

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 135, NUMBER 7

THE ANATOMY OF THE LABRADOR
DUCK, CAMPTORHYNCHUS
LABRADORIUS (GMELIN)

(WITH FIVE PLATES)

By

PHILIP S. HUMPHREY

Assistant Curator of Birds
Peabody Museum of Natural History
Yale University

AND

ROBERT S. BUTSCH

University Museums
University of Michigan



(PUBLICATION 4334)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
MAY 28, 1958

THE LORD BALTIMORE PRESS, INC.
BALTIMORE, MD., U. S. A.

THE ANATOMY OF THE LABRADOR DUCK,
CAMPTORHYNCHUS LABRADORIUS
(GMELIN)

By PHILIP S. HUMPHREY
Assistant Curator of Birds
Peabody Museum of Natural History
Yale University

and

ROBERT S. BUTSCH
University Museums, University of Michigan

(WITH FIVE PLATES)

Very little is known about the anatomy of the Labrador duck. Wilson (1829, p. 370) briefly described the trachea of the male and remarked, in addition, that "the intestines measured six feet . . ." Leib (1840, pp. 170-171), describing a supposedly new species of *Fuligula (grisea)*, which later turned out to be "the young of *labrador* in a plumage heretofore undescribed or figured . . .," said of the trachea that "the labyrinth of the male is large." The sternum, coracoid, and furcula (articulated) are illustrated in Rowley (1877), but there are no published measurements or descriptions of these bones, the only known skeletal remains of the Labrador duck.

The paucity of anatomical, behavioral, and distributional information about the Labrador duck accounts for considerable uncertainty as to the relationships of the genus. Rowley (1877, pp. 215-216), with some misgivings, followed Newton (1875, p. 735) and put the Labrador duck in the eider genus *Somateria*, saying (op. cit., p. 217) that it "had better remain among the Eiders, in which group it appears to be the least beautiful member." Rowley's evidence for this arrangement was the eiderlike modified feathers of the cheek of the adult male Labrador duck. Delacour and Mayr (1945, p. 33) said that "the extinct Labrador duck (*Camptorhynchus*) seems to be about halfway between the eiders and the Old-squaw. The male is colored more like an eider, the female more like a scoter or Old-squaw." The possibility that the eiders (*Somateria* and *Polysticta*) do not belong in Delacour and Mayr's tribe Mergini (Humphrey, in press) leads us to wonder whether the eiders or the scoters are the closest relatives of the Labrador duck.

Realizing that a great deal could be learned about the osteology and other aspects of the anatomy of the Labrador duck by dismantling a study skin of the species, we discussed the problem with Dr. Herbert Friedmann, curator of birds, United States National Museum, who agreed to lend us a specimen of a male with the understanding that we reassemble the specimen after having removed its skeletal elements. Our original purpose was to describe as much as possible of the pterylosis and osteology of the specimen. However, we found on removing the limb bones that their distal musculature is well enough preserved to warrant description. We plan to describe the myology and detailed osteology of the appendages in a separate publication.

ACKNOWLEDGMENTS

It would have been impossible for us to undertake our study of the Labrador duck without the specimen lent to us by the U. S. National Museum through the courtesy of Dr. Herbert Friedmann. We are very grateful to him for allowing us to study this specimen and for giving us helpful advice at the inception of our project. We are also grateful to Dr. Hugh B. Cott, Museum of the University of Cambridge, England, for lending us the only known sternum, coracoids, and furcula. These elements will be described in a future publication on the osteology and myology of the Labrador duck. Dr. Robert R. Miller gave generously of his time, taking several X-rays, without which our study would have been very much more difficult. William L. Brudon exposed and processed all photographs of the specimen. The late Dr. Josselyn Van Tyne gave us much helpful advice and allowed us full use of the facilities of the bird division, University of Michigan Museum of Zoology. We are grateful to Peter Stettenheim, Richard L. Zusi, and Dr. Robert W. Storer for advice and assistance.

Humphrey's part of this study was supported by the National Science Foundation as part of a project on the anatomy of the trachea of ducks and the classification of that group.

SPECIMENS

Study skin.—The specimen lent us by Dr. Friedmann is a male in adult plumage and bears U. S. National Museum catalog number 1972. This specimen is one of a pair presented by S. F. Baird to the Museum. According to Baird (1860, p. 804), the data for this specimen are as follows: "Locality:—North Atlantic . . . Whence obtained:—S. F. Baird . . . Collected by:—J. J. Audubon." In 1846 Audubon gave Baird a pair of Labrador ducks, one of which is

U.S.N.M. No. 1972 (Phillips, 1926, p. 61). There is some question as to the origin of the pair of birds Audubon gave Baird. Audubon (1843, p. 329) says: "The Honorable Daniel Webster of Boston sent me a fine pair killed by himself, on the Vineyard Islands, on the coast of Massachusetts, from which I made the drawing for the plate before you." That these birds may have been the ones given by Audubon to Baird is suggested by Ridgway's statement (*in* Dutcher, 1891, p. 210) that "there were two specimens (male and female) . . . in Professor Baird's private collection. . . . They are the pair figured and described by Audubon, and given by him to Professor Baird." How did Ridgway know that these two birds were in fact the ones figured by Audubon? Phillips (1926, p. 61) has the following to say in his list of specimens in the U. S. National Museum: "1 male adult, No. 1972, skin from Baird's collection, given to him by Audubon, figured by Audubon in his plate of the species. Is this one of a pair presented to Audubon by Daniel Webster who shot them 'on the Vineyard Islands'?" There seems to be no proof that the two Baird specimens are the ones described and illustrated by Audubon, although it seems likely that this was the case. If so, we have Audubon's word that the two birds were collected by Daniel Webster.

Sternum, coracoids, and furcula.—Through the courtesy of Dr. Hugh B. Cott, the only known sternum, coracoids, and furcula of a Labrador duck were lent to us by the Museum of the University of Cambridge, England. These elements are wired together in their proper articulated relationship and mounted on a stand. According to Rowley (1877, p. 214), they were "part of the large collection made by Messrs. Alfred and Edward Newton, now in the Museum of the University of Cambridge." Alfred Newton (1896, p. 222) states that the specimen from which these bones were taken "was killed by Col. Wedderburn in Halifax harbour in the autumn of 1852. . . . The skin of this example is in Canon Tristram's collection, its sternum, which was figured by Rowley . . . , is in the Cambridge Museum." Phillips (1926, p. 62), listing the material in Colonel Wedderburn's collection, mentions "1 male shot by him in Halifax Harbor; sternum in Cambridge Museum."

METHODS

Before beginning to dismantle the study skin of the Labrador duck, we made a series of X-rays, photographs, and measurements of it. All such records of the specimen are on file at the U. S. National Museum. The X-rays were particularly useful, for with their help we were able to learn what bones were present in the study skin before

attempting to remove them. The photographs, each showing a millimeter rule in the picture, serve as a permanent record of the original condition of the specimen.

