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THE BLACK-CROWNED NIGHT HERON (NYCTICORAX NYCTICORAX NAEVIUS) OF SANDY NECK.

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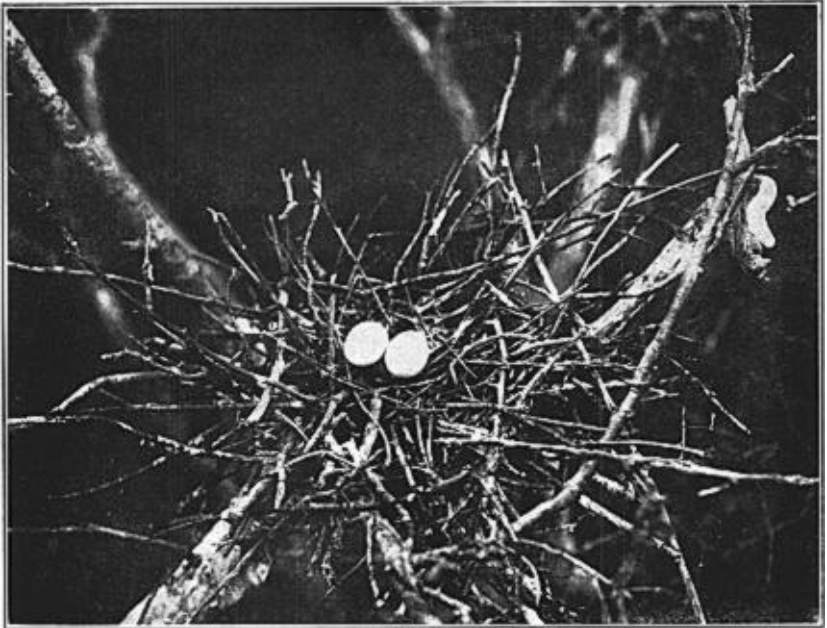
Plates V-XIV.

THE NEST.

THE typical nest of the Black-crowned Night Heron represents a poor type of architecture. Many of the structures are little more than crude, loosely constructed platforms of large coarse sticks which may be lined, usually scantily, with roots, twigs, grass, ferns or other similar materials. The nests are not well adapted for service in the tree tops where they are often exposed to buffeting winds. Some of the nests at Sandy Neck were so frail and insufficiently cupped that several eggs and many young were blown onto the ground during a severe storm on June 18, 1920. It is probable that the instincts of nest building have been handed down to the present day Herons from ancestors that built their nests on the ground or among the reeds and grasses of the marshes where this kind of nest serves all that is intended. Indeed, as has already been noted, many of the Black-crowned Night Herons, especially those in the middle west, still cling to what may be the more ancient habitat.

The composition of the nest somewhat depends on the available material accessible in the vicinity of the rookery. At Sandy Neck the foundations of the nests were constructed of coarse dead

*Concluded from page 30.



NESTS OF BLACK-CROWNED NIGHT HERON

1. Crude type of nest, 1905, H. K. Job.
2. Nest No. 19. A substantial type of nest, made of Pine, Bayberry and Beach Plum branches and lined with grass, Beach Grass roots and Pine Needles.

branches of cedar, oak and especially of pitch pine. Some of the latter were two to three centimeters in diameter and from 50 to 70 centimeters in length. Many of the nests on the east side of the rookery were built of dead densely branched stalks of bayberry and beach plum, shrubs which had been killed by the severe winter and subsequently blown into heaps among the dunes by the sand laden winds. Many of the stalks were large and cumbersome but they made very substantial foundations. A large percentage of the nests were lined in part or wholly with the long flexible roots of beach grass. It puzzled me to know how it were possible for the birds to secure some of the very long roots, some of which were more than a meter in length, until I chanced upon a score of adult Herons tugging at the roots which had been left unearthed in the wake of a traveling sand dune. The numerous foot prints in the sand evidenced that such places were the common source of their supply. The roots provided an unusual but admirable nesting material and some of the nests lined with them represented the finest types built by the Herons at Sandy Neck (Plate VII, figs. 1 and 2). In addition to the materials enumerated above there were variable quantities of wild rose, cat briar, slender weed and grass stalks, blades of marsh and beach grass and pine needles.

In some cases the birds used a last year's nest as a foundation and in several instances the alternate deposits of coarse and fine materials revealed that the structures were the accumulations of materials of two or more years. More frequently, however, the remains of the old nests are torn apart and new ones constructed in the same tree or in a site not far remote. During the month of July I saw Herons dismembering nests, which had recently been deserted by the young, in order to get materials to build a nest for a second brood. In one case I saw a Heron steal material from an occupied nest at a time when the owners were away at the fishing grounds.

At Whaleboat Island the foundations of most all of the nests were composed of dead limbs of spruce more or less interwoven with long stems of raspberry vines and briar. With but few exceptions the nests were lined with the stems of dead fern leaves which are abundant on all parts of the island. When I visited the

Whaleboat rookery in May 1921 every one of the nearly 100 nests examined was occupied, which goes to show that either the nests of the previous year are used or at least the materials are utilized in new construction work.

At the close of the nesting season the nests present an unsightly appearance usually being completely covered with filth and limy deposits. The excreta, because of their liquid nature, cannot be removed by the parent birds even though they desired to keep the nest clean. Under normal conditions there are but few regurgitations of indigestible matter for even the bones of the larger fish are dissolved by the acid secretions of the digestive tract. It is the bones of the animals eaten that contribute the calcium constituents of the excreta, which give not only the nests but also the trees and vegetation underneath the rookery a veritable whitewashed appearance.

Both the male and the female actively concern themselves in the work of building the nest which usually requires from two to five days, but, in the case of one nest, construction work and alterations were going on for a period of more than a week.

