Indies; the Mississippi Valley birds into Mexico and Central America . . . . . *trichas.*

Along the Atlantic coast through the Bahamas to the West Indies, and perhaps further . . . . . *brachidactyla.*

California and southern tier of States into Central America and Lower California . . . . . *occidentalis.*

Into southern Mexico . . . . . *melanops.*

Comparative Areas of the Habitats.

The following figures are only approximate, but are well within the truth. They illustrate only the breeding range of the respective forms.

East of the Appalachians, 1000 × 150 miles = 150,000 square miles, plus Mississippi Valley area, 800 × 700 miles = 560,000 square miles. Total, 710,000 square miles. General elevation, 50 to 1000 feet. . *trichas.*

A coastwise strip about 2,000 × 25 miles = 50,000 square miles. General elevation, less than 50 feet . . . . . *roscoe.*

Practically an area 600 × 500 miles = 300,000 square miles. General elevation, northern sea level to 1,000 feet . . . . *brachidactyla.*

An area 1200 × 1200 miles = 1,440,000 square miles. General elevation, almost entirely above 2,000 feet . . . . . *occidentalis.*

Area and elevation not known . . . . . *melanops.*

The areas here given total 2,500,000 out of the 3,500,000 square miles of southern British America and the United States. Contrasted with this immense area, with but four forms of *trichas* and four other species, we have in Central America, with but 950,000 square miles, at least 17 forms; an instance of the greater wealth of a tropical habitat.

The extension of the range of *roscoe* to Chesapeake Bay is based on my collection of the bird (June 1896–7–9) in the Dismal Swamp, where it is quite abundant in the cane (*Arundinaria tecta* and *macrosperma*) and the cypress (*Taxodium distichum*). In 1898 Mr. R. G. Paine, at my request, sought for Yellow-throats in the vicinity of Charleston, South Carolina. He found two, and took a specimen on November 1 in St. Andrew's Parish. It is an immature *roscoe.* Wilson has the following to say, undoubtedly of this bird:[1] "I found several of them round Wilmington, North Carolina, in the month of January [1809] along the margin of the river, and by the cypress swamp on the opposite side." It is doubtful if this form occurs far from the coast, certainly not above the 100-foot contour.

A specimen is in the Biological Survey collection taken by Wm.

[1] Am. Orn., II, 1810, 163.

Lloyd on East Caranchus Creek, Jackson County, Texas, Jan. 6, 1892. Another is in the National Museum collection taken by Dr. Shufeldt at New Orleans Nov. 26, 1882 (No. 90665). Audubon's specimen was taken in a deep cypress swamp in September, 1821, "not far from the river Mississippi, in the State bearing the same name."

Comparative Ecological Values of the Habitats.

Large amount of sunshine, great radiation, temperate climate and vegetation, perfect and rapid drainage, open and generally dry soil conditions, low to medium elevation, short to fair migration . *trichas.*

Fair amount of sunshine but tempered by insular characteristics, copious moisture, slow radiation, subtropical climate and vegetation, deep shade, slow drainage, low elevation, practically no migration. *roscoe.*

Fair amount of sunshine tempered by sea and boreal characteristics, slow radiation, subboreal climate and vegetation, good drainage, generally damp soil conditions, low elevation, extensive migration into a tropical climate . . . . . *brachidactyla.*

Excessive sunshine tempered by altitudinal characteristics, excessive quick radiation, partial desert climate and vegetation, generally poor and arid soil conditions, high elevation, fair migration into subtropical climate. . . . . *occidentalis.*

Subtropical habitat, otherwise unknown . . . . *melanops.*

Nomenclature.

As the first form of this species to be described binomially was the Maryland bird it becomes the type from which to differentiate others. The northern bird has not heretofore been separated except by Swainson, who evidently considered it distinct from the Maryland bird, for which he had substituted the name *Trichas personatus.*[1]

Mr. C. J. Maynard has described a specimen taken on February 2, 1884, at Nassau, New Providence Island, Bahamas, as a

[1]Zool. Journ. *III.* 1827, 167.

new species.[1] I have, through the kindness of Mr. G. S. Miller, Jr., to whom it belongs, examined the type. It is a midwinter immature *trichas-brachidactyla*, more nearly the latter, and probably from about New Jersey, Mr. Maynard's familiarity with the large New England bird and non-familiarity with the small Maryland bird, causing him not unnaturally to describe the stranger as new. (See Bonhote, Ibis, 1899, p. 510.)