The following X-rays were made of the study skin :

1. View of body of specimen, showing wings, feet, and tail. (Hard ray.)
2. Lateral view of head. (Hard ray.)
3. Ventral view of head. (Hard ray.)
4. Right wing (prior to removal of bones); under surface of wing closest to film. (Soft ray; exposure 12 minutes.)
5. Left wing (prior to removal of bones); upper surface of wing closest to film. (Soft ray; exposure 12 minutes.)
6. Right wing (prior to removal of bones); upper surface of wing closest to film. (Hard ray.)
7. Left wing (prior to removal of bones); upper surface of wing closest to film. (Hard ray.)
8. Right wing (prior to removal of bones); under surface of wing closest to film. (Hard ray.)
9. Left wing (prior to removal of bones); under surface of wing closest to film. (Hard ray.)
10. Right wing (after removal of bones); under surface of wing closest to film. (Soft ray; exposure 12 minutes.)
11. View of spinal tract of opened skin; feathered surface of skin closest to film. (Soft ray; exposure $3\frac{1}{2}$ minutes at a distance of 20 inches.)

Measurements of the specimen prior to removal of any bones are as follows: Right wing, chord, 220 mm.; left wing, chord, 220 mm.; tail, 78 mm.

Butsch took care of all the dismantling and relaxing operations on the specimen. He began by removing the wings and legs. Each appendage was dealt with individually, and work on each was largely completed before beginning on the next. Relaxing a leg or a wing in a box of damp sand took a day or so; removing the bones from an appendage and taking care that they remained articulated and that none of the musculature was damaged generally took the better part of a day. Before beginning work on the wings, Butsch drew a detailed plan of the spread wing, using the unrelaxed folded wing as a model. This basic drawing of the spread wing was later modified when we completed our study of the pterylosis of the wing from the relaxed specimen. When study of the wings and legs was completed, Butsch relaxed the body of the specimen and opened the midventral incision. This incision was extended a slight distance anteriorly to facilitate taking an X-ray ("soft ray"; see Robert R. Miller, 1957) of the spinal tract of the opened skin. We did not, however, extend the incision far enough anteriorly to allow us to include all the spinal aperature in the X-ray. The skin of the neck was not opened, nor was

what remained of the skull disturbed. The only skeletal elements remaining in the specimen are the incomplete skull, the pygostyle, and the unguis phalanges of the feet.

When examination of the dismantled specimen was completed, Butsch replaced the bones with wire, tow, etc., and put the specimen back together again. This took several days.

Before we began our study, this specimen was in rather poor condition. The neck was weak and had a large tear in it from which cotton protruded; there was a transverse break in the skin of the belly near the tail. Most of the exposed plumage that should have been white was gray with dirt.

The completed specimen is considerably improved in appearance, parts of it having been washed and degreased; it is also substantially more durable. Plate 1, figures 1 and 2, are photographs of the specimen before work was begun on it; plate 2, figures 1 and 2, are photographs of the same specimen after dismantling, removal of the limb bones, and reassembling of the parts.

PTERYLOSIS

In studying the pterylosis of the Labrador duck we depended not only on several careful examinations of the specimen but also on X-rays (both "soft" and "hard") of the wings (with and without bones) and of the spinal and other tracts. All drawings have been critically compared to the specimen many times.

We have followed Compton (1938) in naming the various feather tracts and their regions. We have followed Howard (1929) in naming bones and parts of bones. To avoid confusion we have retained the older nomenclature of the digits of the wing (digits I, II, and III, digit I being the pollex and bearing the alula) instead of following Montagna (1945).

ALAR TRACT

Primaries.—There are 11 primaries, of which the eleventh (the distalmost) is very much reduced. Primaries 1 through 5 cross the intermetacarpal space and are attached to metacarpal II; primary 6 is also attached to metacarpal II but passes distal to the intermetacarpal space. Primary 7 is attached to digit III. Primaries 8 and 9 are attached to phalanx 1 (proximal) of digit II; primary 10 is attached to phalanx 2 of digit II; primary 11 (reduced) is attached to the minute phalanx 3 of digit II.

Primary 11 of each wing became detached during the skinning

process. The measurements of the right eleventh primary are as follows: Total length (i.e., shaft length), 29.8 mm.; calamus length, 5.8 mm.; rhachis length, 24.0 mm.; greatest width, 3.9 mm. The eleventh primary is slightly shorter than its greater upper primary covert.

The distal end of the inner vane of primary 10 is incised for approximately 45 mm.; the outer vane is not incised. The distal end

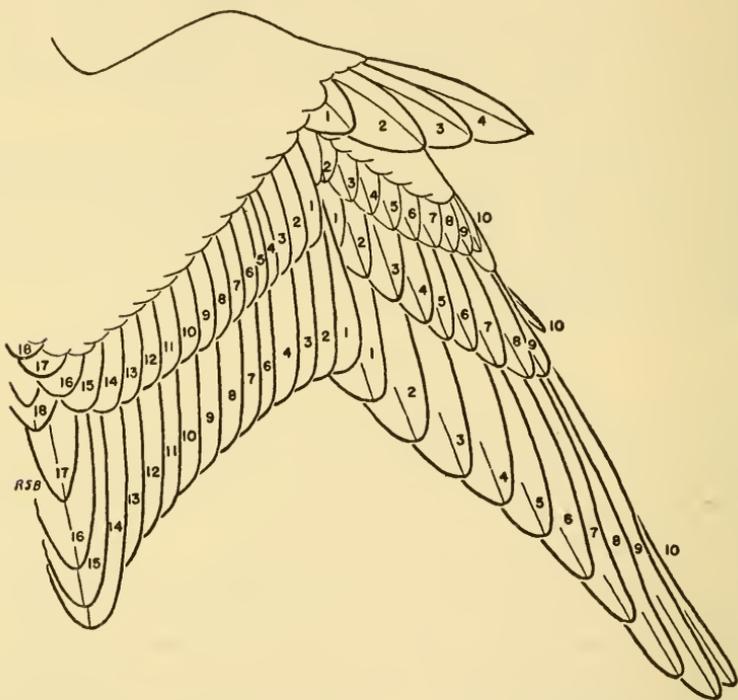
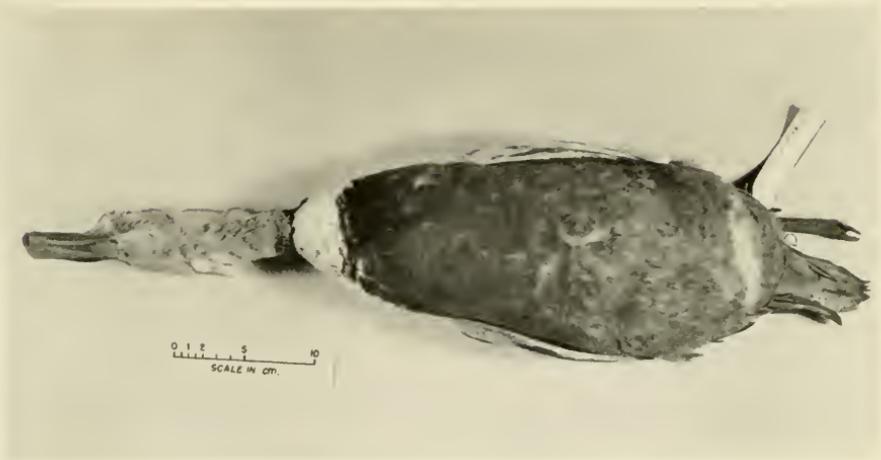


FIG. 1.—Diagram showing arrangement of feathers on dorsal surface of wing of male. (Compare with wing on plate 3. The same base drawing was used for both figures.)

of the inner vane of primary 9 is also incised for approximately 45 mm. but less deeply than in primary 10. The outer vane of primary 9 is incised for approximately 45 mm. The outer vane of primary 8 is incised but less deeply than in the ninth primary.