The following table contains the measurements of 10 representative Black-crowned Night Heron nests from the colony at Sandy Neck, Barnstable, Massachusetts.

MEASUREMENTS OF NESTS

Record Number of nest	Distance from the ground	Diameter		Depth of cup	Depth of the entire nest
		outside	inside		
1	30 feet	55×60 cm.	24 cm.	.8 cm.	26 cm.
2	12	57×60	25	7.0	28
17	17	40×46	18	4.5	18
19	16	50×80	24	7.0	16
20	14	58×90	28	6.5	41
21	21	44×80	18	5.0	18
38	22	48×64	30	4.2	23
39	16	50×60	28	4.5	15
45	10	58×65	30	4.0	20
56	18	42×47	19	2.0	8

In the above table the measurements of the outside diameter include the extreme tips of materials comprising the nest. The

inside diameter is the approximate area of the cupped depression used by the nesting bird and young. The depth of the cup is the distance from a meter-stick resting on the top of the nest to the bottom of the interior of the cup. The entire depth is the distance from a meter-stick placed as indicated above to the lowest twigs on the exterior of the nest. Some of the newly constructed nests, as number 56 in the above table, were so thin and composed of such coarse sticks that the eggs were plainly visible when viewed from below (Plate V, fig. 1). Other nests as number 20 were the accumulation of materials of two or more years.

THE EGGS

The eggs of the Black-crowned Night Heron are variously described by different authors as clear blue,¹ pale bluish green,^{2,3} blue,⁴ bluish green to greenish yellow,⁵ pale greenish blue,⁶ pale dull blue,⁷ pale sea green color,⁸ pale green tinged with blue,⁹ and light pea-green.¹⁰ These few examples are I think sufficient to impress the reader with the importance of using some standard of color. The color of the Heron's egg is clear blue to one writer and pale sea green to another and the impression of each of these colors conveyed to the reader is necessarily a variable one unless there is some means of making a comparison with the same standard. At the present there is nothing better for this purpose than Ridgway's Standards of Color Nomenclature. The color of the majority of the eggs which I have examined approaches very nearly that represented by Ridgway as Glaucous-green. If the reader refers to this color as represented in Ridgway's color standards he will receive a fairly correct impression of the color of the Night Heron's freshly laid egg.

The eggs vary in number from one to five but sets containing six and even as many as eight have been reported. The latter

¹ Barrows, W. B., 1912, *Michigan Bird Life*, pp. 146-147.

² Reed, C. A., 1904, *North American Bird's Eggs*, pp. 98-99.

³ Macoun, J., 1900, *Catalogue of Canadian Birds*, p. 134.

⁴ Finley, W. L., 1907, *American Birds*, p. 226.

⁵ Hatch, P. L., 1892, *Birds of Minnesota*, pp. 95-96.

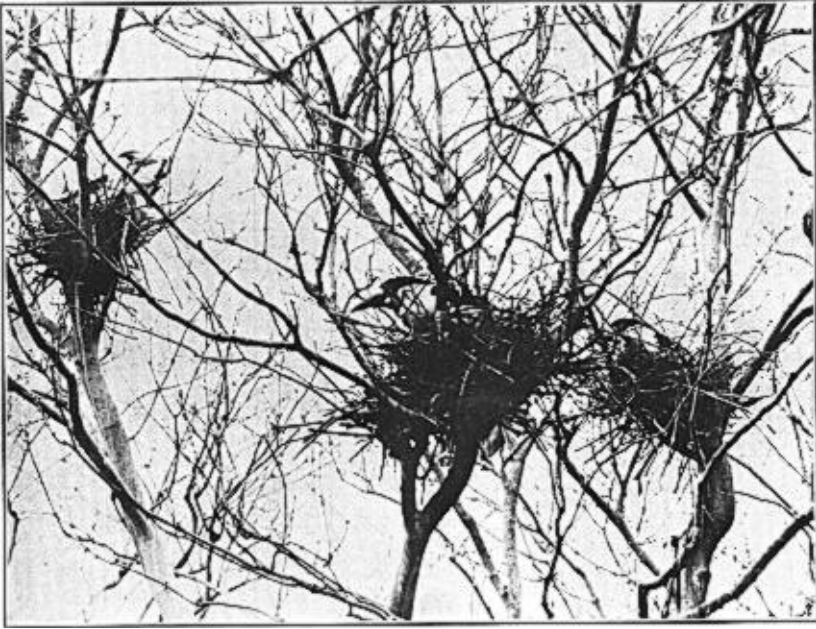
⁶ Butler, A. W., *Birds of Indiana*, p. 666.

⁷ Chapman, F. M., 1916, *Birds of Eastern North America*, p. 228.

⁸ Coues, E., 1896, *Key to N. A. Birds*, p. 663.

⁹ Chamberlain, M., *Nuttall's Ornithology*, p. 91.

¹⁰ Samuels, E. A., 1867, *Ornithology and Oölogy of N. England*, p. 411.



1. Black-crowned Night Herons on nests in oaks and maples, 1905.
H. K. Job.

2. Bird just settling on Nest in Pitch pine, 25 ft. up. Taken with
camera concealed in neighboring tree.



NESTS OF BLACK-CROWNED NIGHT HERON.

1. Nest No. 21. June 26, 1920.
2. Nest No. 3. June 19, 1920. One of the finest structures among hundreds studied; in pine, 12 feet up.

numbers are of course very extreme and, in all probability represent the eggs of more than one female. I have had nests which contained only one egg under continual observation so apparently one egg may represent a complete set. The average number of eggs in complete sets is greater at the beginning (first nest) than it is at the end of the nesting season; a correlation which has been noted in the case of many other species of birds.