I have accepted Audubon's name for the southern bird. There can be no question as to the Florida bird occurring along the Gulf coast, and therefore his bird, readily distinguishable when collected, though afterwards placed with *trichas*, should be given proper rank. As the bird was taken in a cypress swamp it renders this view more probable. The mistake of Dr. Hasbrouck occurred through assuming that a lowland resident Florida bird should also occur far up the Mississippi valley unchanged.

Mr. Oberholser's *arizela*[2] is based on extremely slight characters, but chiefly on 'geographical reasoning.' In the lowlands of the west occur smaller individuals than are to be found at higher altitudes close by. The birds of the Great Plains are intermediate in size between *occidentalis* and *trichas*, as are also more northern individuals. It is altitude that fixes the greater size of the large specimens of *occidentalis*, a fact evidenced by many other species. Wearing changes the coloration of the feathering in these birds to such a great extent that it seems unfortunate to base color values on summer specimens which acquired their plumage early in the previous autumn. The type of *arizela* is unfortunately an old and badly made skin. The greater yellowness, both above and below, of lowland and more southern California specimens is due to an approach toward influences which have produced *beldingi* and *melanops*.

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[1] "LITTLE BAHAMA YELLOW THROAT. *Geothlypis restricta.* — Above, dark olive green with space next to black abruptly ashy, mark restricted on the cheeks to about the same width as on the forehead, beneath, light yellow becoming lighter on abdomen and brownish on sides; wings shorter and rounder than in the common *trichas;* dimensions, wing, 2.40; bill, 23; tarsus, 25. Occurs in Bahamas." — *The American Exchange and Mart*, Feb. 5, 1887, 69.

[2] Auk, 1899, 257.

Differences.

The differences between typical specimens of the three eastern forms are quite strong. True *trichas* (Maryland) is a very small bird with a slender, short bill, restricted black facial area and pale colors in spring. It has a short, well-rounded wing in which there is little difference between the 3rd, 4th and 5th primaries, while the 1st is decidedly much shorter than the 6th. The formula[1] of length is usually 3–4–2–5–6–1–7–8, sometimes 4–3–5–2–6–1–7–8, rarely 4–5–3–2–6–1–7–8. In immature birds and in the most unworn spring specimens the formula is 4–3–5–2–6–7–1–8, the differences between the 1st and 7th being slight. The inner primaries wear faster than the outer, being weaker. Spring specimens taken about Washington, D. C., are always well worn and pale, contrasting strongly with the less worn and brighter specimens of *brachidactyla* taken at the same time and place. Nine spring males range in size: wings, 50–54 mm.; tails, 48.5–52 mm.; culmens, 9–10 mm.; tarsi, 21–23 mm. Ten females: wings, 47–51 mm.; tails, 46–48.5 mm.; culmens, 9.5–11 mm.; tarsi, 19–21 mm. The females sometimes lack entirely the yellow of the throat and breast which is never as extensive and as strong as in the other forms.

In its well rounded wing *roscoe* agrees with *trichas* but difference in length of the feathers makes a different formula. The 3rd, 4th and 5th are nearly equal, and a slightly wider interval separates the 2nd and 3rd, while the 1st is considerably shorter than the 2nd, as in *trichas*. But the inner primaries are longer, so that the formula is 4–5–3–2–6–7–8–1. Wearing takes place more rapidly on the inner primaries so as to result in the usual formula on worn individuals of 4–3–5–2–6–1–7–8. It is a much larger bird with a longer, stouter bill and tail, and a strong brownish tinge even in worn summer specimens. The wide forehead black and the ochraceous tinge of the yellow of the underparts are characteristic of this form. Thus *trichas* and *roscoe* agree well in the wing pattern but differ greatly in size and color.

[1] The outermost primary is here for convenience considered the first: the first number represents the longest feather, the last the shortest.

Dr. Shufeldt's New Orleans specimen, an adult male, is in fine unworn plumage and has much less ochraceous beneath than is usual in eastern specimens; it measures, wing, 56.5; tail, 55; culmen, 13; tarsus, 23. Its wing formula is 4–3–5–2–6–1–7–8.

Lloyd's Texas specimen is the palest example I have seen; its bill, though long, is rather slender, and though in good plumage it has much less brownish and ochraceous than in eastern specimens. It measures, wing, 55; tail, 56; culmen, 11.5; tarsus, 22.

Its tail is thus a trifle longer than the wing, the only instance in the species. The wing formula is 4–3–2–5–1–6–7–8.

An immature specimen from near Charleston, S. C., Nov. 1, 1898, in unworn condition, measures, wing, 55.5; tail, 52; culmen, 10.5; tarsus, 21. 5.