The primaries, arranged in order of decreasing length are: 9-10-8-7 (right wing); 9-10(equal)-8-7 (left wing).

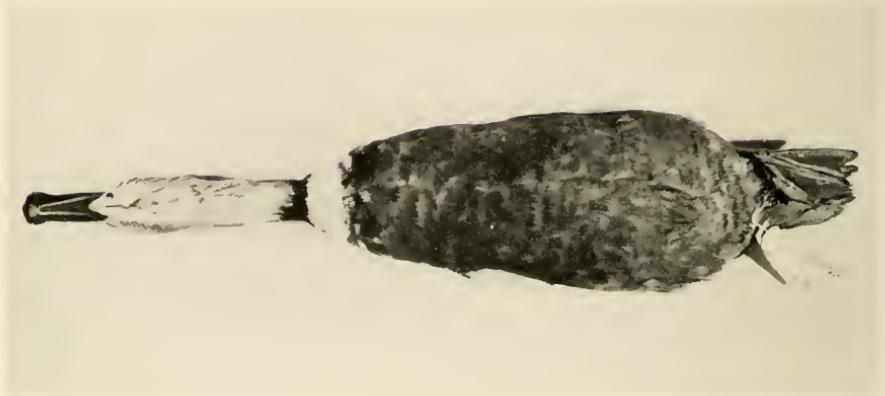
Primary coverts.—There are 10 greater upper primary coverts of which the tenth (distalmost) is quite reduced (see pl. 3, and fig. 1) and the ninth is slightly reduced. Greater upper primary coverts 1 and 2 have pale markings on outer webs.



1. Ventral view of study skin of male Labrador duck, *Camptorhynchus labradorius*, in its original condition. (U.S.N.M. No. 1972.)



2. Dorsal view of study skin of male in its original condition.



1. Ventral view of study skin of male after removal of limb bones.



2. Dorsal view of study skin of male after removal of limb bones.

There are 10 middle upper primary coverts of which the tenth (distal-most) is slightly reduced and the first is greatly reduced. Middle upper primary coverts 9 and 10 are dark colored and lack the white edging present on the others.

There are 11 greater under primary coverts of which the eleventh (distal-most) is quite reduced and the tenth is slightly reduced (see pl. 4 and fig. 2).

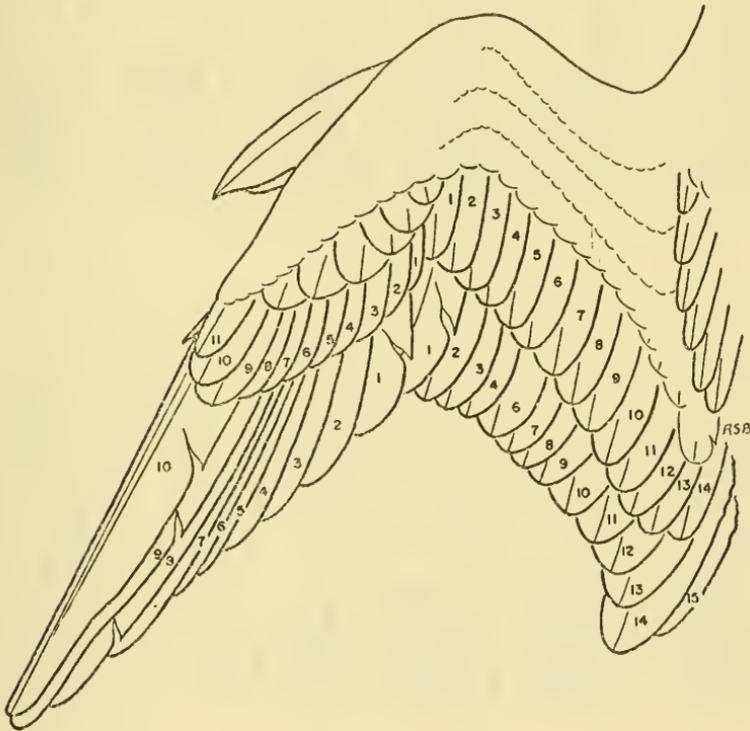


FIG. 2.—Diagram showing arrangement of feathers on ventral surface of wing of male. (Compare with wing on plate 4. The same base drawing was used for both figures.)

Secondaries.—We have been unable to discover any satisfactory definition for the proximal limit of the secondaries in Anseres. All feathers forming a continuation of the secondary series in the region of the elbow were counted as secondaries even though they have no direct connection with the ulna. We do not recognize the terms “tertiary” or “tertiary.”

There are 17 secondaries. The Labrador duck is diastataxic—that is, lacks the fifth secondary. In numbering the secondaries, we have

assigned a number (5) to the missing fifth secondary. Secondaries 12 through 16 are elongate and secondaries 17 and 18 are shorter than secondaries 1 through 11. The secondaries, arranged in order of decreasing length are: 14-15-13-16-12-11-1 (11 through 1 equal in length)-17-18.

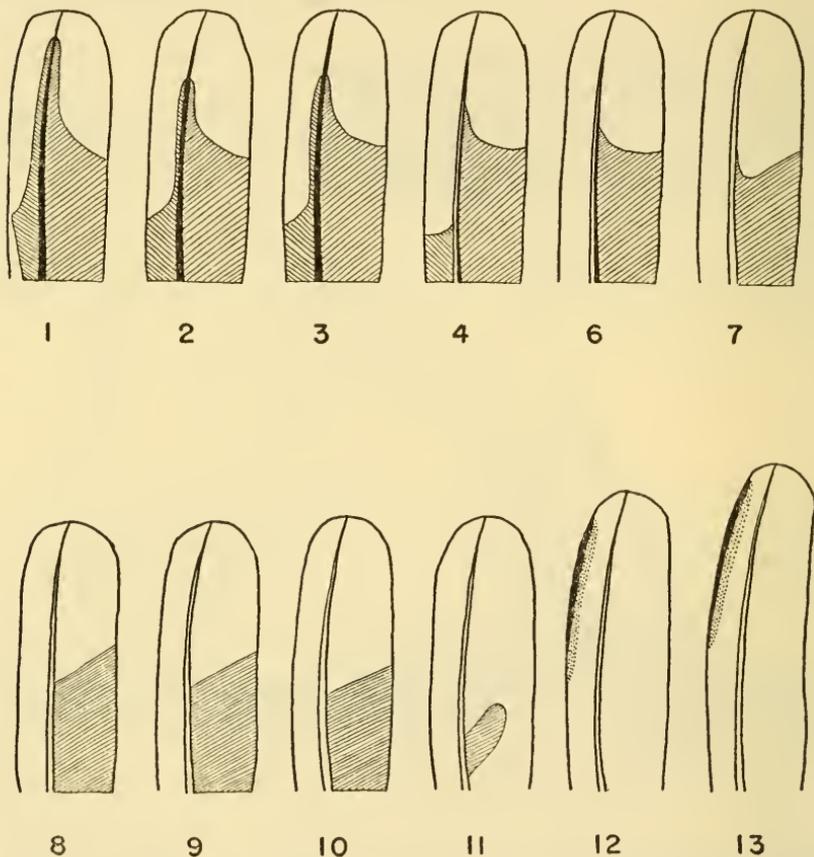


FIG. 3.—Dorsal view of secondaries 1 through 13 from the right wing of male. The missing fifth secondary (the Labrador duck is diastataxic) was assigned the number 5.