The weights and measurements of ten random sets of eggs which were complete as far as could be determined are as follows,—

Number of nest	Weight in grams	Long diameter in centimeters	Short diameter in centimeters
1	33.7	5.30	4.85
	34.8	5.55	4.76
3	31.0	5.22	3.50
	32.0	5.10	3.60
	32.5	5.25	3.60
11	33.8	5.10	3.50
	34.0	4.91	3.72
	34.9	5.05	3.70
13	32.5	4.90	3.51
	32.8	5.40	3.49
15	31.9	4.95	3.68
	29.3	4.80	3.55
	29.9	4.91	3.62
16	34.5	5.80	3.60
	36.9	5.85	3.63
	33.7	5.10	3.82
	33.0	5.62	3.65
17	33.1	4.95	3.62
	34.4	5.11	3.70
	32.2	4.90	3.72
	33.8	5.31	3.65
19	37.0	5.30	3.75
	31.8	5.02	3.58
	36.2	5.10	3.84
	32.3	4.95	3.61
	33.1	5.00	3.58

Number of nest	Weight in grams	Long diameter in centimeters	Short diameter in centimeters
21	39.5	5.10	3.46
	39.0	5.21	3.28
	39.3	4.86	3.49
	35.5	4.72	3.24
54	29.8	4.65	3.40
	32.2	4.95	3.62
	33.5	4.60	3.75

The average weight and measurements of one hundred eggs are as follows:

Weight 33.92 grams; long diameter 5.14 cm.; short diameter 3.67 cm.

All the above measurements were made in the field and the eggs were returned to the nests as soon as the measurements were completed. No attempts were made to weigh the empty shells but the following determinations made by Lt. G. Ralph Meyer, Fort McKinley, Maine¹, are of interest.

"Only averages are given for each set or series of eggs.

Set of 3	Average Weight				Empty		Cubic Contents
	1 oz.	2 dr.	1 scr.	4 gr.	2 scr.	15 gr.	
"	1 "	1 "	2 "	0 "	2 "	9 "	24 "
"	1 "	2 "	1 "	6 "	2 "	9 "	25 "
"	1 "	1 "	1 "	19 "	2 "	9 "	24 "

INCUBATION

The first egg is laid soon after the nest is completed. In the case of one nest under daily observation the first egg was laid two days after all construction work had ceased and seven days after the first sticks forming the foundation were put in place. It seems to be customary among Black-crowned Night Herons to start incubation at the time of the laying of the first egg though it may be several days or even a week before the set of eggs is complete. This accounts for the irregular and sometimes long intervals of time which may elapse between the hatching of the different eggs in any one nest and also the unequal age and size of the young which in some instances is very apparent even to

¹ Meyer, Lt. G. Ralph, Auk, 1916, vol. 33, p. 82.

the casual observer. There was a difference of six days in the hatching period of the young in one nest under daily observation. I have seen broods in which there seemed to be even more marked difference in size but in these cases where no hatching records were made it is possible unequal feeding may have been an important factor in producing the marked inequalities in size and weight.

The time required for incubation as ascertained from observations made in the field in which the laying and hatching times of individual eggs were known varied from 24 to 26 days. Both sexes take an active part in incubation. I have frequently had nests under observation when the shift from one sex to the other took place. The instinct for incubation seems strongly developed in these birds. From my blind I could see the brooding bird was very loath to give up the place on the nest and the oncoming bird was just as determined to take a turn. Sometimes the shift involved a domestic quarrel in which there resulted a vigorous interchange of sharp, rebuffing shrieks accompanied by violent thrusts. I never observed a bird deliver food to its mate but the sharing of the responsibilities in brooding the eggs gave each an opportunity to secure the necessary amount of food and relaxation.

HATCHING

The emergence of the chick is a somewhat prolonged process, at least it was in the few cases in which I have had a chance to make observations. In one instance the embryo in an egg pipped at noon, June 19, was still imprisoned in the shell at eight o'clock the next morning (Plate VIII, fig. 1). At noon June 20, portions of the calcareous shell were broken away and the shell membrane was partially ruptured (fig. 2). At four P. M. the head was unfolded (fig. 3) and twenty minutes later the chick was completely free from the egg (fig. 4). In about two hours after hatching the natal down of the little Heron was dry enough to form a substantial protective covering (fig. 5). The eyes were open from the beginning and on the following day the young bird was very active and able to sit up in an erect position (fig. 6). The little Heron uttered a faint plaintive "pip, pip, pip," when it was hungry and also at times when it was left alone at the nest after the adults were frightened by my entrance into the blind.