The northern bird resembles *trichas* in color, but comparable spring specimens are deeper and better colored, which is also the case with autumn specimens. Wearing produces similar effects as in the other form, so that summer specimens of both are quite similar except in size and wing outline. In *brachidactyla* we have a larger bird with a much stouter bill, longer wing and relatively shorter tail. The wing is less rounded, a greater interval separating the 4th and 5th primaries and a less interval the 2nd and 3rd, and the 1st and 2nd. This results in a longer outer primary and in its being next to the 5th in length, sometimes it follows the 4th. It is always longer than the 6th, not shorter as in the other forms. The formula is almost without exception 4–3–2–5–1–6–7–8. A variation is 4–3–5–2–1–6–7–8, another 3–4–5–2–6–1–7–8, but these are rare and are evidently due to wearing, occurring on spring specimens. Specimens taken in Virginia near Washington in spring measure, males, wings, 52–55; tails, 48–51; culmens, 11–12; tarsi, 20–21. Females, wings, 51–54; tails, 46–47.5; culmens, 11–11.5; tarsi, 17–18. In a series of Long Island May specimens the wings are 54–57; tails, 49.5–52.5. New England and Canada spring specimens are: wings, 55.5–57.5; tails, 49.5–53. Spring male specimens from the Bahamas: wings, 54–59; tails, 50–55.5. A series from the mountains of western Pennsylvania in summer: wings, 48–57.5; tails, 44–52. The largest *trichas* that I have seen from about Washington has a wing of 54, while the average is much less. A series of New York city autumnal

males give, wings, 54–59; females, wings, 53–56.5. These and numerous others show that the size increases northwards, also the length of the outer primary. In Pennsylvania in the same latitude, different sized birds are found on opposite sides of the mountain divide, the larger, curiously enough, occurring at a generally lower elevation on the western side. The cause is explained under migration. The females of all the forms are smaller than the males of its subspecies and, except in *brachidactyla* and *occidentalis*, have relatively stouter bills.

The western bird, *occidentalis*, is a little larger than *brachidactyla*, but grayer in dorsal coloration with a broad white posterior edging of the facial black. The yellow of the throat is more intense and the black of the forehead is relatively narrower. Freshly molted adult birds are but slightly paler dorsally than eastern birds, but immature birds are fully as dark and as brown above as in similar aged eastern birds. The females in summer are as a rule less yellowish and paler than eastern birds. A few have decidedly yellow throats but it is far from the rule. The immature females are browner and duller above and beneath with a much browner tinge across the breast than in either *trichas* or *brachidactyla*. As a rule the 4th primary is slightly the longest, but wearing in many cases soon makes the 3rd the longest, and sometimes the 3rd is the longest in immature birds. The wing formula is usually 4–3–2–5–1–6–7–8; rarely the 6th is longer than the 1st, and sometimes the 5th is slightly longer than the 2nd; wearing reduces the inner primaries so that the formula becomes 3–4–2–5–6–1–7–8 or 3–4–2–5–1–6–7–8.

Melanops differs from the other forms in having a yellow border to the ashy crown band,[1] an indication of the more tropical forms *beldingi*, *flaviceps* and *flavovelata*. The type is the only one that I have seen. It is in partially worn plumage, the yellow bordering the crown band being almost completely obscured by brown tips to the feathers. If the tail was unworn it would undoubtedly exceed the wing in length. This bird differs from *occidentalis* by its shorter outer primaries, longer and larger tail and feet, and the

[1] All the *trichas* group have a trace of yellow back of the ear-coverts in many specimens, but in this form the yellow is well developed.

more extensive yellow of the underparts and dorsum. The type has a wing formula of 4–3–5–2–6–1–7–8, with the widest space between the 5th and 6th. The 6th is of course more worn.

Except in *formosa* the females of all the forms are quite different from the males in coloration. The presence of an interrupted eyering in the females of the *trichas* group is also found in the males of some of the *agilis* and *poliocephala* groups, an evidence of their incomplete or imperfect evolution. This eyering is absent or slight in the more tropical forms. Its occurrence in young males indicates a step in their evolutional change from the ancestral form.

In *melanops* we have an approach to the Mexican and Central American species in which the ashy crown band is absent and replaced by a yellow band or by the green of the dorsum. It is truly an intermediate between the highly specialized *trichas* type and the lower but more brilliant *subflava* type, the transition occurring on the one hand through *flavovelata* and *bairdi* and on the other through *occidentalis* and perhaps *roscoe*. *Beldingi* is another extreme of the *flavovelata* and *flaviceps* type.