In order adequately to describe the distribution of pattern and texture on the dorsal surface of each of the secondaries, these feathers are described individually in the following. Secondaries 1 (distal) through 11 (proximal) lack markings on the distal margins of the inner and outer webs. The outer web of secondary 11 has a slightly velvety texture.

The pattern in the medial and proximal parts of each of secondaries 1 through 11 is best shown in a diagram (see fig. 3).

Secondaries 12 through 14 have pearly-gray and black edgings on the distal margin of the outer web (see pl. 3). Secondary 12: distal half of outer web velvety; distal third of inner web near shaft velvety. Secondary 13: distal two-thirds of outer web velvety; distal third of inner web velvety although velvety structure does not run to margin of the web. Secondary 14: distal two-thirds of outer web velvety; distal half of inner web velvety although the velvety texture does not extend to the margin of the web except at the distal quarter of the feather; there is a narrow black margin on the distal sixth of the inner web. Secondary 15: distal two-thirds of outer web velvety; distal half of inner web velvety. The whole margin of the inner web is soft gray; this gray margin decreases in width toward the distal end of the feather and is darkest (almost black) at the distal end of the feather. Secondary 16: distal half of outer web velvety; distal quarter of inner web velvety. Secondary 17: distal third of outer web velvety; distal eighth of inner web velvety. Secondary 18: not at all velvety.

Secondary coverts.—There are 18 greater upper secondary coverts of which numbers 17 and 18 are very much shorter than the others.

There are 17 greater under secondary coverts. Numbers 1 through 13 have brownish-gray tips; numbers 1 through 7 have only a narrow margin of brownish gray at the tip; from 8 through 13 this apical mark increases in size. The proximal four greater under secondary coverts (numbers 14 through 17) are entirely dark in color and show no pattern; all four of these feathers are reduced in size—17 the most, 14 the least.

Alula and claw.—The alula has four quills; the distalmost one became detached during skinning. There is a very small element at the distal end of digit I; this may be a much-reduced claw.

Carpal remex.—The carpal remex, carpal covert, and middle carpal covert present.

SPINAL TRACT

Our study of the pterylosis of the trunk of the Labrador duck was necessarily limited because of the inadvisability of using the more usual method of clipping the feathers. Nor was it possible to make a careful examination of the interior of the skin. The fragility of the skin and the accumulation of fat obscuring many of the feather bases made it inadvisable to conduct a prolonged examination which might damage the specimen.

The following description of the pterylosis of the trunk is based entirely on an X-ray ("soft ray") of the opened skin. A contact print of the X-ray was made and the feather tracts were traced from

the print. Insofar as possible, the feather tracts were drawn feather by feather. Because certain feather areas were difficult to interpret from the X-ray, and because we could not compare our drawing with the specimen itself, we cannot be sure that the drawing is entirely

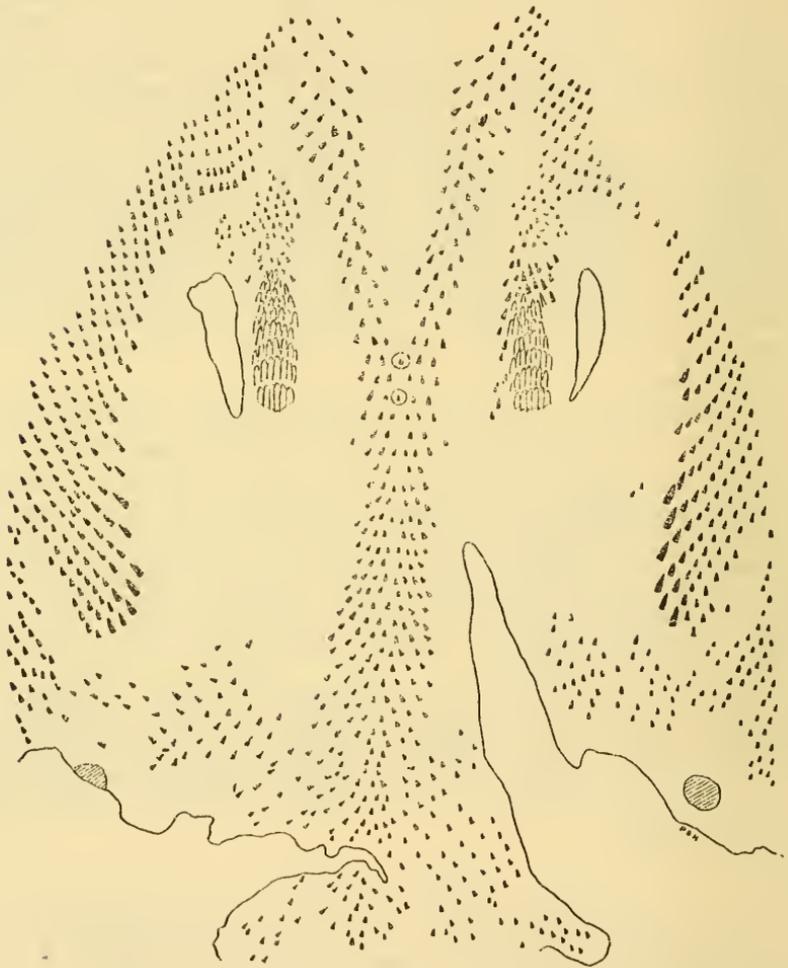


FIG. 4.—Pterylosis of trunk of male. This diagram was traced from the positive print shown on plate 5. For the nomenclature of the feather tracts and their regions, see text figure 5 (opposite) and the text.

accurate. This is the case for the humeral tract and for the enlarged feathers (flank feathers) at the dorsocaudal margins of the sternal regions of the ventral tract. The loss of feathers from certain areas of the skin is another possible source of error. There seem to be feathers missing from the area of the junction of the humeral tract

(right side) and the ventral cervical and sternal regions of the ventral tract. There are probably some feathers missing from the posterior part of the pelvic region of the spinal tract, and from the femoral tracts.