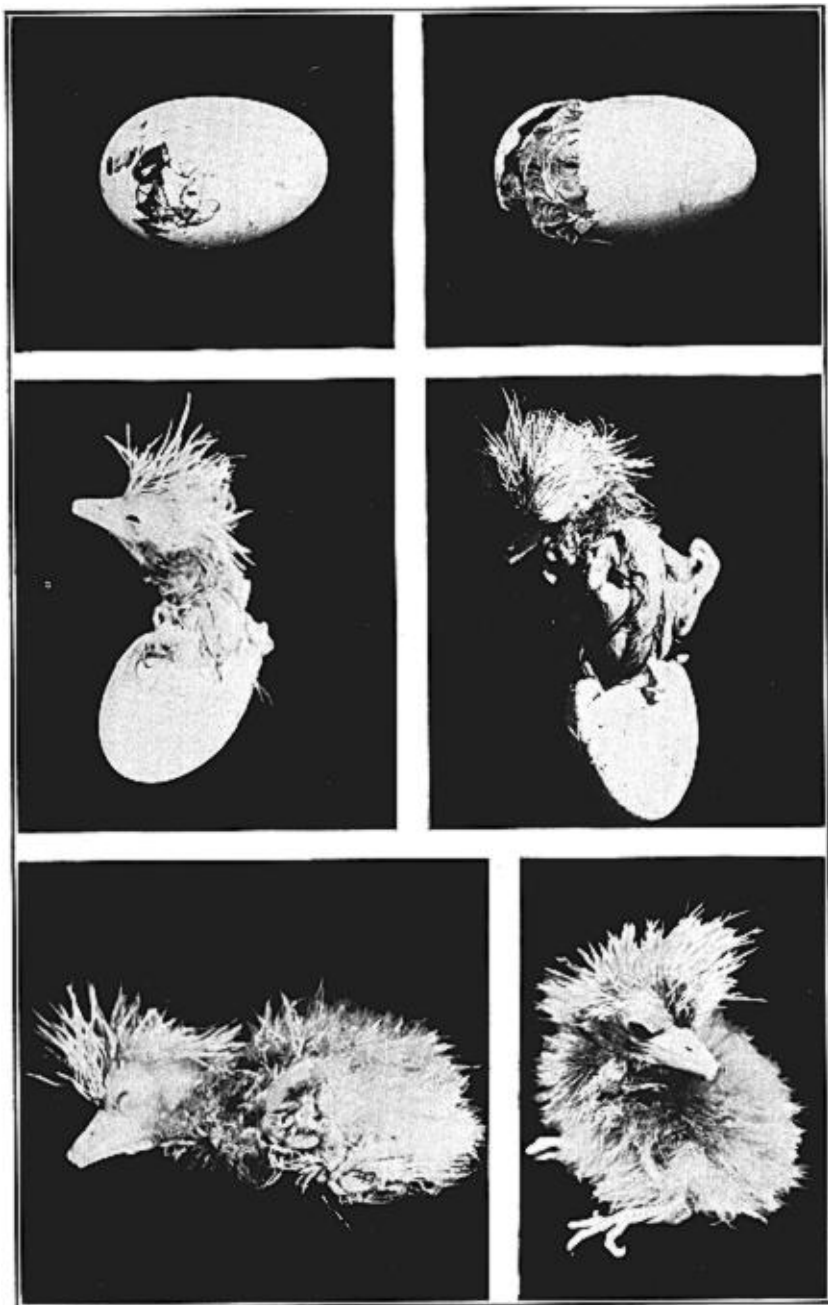
NATAL PLUMAGE

The natal down of the head, neck and dorsal portions of the body of a day old chick varies from a dark mouse gray to a deep neutral gray. The outer three fourths of the crown filaments are white. These white tips are very conspicuous in the freshly hatched chick but after a few days' exposure to the sun and air they are much less sharply differentiated. The down of the ventral tracts varies from pallid neutral gray on the lower belly to gray on the breast and dark mouse gray on the neck. The down of the crown is much longer than that of the body so that a conspicuous crest is formed. The longest filaments of down on the crown in one day old Herons are 2.8 to 3.0 centimeters long while those of the back average only 1.5 and seldom exceeded 1.7 centimeters in length. The down of a chick when dry, completely conceals the wings and aptera and even the feet and bill do not appear conspicuous in the downy contour.

At five days of age the down of the dorsal parts of the bird fades to a mouse gray; the ventral down seems to have acquired a pale gull gray tinge, due perhaps to the constant contact with the filth stained twigs of the nest. The fading out process seems to be more marked in the 10 day old bird which, with the numerous papillae of the juvenal plumage appearing through the skin, is any thing but a handsome creature. The transition from the natal to the juvenal plumage is not abrupt for vestiges of the natal down remain even after the birds leave the nest. The post-natal molt is not completed until the bird is five to six weeks old, an age in which the feathers of the juvenal plumage have made considerable progress.