The differences here presented are zoögeographical. As the food of males and females is probably similar we have no clue there to the causes that have brought about such a contrast between the sexes. Why then have they differed and why in *formosa* are they so alike? *Formosa* differs from the others in the character of the songs of the males. It is a simple warble, not the outpouring burst of the *trichas* type. The vivacity and more active life of the males of this last species and their great song powers have seemingly led to an accentuation of pigment on the forward part of the body. It would seem that there is some element in their food taken in the damp shady retreats of their habitats which in combination with their active, songful life has permitted this accentuation of pigment. Natural selection by permitting, as a rule, the most striking and hence the most active and enduring, to propagate, not by any selective ability of the females, but by the greater vigor and persistence of the males, has slowly evolved the strong characters of the males. Boreal influences and a long migration have prevented the *agilis* group from progressing to the same extent as in *trichas*.

The northern birds have short secondaries while the non-migratory and especially the lowland birds have long secondaries.

Causes of the Differences.

Freshly molted autumnal specimens of the four United States forms are not greatly unlike in color, but *roscoe* is the richest and deepest colored. These richer and browner colors are evidently due to its moisture, lowland, semi-tropical habitat, while its size and well-rounded wing are evidence of its non-migratory habit, its practically insular home and abundant and easily obtained food. It is a rather shy, retiring bird not easily coaxed from its leafy retreats. It inhabits a region of the least relative radiation and is not a sun-loving bird.

The smaller, paler *trichas* is at home in summer about the marshes and low places of the Coastal Plain and Piedmont Plateau, where it is exposed to more sunlight, less rich and generally drier conditions. The shortness of its migration accounts for its similarity in wing contour to *roscoe*. It inhabits a region of great relative radiation of heat and moisture, rendered stronger by the effects of civilization upon forest growths, the bird having undoubtedly greatly extended its range as the country became deforested, as for instance in the mountains of Pennsylvania up to 3000 feet. It greatly enjoys sunlight. In winter it seeks as nearly as possible similar conditions. Its very close relative, too near perhaps to be subspecifically separated, the Mississippi Valley bird, is, in comparable specimens, more highly colored and often larger. It inhabits a moister and richer region and its winter residence in Mexico and Central America causes a longer migration, hence its longer wing and greater size. The usually greater extent of yellow on the under body as compared with eastern specimens shows less wearing and consequently the less harsh character of both its winter and summer habitats. Specimens of *trichas* that I took in Chotank Creek marsh, King George County, Virginia, in July, 1898, had the yellow of the throat extending to a point down the centre of the under body, while the sides are even more worn than in ordinary birds.

This was caused by the bird's habit of perching on the long inclining leaves of wire-grass abundant in the marsh, bushes and twigs being uncommon. Alternate contact of the sides of the body with the grass wears the yellow tips of the feathers leaving the centre of the body almost untouched. The constant perching of most individuals of *trichas* and *brachidactyla* on generally horizontal twigs produces the same effect but evenly up to the breast. The Mississippi Valley birds, owing to the less harsh character of the vegetation mainly of the winter habitat, have in comparable specimens less of the yellow worn off than occurs in eastern birds. Some examples are, however, identical in wearing with these two preceding forms.

The more boreal habitat of *brachidactyla* and its consequently much longer migration accounts for its greater size, its longer wing and longer outer primary. The relatively less radiating power of its northern home, with a diminished amount of sunlight, has also assisted, besides the more tropical character of its winter home. Spring and summer specimens from the southern portion of its range are paler and more bleached than in more northern examples of even date. The more northern birds are also more shy and more difficult to secure.

In *occidentalis* the 4th primary is often longer than the next on either side, the 3rd, 2d and 1st graduating quite evenly in a manner not seen in true *trichas*. In the Mississippi Valley a less pronounced similarity is evident on birds from the western portion of the valley; but to the northeastward the outward primaries become longer and the wing contour merges into the typical of *brachidactyla*. The great elevation of the habitat of *occidentalis*, from 2000 feet up, has produced its greater size. Its practically short migration permits it to retain the ancestral wing contour; but in the more northern birds and those of the Plains the 3rd primary is often the longest, and the wings are slightly more pointed.

In *melanops* we have a richer colored and yellower bird, due undoubtedly to its more tropical habitat, as shown in all the southern forms. Food is of course the prime factor in determining the amount and character of the pigment of these feathers, but we have little evidence as to its precise relation to color values.

The longer tails of the most southern specimens of *roscoe*, and of *melanops*, point to a sub-tropical and almost sedentary life; while the shorter tails and longer wings of far northern birds show results due to migration.

Intergrades.