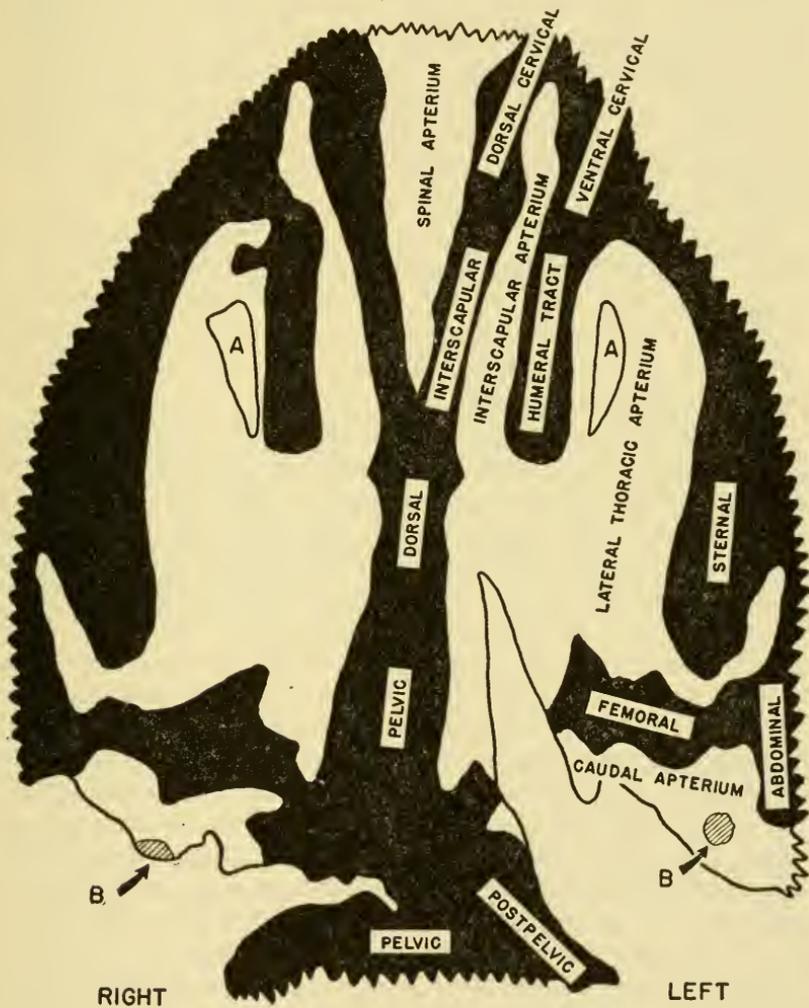


FIG. 5.—Nomenclature of the feather tracts (and their regions) of the trunk of the male. Feathered areas are shown in black. The feathered areas outlined with a scalloped margin extend beyond the limits of the diagram. The letter "A" marks the holes cut in the skin when the wings were removed. The letter "B" marks the locations of the legs. (Compare with plate 5 and text figure 4.)

Plate 5 and figures 4 and 5 illustrate as much of the skin as could be studied. The feather tracts outlined with a scalloped margin (see fig. 5) extend beyond the limits of the diagram. The wings and legs

of the specimen were removed before the X-ray was taken. The letter "A" on figure 5 marks the holes cut in the skin when the wings were removed. The letter "B" marks the locations of the legs.

Because there seem to be no natural boundaries between most of the feather tracts (or their regions) on the trunk of the Labrador duck, we have avoided drawing any arbitrary divisions between them. We were unable to delimit the following regions illustrated by Compton (1938, pp. 182, 190): Lateral scapular and lateral pelvic regions of the spinal tract; axillar and subaxillar regions of the ventral tract. We are not sure that what we have designated the "postpelvic region" of the Labrador duck corresponds to Compton's term.

The posterior margin of the pelvic region shown in plate 5 and figures 4 and 5 is slightly anterior to the uropygial gland.

Compton (1938, pp. 182-183) divides the spinal tract into six regions: (1) Dorsal cervical, (2) interscapular, (3) lateral scapular, (4) dorsal, (5) pelvic, and (6) lateral pelvic. Compton includes the postpelvic region in the caudal tract.

We judge that our figures (pl. 5 and figures 4 and 5) show the posterior ends of the paired dorsal cervical regions. There is no perceptible division between the posterior end of the dorsal cervical region of each side and the anterior margin of the corresponding interscapular region. The dorsal cervical regions are each bounded laterally by an interscapular apterium and medially by the unpaired spinal apterium. We do not know how far anteriorly the spinal apterium extends. This should be determined on another specimen as the extent of the spinal apterium is a matter of considerable interest. The spinal apterium terminates posteriorly at the posterior junction of the interscapular regions. The interscapular regions join at a median, unpaired feather (anteriormost encircled feather on fig. 4). From the median unpaired feather caudad, the interscapular region is a single median region. Two rows posterior to the median unpaired feather which forms the caudal limit of the spinal apterium there is a second median unpaired feather. The dorsal region continues caudally from the interscapular region without any break. Nor is there any perceptible break between the dorsal region and the pelvic region. The spinal tract anterior to its junction with the paired femoral tracts forms a continuous Y-shaped area of feathers. Posterior to its junction with the femoral tracts, the pelvic region becomes considerably broader and terminates caudolaterally on each side in the so-called postpelvic regions which may or may not be distinct from the median posterior part of the pelvic region. We have no way of knowing how many feathers are missing from this part of the specimen.

HUMERAL TRACT

The paired humeral tracts (comprising the scapulars) are each bounded laterally and caudally by a lateral thoracic apterium. Medially each is bounded by an interscapular apterium. Anteriorly each humeral tract merges with a dorsal spur of the ventral cervical region of the ventral tract and with the anterodorsal extremity of the sternal region. Drawing boundary lines in this area of junction seems to us an arbitrary matter; we therefore refrained from doing so.

We are vague about the arrangement and number of feathers in the humeral tract. There was so much overlap of the calami of the large feathers that the X-ray did not give a clear picture. We did not feel justified in risking damage to the specimen to obtain a more accurate idea of the disposition of the scapular feathers.

FEMORAL TRACT

The paired femoral tracts join the pelvic region medially and extend laterally and ventrally to merge with the corresponding abdominal region of the ventral tract. The femoral tract is bounded anteriorly by a lateral thoracic apterium and posteriorly by a caudal apterium. Near the junction with the abdominal region, the femoral tract becomes very narrow. This narrow area in each femoral tract lies anterior to the place on the skin where the leg was located.

VENTRAL TRACT

Compton (1938, pp. 189-191) divides the ventral tract into five regions: (1) Ventral cervical, (2) sternal, (3) axillar, (4) subaxillar, and (5) abdominal. Our figures (pl. 5 and figs. 4 and 5) illustrate parts of the ventral cervical, sternal, and abdominal regions. All these regions are paired, the two sides being separated by a narrow, midventral apterium. Because the specimen was prepared by the original collector by making an initial midventral incision, the midventral apterium was obscured. The edges of the incision were puckered and drawn together so much anteriorly that a midventral apterium could not be distinguished in that area. The midventral apterium was present between the abdominal regions but its width and posterior extent could not be determined.

The paired ventral cervical regions each merged posteriorly with the corresponding sternal region. At this area of junction a spur arises and extends dorsally and posteriorly to join with the dorsally located humeral tracts. The ventral cervical and dorsal cervical

regions merge on the lateral surfaces of the base of the neck and presumably extend anteriorly uninterrupted.

The paired sternal regions extend from the ventral cervical region caudad over the breast to merge posteriorly with the corresponding abdominal regions. The lateral and posterior end of each sternal region is a lobe-shaped area of feathers bounded by the lateral thoracic apterium dorsally, and by a narrow extension of the lateral thoracic apterium caudally and ventrally. The posterior, dorsolateral rows of feathers of the sternal region are the large flank feathers.

CAUDAL TRACT

Compton (1938, p. 197) includes the following in the caudal tract: (1) Rectrices, (2) upper tail coverts, (3) under tail coverts, (4) postpelvic region, (5) tuft and covering of the uropygial gland, (6) postventral region, and (7) anal circle.