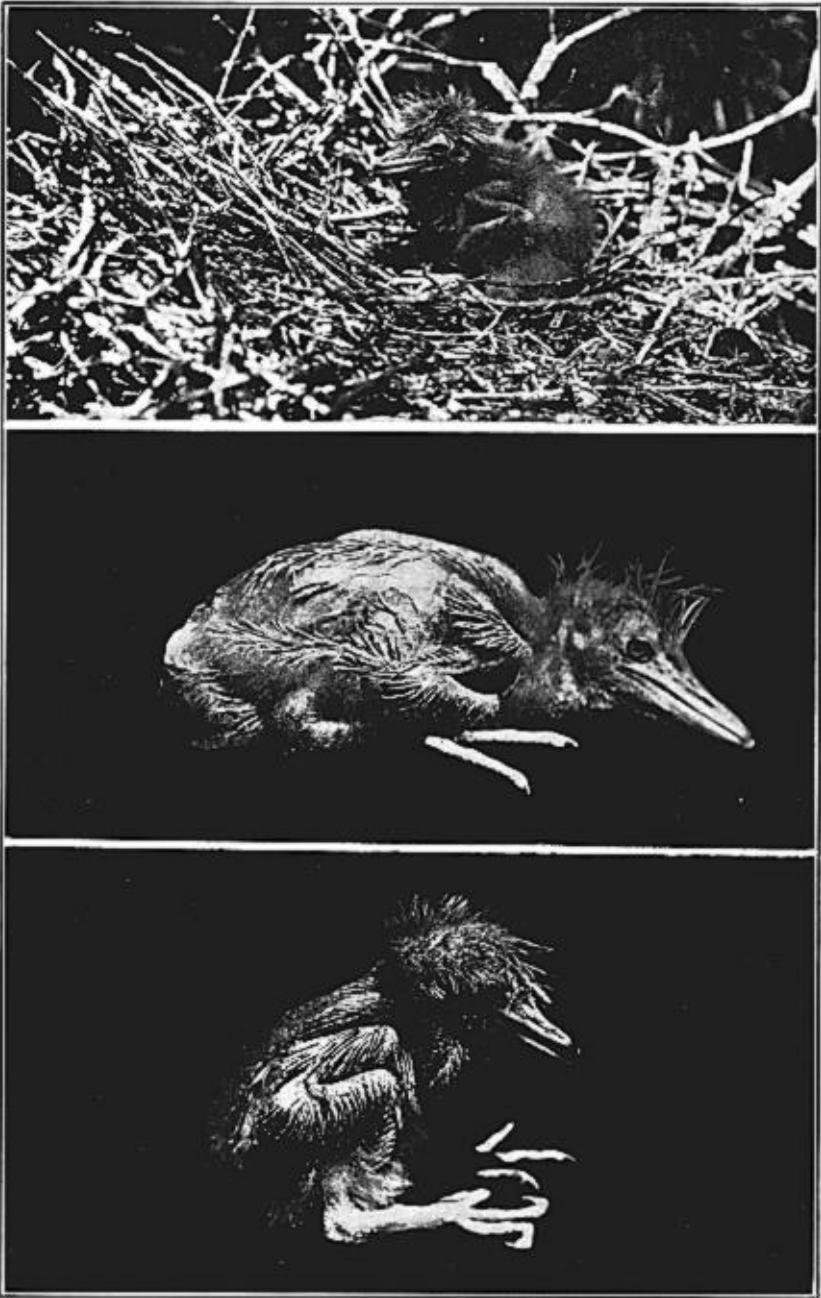
JUVENAL PLUMAGE

The first papillae of the juvenal plumage make their appearance in the region of the flanks and scapulars on the fifth or sixth day after hatching. These are closely followed by the papillae of the wing coverts and of the ventral tracts. By the seventh day the papillae of the alar tracts, (primaries and secondaries), show through the integument but those of the rectrices (tail) do not appear until the bird is about ten days old. At this age the tips



HATCHING OF BLACK-CROWNED NIGHT HERON.

1. A pipped egg, July 20, 8 A.M.
2. Same egg at noon.
3. Same at 4 P.M.
4. Same at 4:10 P.M.
5. Chick at 6 P.M.
6. Chick one day old.



YOUNG BLACK-CROWNED NIGHT HERONS.

1. Bird six days old. Fellows removed from nest.
2. Ten days old.
3. Twelve days old.

of the feathers of the scapular region and flanks are unsheathed. The primaries and secondaries present their unsheathed tips about the fifteenth day, but no unsheathing takes place in the rectrices until the bird is about three weeks old. The unsheathing when once started proceeds rapidly and by the time the bird is four weeks old it has the smooth contour possessed by an adult bird. The complete growth of the juvenal plumage is not accomplished, however, until the bird is about fifty days old.

The changes in the coloration of the iris, the exposed parts such as the bill and feet and the general integument are so marked and so rapid that it has seemed best to indicate them by means of a special table. The remarkable changes in the color of the iris are so striking and so interesting from a histological and physiological point of view that they have provided material for a separate paper. The names of colors, used in this table as well as in all descriptions of birds in this paper, are taken from Ridgway's 'Color Standards.'¹ Great care has been exercised in matching the colors, and in most every case the color given is an approximation of the average found in several individuals known to be of the same age. The colors in this table, especially those of the iris and other parts subject to change soon after death, were determined in the field or at my camp from living birds or from freshly killed specimens in which the colors had undergone no change.

IRIS.

<i>1-day old.</i> Grayish olive	<i>40 days.</i> Deep chrome.
<i>2-3 days.</i> Reed yellow to olive yellow.	<i>50 days.</i> Pinard yellow.
<i>4-5 days.</i> Chalcedony yellow.	<i>1 year</i> (2nd year plumage). Orange chrome.
<i>10 days.</i> Barium yellow.	<i>2 years</i> (3rd year plumage). Flame scarlet.
<i>20-25 days.</i> Lemon yellow.	<i>Adult.</i> Scarlet to scarlet red.
<i>30 days.</i> Strontian yellow.	

UPPER DORSAL MANDIBLE.

<i>1 day old.</i> Light drab, tinged with dark grayish olive at tip.	<i>4-5 days.</i> Marguerite yellow to yellowish olive.
<i>2-3 days.</i> Pale smoke gray, tinged with olivaceous black at tip.	<i>10 days.</i> Ivory yellow, tinged with dark neutral gray at base.

¹ Ridgway, Robert, 1912, Color Standards and Color Nomenclature.

- 20-25 days. Olive-buff tinged with vinaceous-buff.
 30 days. Vinaceous-buff, shading to olive buff on sides and mouse gray at base.
 40 days. Olivaceous black shading to chartreuse yellow on sides.
 50 days. Black, shading to dark ivory yellow on sides.
 1 year. Black shading to light greenish olive on sides.
 2 years. Black.
 Adult. Black.

LOWER MANDIBLE.

- 1 day old. Light drab with grayish olive on edges near tip.
 2-3 days. Olive-buff tipped with darker.
 4-5 days. Olive gray tipped with darker.
 10 days. Horn color to pale drab gray.
 20-25 days. Olive buff tinged with vinaceous buff.
 30 days. Pale olive buff shading to colonial buff at tip.
 40 days. Same.
 50 days. Horn color.
 1 year. Light yellowish olive with shades of brown and black; tip horn color.
 2 years. Black.
 Adult. Black.

CLAWS.

- 1 day old. Gray to white, color uniform.
 2-3 days. Gray, tips white.
 4-5 days. Buff tinged with white.
 10 days. Same.
 20-25 days. Same.
 30 days. Pale mouse gray; tips paler.
 50 days. Dark olive gray.
 1 year. Dark olive gray, horn color darker on the lateral portions of the base of the claws.
 2 years. Similar.
 Adult. Similar.