The first Yellow-throats to appear about Washington in the spring migration are true *trichas*, later larger birds appear, the latest migrants being *brachidactyla*. During August *trichas*, both adult and young, move southward and gradually are replaced by larger birds, so that by September 1 the summer residents have wholly disappeared and a larger intermediate lot of birds are abundant, especially about the marshes. These are followed during the month by still larger birds with longer wings and longer outer primaries, so that October specimens are almost always typical *brachidactyla*. The proportion of good *brachidactyla* is much less than of *trichas* or of intermediates, as the latter loiter on the southward journey, while the former with a much longer journey in view make fewer stops. Their main bulk, however, journey coastwise. Specimens from the vicinity of New York and Long Island, while not perfectly typical *brachidactyla*, are constantly so different from typical *trichas* as to be placed with the former.

About Washington true *trichas* frequents the roadsides, the marshes and small low bushy places on the hillsides. The intermediates almost entirely frequent the marshes, while the larger *brachidactyla* nearly always is found in ravines and along streams in the deep woods.

The Mississippi Valley bird really is an intermediate, nearer *trichas* in the middle and eastern areas of the valley, nearer *brachidactyla* northward and northeastward, while along the eastern edge of the plains it merges into *occidentalis;* this result having been most evidently produced by the gradual disappearance of the Mississippi Sea.

The birds of the Dismal Swamp are not quite typical *roscoe*, but decidedly are not *trichas*. The birds of Virginia Beach, east of Norfolk, are similar. On the opposite shores of Chesapeake

Bay only *trichas* is found. At Smith's Island the summer residents are rather large *trichas* and quite unlike those from Virginia Beach which is but 20 miles across the mouth of Chesapeake Bay. Intergradation must occur through the region about the mouth of the James River, in fact specimens from near Suffolk, just outside the Dismal Swamp, are less like *roscoe* than those in the swamp.

Occidentalis presents some variation in the direction of other forms. The birds of the great California and Rio Grande valleys are greener above and have the sides of the body more extensively yellow than in other examples. These lowland individuals trend in the direction of *melanops*.

The differences between *occidentalis* and *melanops* are blended in an adult male taken by Dr. E. A. Mearns at Fort Hancock, Texas, June 13, 1893, which is undoubtedly a geographical intergrade (No. 134393 U. S. N. M. Coll.). In this specimen the wing is 58 mm.; tail, 54 mm.; culmen, 11 mm.; tarsus, 22 mm.

There is much yellow mixed with the worn white crown band, and its appearance readily suggests both *occidentalis* and *melanops*

Variations.

"Individual variation" as usually understood and spoken of is simply a phrase to denote our ignorance of the precise relations of individuals to their environment, their ecology. It also generally covers differences of age. As I have shown, most of the differences in the species *trichas* are purely zoögeographical, a result of their peculiar and positive relation to their environment, both in summer and winter, in fact the various forms are products of their own peculiar environments. There is little true individual variation, that is, variation from the average in the same locality. A few specimens, here and there, of *trichas* have a wider and whiter area of ashy on the head. This is simply due to a wider absence of a maximum amount of pigment in the growing feather, caused probably by a local lesion or lapse of pigment (= equal food change) while the feathers were growing. Sometimes a male shows a lightening of the yellow of the throat, but such specimens are rare. More variation is noticeable in the females of *trichas*, less so in *brachidactyla*, a few being entirely destitute of

yellow, others having but a trace. A female from Smith's Island shows strongly the outline of the black and ashy of the male, especially on the forehead. In some immature fall male specimens the black and ashy is either greatly restricted or nearly obscured by brown tips to the feathers; in others the reverse is the case. The difference is doubtless caused by the former being from late broods, the latter from early ones. As a rule the personality of these birds is so strong that the environing influences are unable to allow variation except in geographical directions.

Migration.

The large but well rounded wing of *roscoe*, with its short outer primary, and its known winter distribution, shows that it practically is a resident where found. It evidently entirely withdraws from Virginia in winter, but occurs in that season as far north at least as the central coast district of North Carolina. The very similar wing contour of true *trichas* shows that its migratory journey is not extensive, probably few, if any, leaving the United States. The longer wing and longer outer primaries of the Mississippi Valley birds and their known winter home, shows that their journey is longer, which is also the case in a greater degree with the northern form *brachidactyla*. The following is interesting in this connection. A large series of summer specimens from the mountains of Western Pennsylvania were kindly placed at my disposal by Mr. W. E. Clyde Todd. Upon measuring them, it developed that they could readily be placed according to size in two groups, this being independent of altitude. Distributing these specimens on a map according to localities, it became apparent that the larger birds came from the most western portion of the State, the plateau region, while the group of smaller birds came from the mountains eastward of the divide. The drainage of the plateau is toward the Mississippi, while the mountain area is drained by streams which flow southeastward into the Susquehanna and then into Chesapeake Bay. It is apparent, therefore, that the small birds, almost typical *trichas*, reached their mountain summer home from the southeast by way of the river valleys, while the larger birds of the plateau came