This specimen of the Labrador duck has 14 rectrices. The tail is graduated, the paired "deck" feathers being the longest (79 mm.) and the lateralmost rectrices the shortest (59 mm.). DeKay (1844, p. 326) lists 16 rectrices for the Labrador duck.

We counted 14 greater under tail coverts; however, we are not certain of this count. We could not distinguish satisfactorily between lateral greater under tail coverts and feathers which were not greater under tail coverts.

There are seven upper tail coverts on the left side and six upper tail coverts on the right side of this specimen. Counting the medial pair of upper tail coverts as 1, right upper tail covert number 3 is missing. Anterior to the V-shaped row of upper tail coverts there is a V-shaped row of short, stiff feathers. This area consists of three or four rows of feathers. At the apex of the V these feathers are short (12 mm.) and somewhat downlike (although the rachis is very stiff); they increase in length (the longest was 25 mm.) and become less downlike toward the anterolateral extremities of the V. The barbs of these feathers do not adhere to one another. The uropygial gland is bounded caudally and caudolaterally by the arms of this V-shaped area of feathers.

When this specimen was originally prepared, most of the uropygial gland was removed from the inner surface of the skin and the base of the tail. The posterior end of the gland (papilla) and the superficial covering of the gland were left untouched by the original preparator. We removed what remained of the uropygial gland and its dermal covering. This part of the specimen has been preserved



R. S. B. Fisch

Right dorsolateral view of male; dorsal view of head. (Compare wing with text figure 1.)



Right ventrolateral view of male; ventral view of head. (Compare wing with text figure 2.)

in alcohol. The uropygial gland is tufted (as in other Anseres) and anterior to the papilla is covered with feathers. The tuft on the papilla of the uropygial gland is tawny in color and consists of 36 smaller tufts which are oriented in a definite pattern on the posterior surface of the papilla (see figs. 6 and 7). The papilla anterior to the

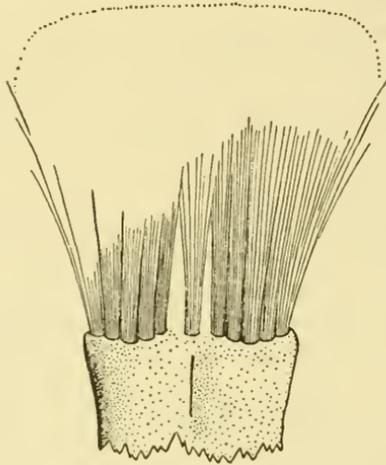


FIG. 6.—Dorsal view of papilla of uropygial gland of male.

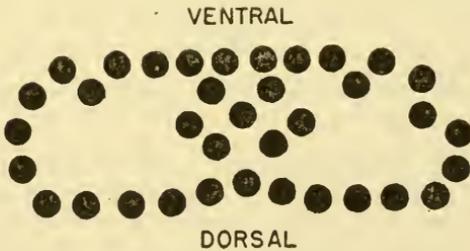


FIG. 7.—Diagram showing distribution of feather tufts on posterior surface of papilla of uropygial gland of male.

tuft is naked. We could not determine how many orifices there are in the papilla of the uropygial gland. There is a median sagittal groove on the dorsal surface of the papilla (see fig. 6).

The postpelvic region of the caudal tract has been discussed elsewhere (see section on spinal tract). Because of the condition of the skin we were unable to distinguish the postventral region of the caudal tract or an anal circlet.

CAPITAL TRACT

Compton (1938, p. 177) has divided the capital tract into 11 areas. Because the head of the Labrador duck (and other Anatidae) appears to be covered uniformly with feathers it seems to us pointless in this case to attempt to subdivide arbitrarily the capital tract into the areas described by Compton.

The patch of modified feathers on the cheek of the male (see pls. 3 and 4) is the only noteworthy feature of the capital tract of the Labrador duck. Rowley (1877, pp. 216-217) felt that this patch of modified feathers was decisive evidence that the Labrador duck is related to the eiders. Rowley states that "there is one point of resemblance, however, which (though a superficial one), in the absence of the bird in the flesh, decided me. It is the presence in the male Pied Duck of those stiff and glistening feathers in the head, which (so far as I have been able to discover), among Ducks, belong to the Eiders alone . . ."

Wilson and Bonaparte (1878, p. 126), describing an adult male Labrador duck, say: "The plumage of the cheeks is of a peculiar bristly nature at the points . . . In young birds, the whole of the white plumage is generally strongly tinged with a yellowish cream color; in old males these parts are pure white, with the exception of the bristly pointed plumage of the cheeks, which retains its cream tint the longest . . ." Audubon (1843, p. 330) described the feathers "on the lower part of the cheeks" as being "very stiff, having the terminal filaments more or less united into a horny plate."

BILL

Audubon (1843, p. 330) described the bill of an adult male Labrador duck as follows:

Bill nearly as long as the head, rather broader at the base, the sides nearly parallel, but at the end enlarged by soft membranous expansions to the upper mandible. The latter has the dorsal outline at first straight and declinate, then direct and slightly convex, at the extremity decurved; the ridge broad at the base, convex toward the end; the side sloping at the base, then convex, the extremity broad and rounded, the unguis broadly obovate; the margins soft, expanded toward the end, and with about 50 lamellae, of which the anterior are inconspicuous. Nasal groove oblong, nostrils linear-oblong, sub-basal near the ridge. Lower mandible flattened, curved upwards, with the angle very long and narrow, the dorsal line very short, and nearly straight, the nearly erect edges with about 30 large and prominent lamellae; the unguis very broad.

Wilson (Wilson and Bonaparte, 1878, p. 126), discussing the bill of a male, says that "towards the extremity it widens a little in the manner of the Shovellers, the sides there having the singularity of

being only a soft, loose, pendulous skin . . . the edges of both mandibles are largely pectinated."

The lamellae on the lower mandible are large as Audubon has pointed out; most of them are much larger than those of the upper mandible. The anterior 12 lamellae project about 2 mm. laterally from the rami; they become progressively smaller posteriorly. The posteriormost five or six lamellae project less than 1 mm. from the rami. The largest lamella in the upper mandible projects 1.3 mm. anteromesially; counting from anterior to posterior, lamellae 8 through 12 project 1.2 to 1.3 mm. from the mesial surface of the upper bill. The anteriormost four lamellae are little more than wrinkles in the ramphotheca; lamellae 13 through 23 become progressively smaller posteriorly. The upper mandible bears 30 lamellae on the left side and 31 on the right; the lower mandible has 23 lamellae on each side. Audubon must have included both sides in his count of "about 50 lamellae" for the upper mandible.

There is very little information on the food and feeding habits of the Labrador duck. According to Audubon (1843, pp. 329-330) and Wilson (Wilson and Bonaparte, 1878, pp. 126-127), it subsisted on the common mussel, small clams, small shellfish, fry, and various kinds of seaweeds. Audubon (1843, p. 330) said that "it procures its food by diving amidst the rolling surf over sand or mud bars; although at times it comes along the shore, and searches in the manner of the Spoonbill Duck."