TARSUS AND TOES (*Upper Surface*).

- 1 day old. Light cinnamon drab to brownish vinaceous on toes.
 2-3 days. Light olive gray.
 4-5 days. Yellowish olive.
 10 days. Deep olive gray.
 20-25 days. Pale turtle to light turtle green.
 30 days. Light turtle green.
 40 days. Light grape green.
 50 days. Light turtle green above heel, shading through tarsus to tea green on toes.
 1 year. Light grape green.
 2 years. Barium yellow.
 Adult. Sea-foam yellow on tarsus to naphthalene yellow on toes.

TARSUS AND TOES (*Lower Surface*).

- 1 day old. Light cinnamon drab.
 2-3 days. Colonial buff.
 4-5 days. Reed yellow.
 10 days. Corydalis green.

- | | |
|--|--|
| <i>20-25 days.</i> Chartreuse yellow. | <i>50 days.</i> Tarsus light grape green, toes as in last. |
| <i>30 days.</i> Same. | <i>1 year.</i> Amber yellow. |
| <i>40 days.</i> Tarsus chartreuse yellow, toes pale chalcedony yellow. | <i>2 years.</i> Barium yellow. |
| | <i>Adult.</i> Primrose yellow. |

NAKED SKIN.

- | | |
|---|--|
| <i>1 day old.</i> Pinkish buff to light ochraceous salmon. | <i>40 days.</i> Lores olivaceous black, skin about eyes water green. |
| <i>2-3 days.</i> Vetiver green about eye; throat pale green-yellow; body light yellowish olive. | <i>50 days.</i> Lores deep lichen green shading to black of bill, skin about eyes light dull green-yellow. |
| <i>4-5 days.</i> Vetiver green about eye; throat and body reed yellow to yellowish olive. | <i>1 year.</i> Lores deep grayish blue green with faint purple reflections. |
| <i>10 days.</i> Deep olive gray, skin under wings glass green. | <i>2 years.</i> Lores and naked skin about eyes tea green to grayish olive. |
| <i>30 days.</i> Lores and region around the eyes, pallid mouse gray. | <i>Adult.</i> Similar. |

EYE LIDS.

- | | |
|-------------------------------------|------------------------------------|
| <i>1 day old.</i> Olivaceous black. | <i>40 days.</i> Same. |
| <i>2-3 days.</i> Same. | <i>50 days.</i> Same. |
| <i>4-5 days.</i> Black. | <i>1 year.</i> Grayish blue green. |
| <i>10 days.</i> Same. | <i>2 years.</i> Olivaceous black. |
| <i>20-25 days.</i> Same. | <i>Adult.</i> Same. |
| <i>30 days.</i> Same. | |

The following description of the juvenal plumage is based upon a bird 28 days old. This age is representative of a plumage in which the unsheathing is only partially completed but at this stage of development the feathers are brighter and richer in color than they are in juvenals in which the plumage has been faded by several months exposure to the sun and air.

Crown and back glossy olivaceous black neck Chaetura drab, the feathers with median streaks of varying shades of buff. The median streaks in the feathers of the back are of a richer and deeper color approaching very nearly that of cinnamon. The apices of the crown feathers have filaments of natal down but the remainder of the juvenal plumage is entirely free of vestiges of this first plumage. The throat with an elongated median patch of white tinged with ivory yellow which extends posteriorly

to the neck. Sides of chin, head and neck streaked with *Chaetura* drab, fuscous-black and various shades of buff. Feathers of the breast, upper belly and flanks white tinged with light cartridge buff, each feather with broad lateral streaks or bands of light fuscous or hair brown. Lower belly and crissum white and not streaked. Tail feathers deep mouse gray, primaries and secondaries fuscous black, tipped with white and with outer veins tinged with cinnamon. The white tips of the secondaries are much reduced and the outer veins have less of the cinnamon than have the primaries. The feathers comprising the wing coverts and tertials have large conspicuous terminal spots of white or light buff.

So little is known concerning the growth of young birds that it seemed well worth while to spend considerable time in making a series of careful comparative measurements and weights of the growing young Herons through the natal and juvenal stages. For this purpose twelve Herons of different ages representing four different broods were selected soon after I arrived at the Sandy Neck rookery in June, 1920. The older birds were kept in poultry coops at my camp as soon as they were able to fly, otherwise I would not have been able to secure measurements of advanced stages of growth. It is impracticable to present all of the numerous measurements in a paper of this kind but those of two birds whose ages overlap at the twenty-eighth day of growth will serve as a representative series. It is necessary to use the measurements of two birds because the time at my disposal was not sufficient to follow the growth to completion on a single individual. In the following table the measurements of the various parts of the body and of certain feathers are given. In the case of feathers of the scapular region, wing coverts etc. the measurement given is the average of two or three of the longest feathers of the region. The progress of unsheathing is indicated by the numbers in parentheses beneath those of the feather measurements. This table will be of value to the ornithologist in aiding him to ascertain the approximate age of immature Night Herons. To be sure there is a variation in the measurements of different individuals but if all the measurements and changes in coloration are considered one can determine the age of even the older young with an error of not more than two or three days.



YOUNG BLACK-CROWNED NIGHT HERONS.

1. Photographed July 11, 1920. The two playing are nine days old. Two of the eggs pipped, July 1, and hatched July 2. Third egg, pipped July 3, hatched July 4.

2. The daily routine of weighing.



YOUNG BLACK-CROWNED NIGHT HERONS.

1. Fifteen days old.

2. Eighteen days old.

MEASUREMENTS OF YOUNG NIGHT HERONS IN CENTIMETERS. (FIGURES IN PARENTHESES INDICATE AMOUNT OF UNSHEATHING OF FEATHER.)