from the southwestward and traveled a much greater distance in going to and from their winter habitat in Mexico and Central America. Thus birds of the same subspecies occurring in the same latitude at the same or a different elevation and in adjoining counties, are divisible into two groups according to size, the difference being due to the contrast in the length and direction of their migrations. This result is peculiar and interesting, and in line with the already known fact that many eastern Mississippi Valley migrants reach New York State, and pass even further east.

The eastern trend of the Atlantic coast line is an important factor in the migration of *brachidactyla*. Twenty-six spring specimens collected in the Bahamas by the naturalists of the U. S. Fish Commission Steamer 'Albatross' are true *brachidactyla*, though somewhat darkened and weathered. They undoubtedly were on their way to northern New England, Nova Scotia, or Newfoundland.

While on Smith's Island, Virginia, in May, 1898, I saw some three dozen Yellow-throats which, with other birds, had struck the lighthouse ten days previously. They all were *brachidactyla* and mostly males. Several struck the lighthouse on the evening of May 21, and I secured three females; they were the same form. The resident birds on the island, which are abundant and slightly larger than typical *trichas*, were all paired and breeding at the time.

Maryland Yellow-throats are frequently mentioned by writers as being abundant during migrations at lighthouses along the coast; they of course are *brachidactyla*. This and the occurrence of the form in abundance during migrations in the Bahamas readily suggests the idea that the migration course is almost if not entirely southward in the autumn; that birds bred in New England and eastward migrate toward the coast and thence over the sea through the Bahamas to the West Indies.

This suggests the probability of a former narrower separation of the islands from the continent.

The birds of the Mississippi drainage area are larger as we go northward but do not attain the pointed wing and long outer primary characteristic of typical *brachidactyla*. The western bird,

occidentalis, migrates comparatively little except along its northern habitat. The birds which summer at a high altitude evidently simply descend to lower stations along our southern borders, where they spend the winter in favorable situations. Migration evidently has little effect on their feather growth, their size being due to the generally high elevation of the summer habitat, a truth shown in many other species.

Little is known of the movements of *melanops*, but there would seem to be little difference from *occidentalis*; its richer coloration implies a more southern and less boreal habitat.

The effects of a long migration are well shown in other species of *Geothlypis* in North America.

In *G. agilis*, the most northern breeder and probably also the most southern in its winter habitat, we have the largest form, and the outer primary (on immature birds the 2nd) is the longest, the others graduating to the innermost. In *G. philadelpha* and *G. tolmiei*, more southern yet high ground breeders, the wing is slightly more rounded, the 3rd, sometimes the 2nd, being the longest; the bill is smaller than in *agilis* and the bird is smaller.

In *G. formosa* there is little difference in the lengths of the three outer primaries; but the outermost is always slightly the shorter, the longer being usually the 2nd. Their migration is less extensive than those given above.

As the more southern and therefore more tropical forms do not migrate extensively we find in consequence a more rounded wing with short outer primaries, the fourth (often the third when the feathers are worn) being the longest. It seems evident then that the comparative lengths of the wings, and especially of the outer primaries and the secondaries, are an index of the comparative length or absence of migration in the respective forms. The comparative differences of size, length of wing, primaries and tails are in this genus simply effects of latitudinal and altitudinal habitats modified when necessary by insular characteristics, or length, character, or absence of migration, hence more of subspecific or specific than of generic or subgeneric values. According to this view a genus *Oporonis* does not exist.

The Molt of the Adult.

In the new autumnal plumage all of the *trichas* group are distinguished by a richness that they do not possess in spring. The dorsum is decidedly brownish, and the ashy of the head is obscured by brown tips, the black by ashy and brown. These tips wear off during the autumn and winter and much of the brownish also, so that the width of the ashy and black areas are increased and the color intensified by wearing. The dorsal brown is worn off, slightly in *roscoe*, much more in *brachidactyla*, and usually almost entirely in *trichas*. A few spring *trichas* retain this brown to some extent on the pileum. There is a spring molt of the throat feathers, also of the facial black, but this last may not be complete. The fall molt takes place while the birds are moving slowly southward; the spring molt evidently occurs before they start northwards. The female does not molt in spring.

The Molt of the Immature.