We cannot even speculate on the function of the loose flaps of skin on the end of the upper mandible of the Labrador duck. The information on the food habits of the species is so scanty that there is no way of knowing whether it had a highly specialized diet to which its peculiar bill was adapted. Phillips (1926, p. 60), commenting on the extinction of this duck, said: "A far more reasonable view, suggested to me by Mr. Outram Bangs, is to suppose that the Labrador Duck had very specialized food habits and that changes in the molluscan fauna, brought about by increased population along our coast, may have proved disastrous. Such changes in minute shell-fish are known to have taken place."

FEET

Audubon (1843, p. 330), describing the feet of the adult male Labrador duck, said that they were "very short, strong, placed rather far behind; tarsus very short, compressed, with two anterior series of rather small scutella, the sides and back part reticulated with angular scales. Hind toe very small, with a free membrane beneath; outer

anterior toes double the length of the tarsus, and nearly equal, the inner much shorter, and with a broad marginal membrane. Claws small, slightly arched, compressed, rather acute."

As Audubon pointed out, the Labrador duck has two rows of rather small scutes on the anterior surface of the tarsometatarsus;

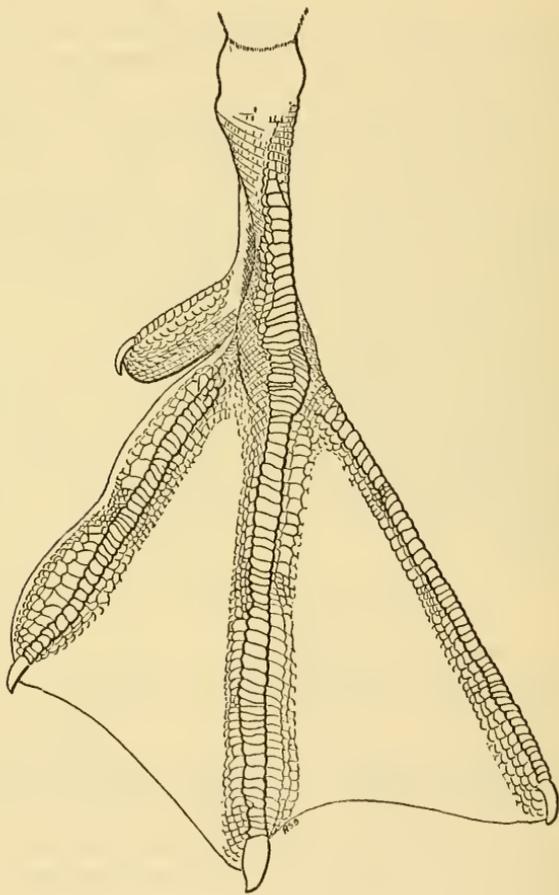
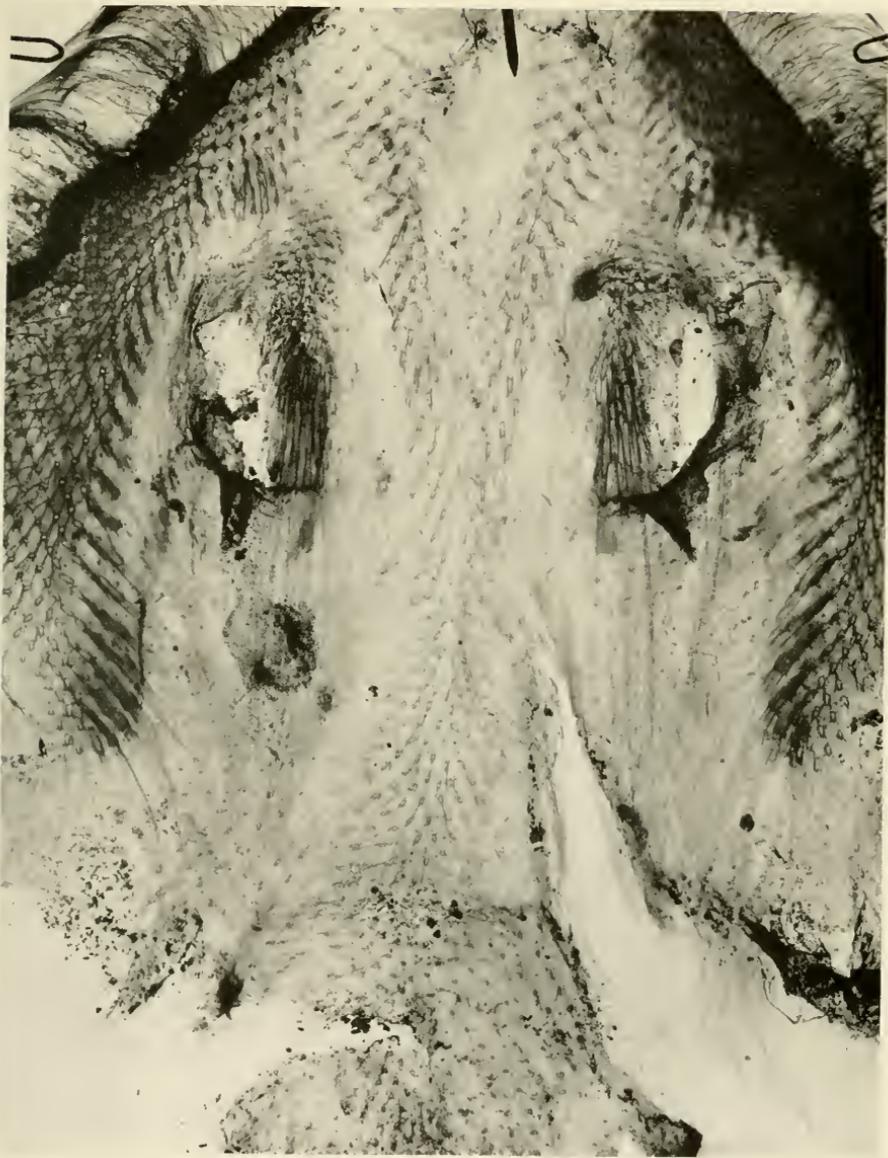


FIG. 8.—Left foot of male.

there are about 14 scutes in the row, of which the row of scutes on digit III forms a continuation. There are about 12 scutes on the lateral row. There is a third row of about 11 small scutes on the medial surface of the tarsometatarsus bordering the medial margin of the row leading to digit III. (See fig. 8.)



Positive print of X-ray ("soft ray") of inner surface of opened skin of male showing feather tracts. (Compare with text figures 4 and 5.)

COLORATION OF SOFT PARTS

There is considerable disagreement in the literature concerning the colors of the soft parts of the adult male Labrador duck. Opinions on this subject are summarized in table 1. Numbers corresponding to parts of the bill are illustrated in figure 9; see also the dorsal view of the head illustrated in plate 3.

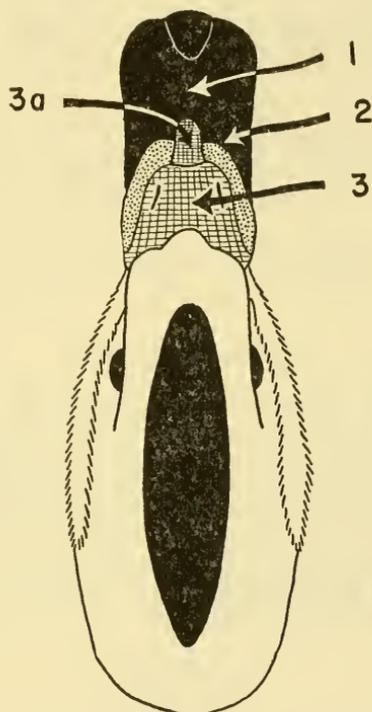


FIG. 9.—Dorsal view of head of male. For explanation see text and table 1.