	1	2	3	4	5	6	7	8	10	12	15	18	20	22	24	26	28	31	34	36	40	44	?	?	
Age in days	10.2	12.5	13.3	14.4	17.1	18.5	21.6	23.4	27.2	31.4	36.2	40.5	42.8	45.8	46.5	47.8	49.5	52.1	55.1	56.6	58.6	60.1	61.5	62.1	
Length	1.45	1.6	1.6	1.8	1.8	2.3	2.4	2.7	3.0	3.6	4.1	4.5	4.9	5.2	5.4	5.4	5.5	5.6	5.8	5.9	6.0	6.1	6.1	6.8	
Bill	2.3	2.4	2.7	3.1	3.8	4.1	4.3	4.5	4.8	5.9	6.8	7.2	7.9	8.3	8.5	8.7	8.7	8.8	9.5	9.6	9.8	10.1	10.2	10.3	
Gape	2.0	2.1	2.2	2.3	2.5	2.9	3.3	3.5	4.2	5.9	6.7	7.1	7.4	7.6	7.8	8.1	8.1	8.3	8.6	8.7	8.9	8.9	8.9	9.1	
Eye to tip of bill	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Tail	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Wing	1.6	1.7	1.8	1.9	2.1	2.4	2.9	3.1	4.6	6.2	8.3	11.5	13.4	15.4	16.2	17.9	18.8	20.5	22.5	23.3	24.6	26.6	30.8	30.5	
Sixth Primary	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Sixth Secondary	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Extent Tarsus with 3rd toe	9.5	10.5	11.0	12.7	14.4	16.0	19.2	21.5	25.2	33.5	45.9	57.0	62.3	70.0	74.9	79.2	82.6	89.4	95.4	103.2	107.8	111.2	113.4	—	
Toe-toe	3.5	3.9	4.2	4.5	5.4	6.2	7.1	8.5	9.8	11.9	12.6	13.8	14.4	15.1	15.4	16.1	16.5	17.3	18.2	18.3	18.4	18.5	18.0	18.7	
Front middle or 3rd toe	2.9	3.1	3.5	3.9	4.6	4.9	6.5	7.6	8.5	11.1	12.9	13.1	13.6	13.8	13.8	13.8	13.9	13.9	14.5	14.5	14.6	14.7	12.5	14.0	
Third toe nail	1.4	1.6	1.7	1.9	2.3	2.6	3.7	3.9	4.6	6.4	7.1	7.6	7.9	8.2	8.4	8.6	8.6	8.6	8.8	8.8	8.8	8.8	8.8	8.8	8.4
Hind or first toe	.4	.42	.5	.55	.56	.58	.70	.80	.70	.75	.80	.90	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.3	1.1	1.2	
Hind toe nail	1.1	1.3	1.4	1.6	1.8	2.2	2.3	2.9	3.2	3.8	4.4	4.5	4.6	4.7	4.7	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.7	5.1
Tertials	.40	.42	.55	.55	.56	.58	.70	.80	.90	1.1	1.2	1.2	1.2	1.4	1.5	1.6	1.6	1.6	1.6	1.8	1.8	1.8	1.5	1.7	
Wing coverts	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Flanks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Ventral tracts	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Weight (grams)	24.2	34.0	53.5	67.0	93.5	105.5	157.0	185.0	249.6	349.8	436.0	456.0	515.0	519.5	510	535	598	580	612	601	797	935	883	758	

Measurements not made.

* Complete.

During the month of August, 1920, six Herons in the juvenal plumage were taken from the rookery at Sandy Neck and placed in the aviary at Franklin Park, Boston, in order to make further observations on molting and plumage changes. I am greatly indebted to Mr. George F. Morse, Jr., former director of the Zoological Garden, for hearty cooperation in this matter. Unfortunately, however, all of the birds died from the effects of fighting or other causes before any molting or plumage changes took place. One was injured and died soon after arriving at the park. Four of the birds died in December but one lived until February twenty-third, just before the time we expected the post-juvenal molt to take place. These birds are of interest because they represent the completely developed juvenal plumage and because they provide evidence that there is no post-juvenal molt occurring soon after the close of the breeding season such as is characteristic of the passerine birds. The entire plumage of the Herons which died in December and of the Heron which lived until the last week of February is in the juvenal stage. No molting according to Mr. Morse had taken place. In the following table are the measurements of three of the birds kept at the Park until the dates as indicated.

Date.....	December 28, 1920	December 29, 1920	February 23, 1921
Length (centimeters)....	58.2	59.8	60.2
Bill.....	7.2	7.3	7.8
Gape.....	9.5	9.8	10.5
Eye to tip of bill.....	8.9	9.1	9.4
Tail.....	10.9	11.6	11.4
Wing.....	28.1	30.9	31.3
Sixth Primary.....	18.1	19.8	20.5
Sixth Secondary.....	16.6	17.4	17.9
Extent.....	108.5	113.1	111.5
Tarsus with third toe....	16.1	17.0	16.1
Toe-toe.....	12.8	13.7	12.9
Front middle or third toe.	7.5	7.7	7.9
Third toe nail.....	1.2	1.2	1.4
Hind or first toe.....	4.4	5.1	4.6
First toe nail.....	1.6	1.8	1.8
Tertials.....	16.1	16.6	17.5
Flanks.....	7.5	7.6	7.7
Ventral tracts.....	7.0	7.5	7.5
Weight (grams).....	1010.00	1113.50	9864.00

The general impression one gains after a superficial comparison of these mid-winter birds with the juvenals collected during the breeding season is that the plumage of the older birds is decidedly paler, indeed so much so that it seems like a new plumage. This paler condition is due as far as I can determine to two causes. First there is a fading of the plumage involving chiefly the buff and cinnamon streaking of the general plumage but especially that of the back; secondly all of the feathers have a chalky or grayish appearance due to a whitish powdery substance produced by the powder down tracts.