As soon as the young is capable of obtaining its own food, it begins to change its nestling (mesoptile) plumage. This is effected rather slowly. First a few yellow feathers appear on the sides of the breast and then on the sides of the throat. Green feathers next appear on the back and scapulars, the body being first covered with the new feathers. In the male blackish feathers then appear under the eyes back of the gape, and brownish feathers on the top of the head, thence the change rapidly continues, the tertials, wing- and tail-coverts changing while the head changes. When the birds complete this stage they start on their southward journey (at least about Washington), so that it is difficult to follow further changes, but there is no doubt that the change continues and includes the wings and tail. No. 3203, August 14, 1893, W. P. collection, is an immature male *trichas* that has nearly completed the molt; the four outer primaries are of various lengths of growth, the inner all having been changed. This is similar to the change in the adults and at once shows how

the length and character of the migration can influence the growth of these feathers, greater wing power having developed and found expression in longer outer primaries as the length of the migration journey gradually increased in the individuals subject to the change. The three outer tail-feathers of this specimen on one side, four on the other, are still in place, but the central ones have dropped out and new ones are growing. A female, No. 3503, August 10, 1894, is in somewhat similar condition, the outer primaries are further advanced and the outer new tail-feathers are of differing lengths. The body change is nearly complete. Other specimens show similar changes, commencing about the middle of July and completed by the middle of August. This molting takes place all along the Atlantic watershed about the same time, but the birds of any given locality move further south before it is completed. It would seem that the night flights begin when the wing molt is fully completed.

A spring molt undoubtedly occurs, especially in the males, but it is confined to the face and throat. The yellow of the throat and most if not all of the immature facial black and the white eyering is replaced, so that the immature spring bird is hardly distinguishable from an adult. No spring molt appears evident on female specimens. Occasionally a male specimen is taken in spring which has not had a spring molt. I have taken several about Washington and have seen others. Immature birds of all the forms have slightly shorter wings and primaries during their second summer.

The high and arid character of the habitat of *occidentalis* accounts for the paleness of spring, summer, and most winter specimens, but the darkness of freshly molted birds tells a different tale. As already stated, the immature when freshly molted are as dark as eastern birds and the adults are scarcely less so. But a paling of the plumage rapidly takes place, being entirely caused by the bleaching action of the dry, clear, western atmosphere. The white feathers bordering the facial black are at first ashy, but little paler than in eastern birds, but they soon bleach even before they have fully grown, except where, as in immature birds, they are protected by brownish tips. This darker coloration of freshly molted birds is an index of the char-

acter of the local habitat. These birds inhabit bushy moist situations, where they obtain their food near or on the ground, so that it is not remarkable that the effects of a generally prevailing arid climate should counteract purely local pigment effects. Thus paleness in this bird is largely a mechanical effect due to climate and wearing. There is a constant struggle between the effects of a local, rich, moist land diet, which alone produces the pigment, and the high and generally arid climate which has many months in which to effect a bleaching change.

CONCLUSIONS.

The evidence shows that the Yellow-throats of the Eastern States can be readily segregated into three well marked subspecies, each occupying topographically, geologically and climatologically distinct faunal areas of enormous extent, and that each one is the product of its own peculiar environment plus in one case the effects of a long migration. The comparatively recent, geologically speaking, retreat of the glacial snow and ice has permitted, slowly to be sure but steadily, the evolution of *brachidactyla* from its preglacial short-winged ancestor. This has been effected not by the extension of the range of a species or even a subspecies but by the slow increase of the more northern individuals as the retreating snow and ice opened up a greater extent northward of possible breeding range. Concomitant with this increase of individuals in one direction occurred also a change of structure and character, the change being in an ascending ratio as a more northern point was reached each year or cycle of years. The result was a constantly increasing difference, the birth of a subspecies. Therefore, like so many other North American birds, *brachidactyla* is a result of a decrease of glacial ice and snow. We have then along approximately the same longitude three distinct forms of one species with two sets of intermediates. At one end the form is large because the individuals obey the well known law, that: *where a species occupies a longitudinal or altitudinal range the more boreal individuals are larger than their relatives of adjoining lower ground habitat.*