Study of the upper bill of Labrador duck specimen U.S.N.M. 1972 convinced us that the area marked "3a" in figure 9 could well have been orange in color. We have no evidence on this point except for a slight difference in the appearance of area "3a" suggesting that it might have been differently pigmented than area "3."

TRACHEA

There is no known specimen of the trachea of the Labrador duck. Wilson (1829, p. 370) describes the trachea of the male Labrador duck as follows:

The windpipe of the male measures ten inches in length, and has four enlargements, viz., one immediately below the mouth, and another at the interval

TABLE-1.—*Colors of the soft parts of the adult male Labrador duck (Camptorhynchus labradorius) according to various authors*
 Numbers corresponding to the parts of the bill are illustrated in figure 9.

	Irides	Tarsus and toes	Web	I	Bill 2	3 and 3a
Audubon (1843, p. 331).....	Reddish hazel	Light grayish blue	Dusky	Black	Dull pale orange	Pale gray- ish blue
Fuertes (<i>in</i> Phillips, 1926, p. 58).....	Reddish hazel	Light grayish blue	Dusky	Black	Dull pale orange	Pale gray- ish blue
Phillips (1926, p. 57).....	Reddish hazel to yellow	?	?	Black to blackish brown	Pale yellow or orange	Pale yellow or orange
Hall (1862, p. 427).....	Yellow	Yellow	?	Blackish horn color	Flesh color	Flesh color
Baird (1860, p. 803).....	?	?	?	Black	Yellowish	Yellowish
DeKay (1844, p. 326).....	Hazel	Light bluish	Darker	Black	Pale orange	Pale orange
Pennant (1792, p. 282).....	?	Black	?	?	?	?
Rowley (1877, pl. facing p. 205).....	Bright yellowish	Light-yellow- ish tan	Medium brown	Black	Yellow	Yellow
Wilson (1829, p. 370).....	Dark hazel	Pale whitish ash	Black	Black	Pale orange color	Pale orange color

of an inch; it then bends largely down to the breast bone, to which it adheres by two strong muscles, and this has at that place a third expansion. It then becomes flattened, and before it separates into the lungs, has a fourth enlargement much greater than any of the former, which is bony, and round, puffing out from the left side.

Leib (1840, p. 171) says only that "the labyrinth of the male is large."

The tracheas of male white-winged and surf scoters are the only ones having any resemblance to that described by Wilson for the male Labrador duck. Male white-winged and surf scoters are the only species of waterfowl known to have an expansion of the trachea immediately posterior to the larynx. The Labrador duck differs from the scoters in having two midtracheal expansions (the white-winged and surf scoters have but one) in addition to an expansion at either end of the trachea. For figures of the tracheas of scoters see W. deW. Miller (1926, p. 2).

RELATIONSHIPS

We judge that the Labrador duck should be placed in the tribe Mergini along with the scoters, oldsquaw, bufflehead, goldeneyes, and mergansers. The eiders, as Humphrey (in press) has pointed out, are best taken out of the Mergini as originally defined by Delacour and Mayr (1945) and placed either in, or close to, the tribe Anatini. The Labrador duck seems to us most closely allied with the scoters and the oldsquaw. In a linear classification the genera are probably best arranged as follows:

Melanitta
Camptorhynchus
Clangula
Bucephala
Mergus

We have little evidence on which to base our tentative remarks on the relationships of the Labrador duck. Wilson's (1829, p. 370) description of the trachea of a male strongly suggests affinities with the scoters. The plumage patterns of the male and female suggest affinities not only with the scoters but also with the goldeneyes and mergansers. Humphrey (Ph.D. thesis), discussing plumage characters of the scoter-goldeneye-merganser group (Mergini), says that "except for three species (*Oidemia nigra*, *Melanitta perspicillata*, and *Clangula hyemalis*) both sexes have extensive white on the proximal part of the wing (dorsal surface). This white area always includes most of the secondaries; it may also include most of the greater upper

secondary coverts and, in some species, a varying number of the lesser upper secondary coverts." This is not true of the eiders. The Labrador duck shares with most species of the scoter-goldeneye-merganser group the character of a dorsal white patch on the secondaries. This seems to us additional evidence for placing it in the tribe Mergini.

In the hope that we will be able to find more evidence clarifying the relationships of the Labrador duck, we are now engaged in a comparative study of the pterylosis, appendicular myology, and osteology of the Labrador duck, scoters, oldsquaw, and eiders.

LITERATURE CITED

- AUDUBON, J. J.
1843. The birds of America, vol. 6.
- BAIRD, SPENCER F.
1860. Birds of North America.
- COMPTON, LAWRENCE V.
1938. The pterylosis of the Falconiformes with special attention to the taxonomic position of the osprey. Univ. California Publ. Zool., vol. 42, pp. 173-212.
- DEKAY, JAMES E.
1844. Zoology of New York, Part 2, Birds.
- DELACOUR, JEAN, and MAYR, ERNST
1945. The family Anatidae. Wilson Bull., vol. 57, pp. 3-55.
- DUTCHER, WILLIAM.
1891. The Labrador duck—A revised list of extant specimens in North America, with some historical notes. Auk, vol. 8, pp. 201-216.
- HALL, ARCHIBALD.
1862. On the mammals and birds of the District of Montreal. Canadian Nat. and Geol., vol. 7, pp. 426-427.
- HOWARD, HILDEGARDE.
1929. The avifauna of Emeryville shellmound. Univ. California Publ. Zool., vol. 32, pp. 301-394.
- HUMPHREY, PHILIP S.
The relationships of the sea-ducks (Mergini). Unpublished Ph.D. thesis, 1955.
Classification and systematic position of the eiders. Condor, vol. 60. (In press, 1958.)
- LEIB, GEORGE C.
1840. Description of a new species of *Fuligula*. Journ. Acad. Nat. Sci. Philadelphia, vol. 8, pp. 170-171.
- MILLER, ROBERT R.
1957. Utilization of X-rays as a tool in systematic zoology. Systematic Zool., vol. 6, pp. 29-40.
- MILLER, W. DEW.
1926. Structural variations in the scoters. Amer. Mus. Nov., No. 243, pp. 1-5.

MONTAGNA, WILLIAM.

1945. A re-investigation of the development of the wing of the fowl. Journ. Morphology, vol. 76, pp. 87-113.

NEWTON, A.

1875. Birds. Encycl. Brit., 9th ed., vol. 3, pp. 694-778.

1896. A dictionary of birds.

PENNANT, THOMAS.

1792. Arctic zoology, vol. 2.

PHILLIPS, J. C.

1926. A natural history of the ducks, vol. 4.

ROWLEY, G. D.

1877. *Somateria labradoria* (J. F. Gmelin). Ornithological Miscellany, vol. 2, pp. 205-223.

WILSON, ALEXANDER.

1829. American ornithology, vol. 3.

WILSON, ALEXANDER, and BONAPARTE, C. L.

1878. American ornithology, vol. 3.