At the southern end the form is also a large one because the individuals obey the law, that: *where a species occupies a range one end of which is a low, tropical or island area, then the individuals occupying this portion are larger than those occupying an adjoining dissimilar habitat.* The result may be a species or subspecies differing from the parent stock according as the separation is long, or the environing influences are intense or weak. In the case of *brachidactyla* migration has intensified the divergence by compelling a longer wing, a process still in progress. The lapse of time since the glacial retreat has not been sufficient to make the outer quill the longest but such is evidently the tendency. In *agilis* we have a species which evidently occupies largely what was an island area in preglacial or interglacial times, and the development of the wing was hastened by the birds having to migrate over, or by, a Mississippi Sea.[1] In *tolmiei* and *philadelphia* we have two slightly differing species, evidently two divergents from a common stock; divergent because they extended their range northward on opposite sides of the Mississippi Sea. It would seem also that in *trichas* and all its eastern relatives we have one branch, and in *melanops* and *occidentalis* another, long separated by the same cause. The retreat of the ice has permitted the forms to be localized where we now know them, and as the Mississippi Sea disappeared *trichas* and *occidentalis* approached each other and have apparently insensibly intergraded. A similar case is the Meadowlarks which have joined habitats during the historical period.

It will have been noticed that the ranges of the three forms of *trichas* on the Atlantic slope are quite peculiar. Considered latitudinally the range of *roscoe* ends where *trichas* is in its prime, and in its turn this gives way to *brachidactyla*. The reason is evident, they occupy different faunal areas, the characteristics of which are determined by altitude, the slope angle and the character of the drainage. The width of the faunal area and the char-

[1] The former presence of this sea is indisputable and its effects on the distribution of North American bird life have hardly been noticed, yet it divided it into two parts, usually with representatives on each side. The life of the parts have approached each other as the sea disappeared and at the same time southern forms have moved northward.

acter of the topography, geology and vegetation are important factors. The Mississippi Valley bird is like true *trichas* because it occupies similar altitudinal and geological territory; it is unlike *trichas* mainly because its winter habitat is different and is at a greater distance. The latter influence is the slightest and permits us to retain the bird in the same subspecies, but further northwards and especially northeastwards, the other influence becomes stronger and a different subspecies is the result. The best examples of *brachidactyla* are from the Atlantic coast, because there the birds make a sea journey and evidently specialized quicker because of their comparatively narrow habitat during the glacial retreat; the broader area of the Mississippi region and the lake barriers having delayed the development of the birds northward. The migration of *brachidactyla* through the Bahamas proves that this group of islands was formerly less widely separated from the continent.

In my study of these birds, I have been unable to consider temperature as an important factor in producing differential characters. The strong psychological characters cannot be accepted as caused by temperature, for they are almost entirely absent in the females. The physiological characters are necessarily to be correlated with other more direct influences, many of which I have indicated. One effect of temperature has been to permit of a larger number of forms in the tropics, but only indirectly by its influence on other life and in connection with other causes in affecting the topography. Northward few species are found, but they are strikingly different even in the same temperature areas. Temperature acts principally as a barrier in preventing, along the northern and higher borders of the ranges of these birds, favoring topographical conditions. If our present arctic zone was to disappear, these birds would gradually work northwards and eventually, if favorable conditions continued for a long period, would break up into various forms under the influence of local conditions; but they would never have the short rounded wings of their tropical relatives unless their migration should wholly cease.

The genus *Geothlypis* is purely Nearctic wherever it is found, and undoubtedly developed in North America during preglacial

times. Its presence south of the United States is due to former glacial influences, and it is evident that such forms are the lowest and most generalized. The *trichas* group represents its highest development.

I would extend the present accepted southern limit of the Nearctic subregion to include nearly all of the West Indies, Central and South America, and consider its life as an invasion and overlaying of the Neotropical region consequent upon the effects of a glacial period. Neotropical life now barely reaches the United States. Present winter North American life represents a transition between the original Palæarctic, from which it has been derived, and the pure Nearctic, an earlier result, of which *Geothlypis* is an example.

My indebtedness to the collections of the National Museum and the Biological Survey is gratefully acknowledged.

NOTES ON A FEW SPECIES OF IDAHO AND WASHINGTON BIRDS.

BY JOHN O. SNYDER.

DURING the year 1894 the following notes were made in northern Idaho and Washington. Specimens of each species mentioned were taken and preserved. The localities visited were Kaniksu Lake, Blue Lake, Hoodoo Lake, and Spirit Lake in Kootenai Co., Idaho; Diamond Lake in Stevens Co., Mt. Carleton in Spokane Co., and Pullman in Whitman Co., Washington.

1. **Merganser americanus.** AMERICAN MERGANSER. — Several females with young observed at Diamond Lake, where downy young were taken, June 21.

2. **Anas boschas.** MALLARD. — Very common in Hoodoo Valley during August, when females with large flocks of young were frequently seen. No males were taken. Also seen at Lake Kaniksu.

3. **Aythya americana.** REDHEAD. — Lake Kaniksu and Hoodoo Valley. Young were seen at the latter place, Aug. 18.