POWDER DOWN TRACTS

The development of the powder down tracts, areas of modified and highly specialized downy feathers, peculiar to the Herons and a limited number of groups of birds, is of interest. In birds of the natal plumage the areas of skin destined to give rise to powder down tracts are void of natal down. The powder down areas become differentiated from the general integument in chicks about ten days old, and in twelve day old birds the minute papillae of the dorsal tracts show through. The papillae of the ventral powder down tracts make their appearance a few days later. At three weeks of age the powder down tracts are a dense mat of developing papillae, but none are unsheathed at this age. In juvenals four weeks old the tracts are well advanced and the tips of some of the papillae are unsheathed. In birds 50 days old the powder down tracts have very much the appearance of the tracts in the adults. Thus far I have not substantiated the statements frequently made that these tracts are phosphorescent organs, nor have I been able to find any reliable observer who has seen light produced by these patches of downy feathers. Some of the fishermen along the Cape relate startling stories of how the Herons produce a luminous glow in order to attract fish and other prey at night but after studying the birds confined in cages and others at their feeding grounds at night I am inclined to believe that the phosphorescence is a product of the imagination. The theory advanced by some ornithologists that the oily particles freed from these tracts fall on the surface of the water and thus lure prey to the birds has not been proven. Experiments which the

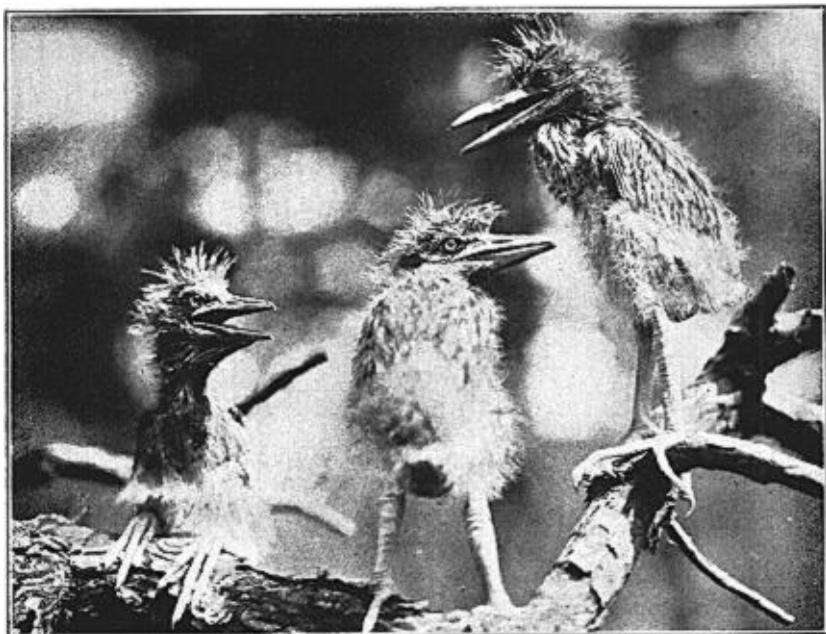
author conducted at Sandy Neck in attempts to attract aquatic animals with these particles were negative in character.

Dr. Alexander Wetmore¹ has shown very conclusively by his detailed observations that Herons, including the Black-crowned Night Heron, utilize the greasy powdery substance given off by the powder down tracts to dress and oil the contour feathers. He has correlated the time of the development of these tracts with the appearance of the contour feathers and he observed that the uropygial glands were relatively undeveloped in the young Herons at the time the powder down tracts became functional. My own observations confirm Dr. Wetmore's statements concerning the function of the powder down tracts. His further suggestion of the hypothetical origin of the uropygial glands through the amalgamation of a number of separate tubes opening separately is interesting.

In addition to the birds seen and studied at Sandy Neck the following series of skins representing the juvenal plumage were examined.

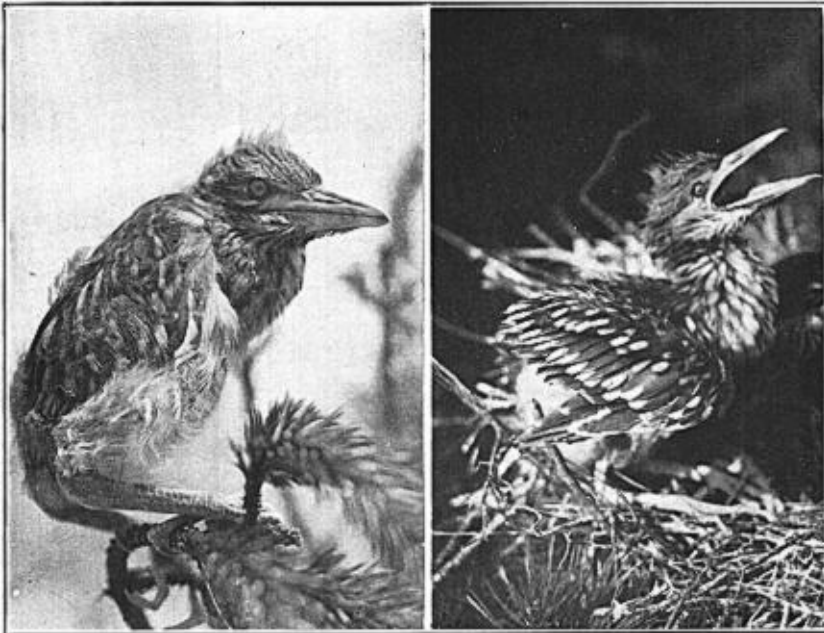
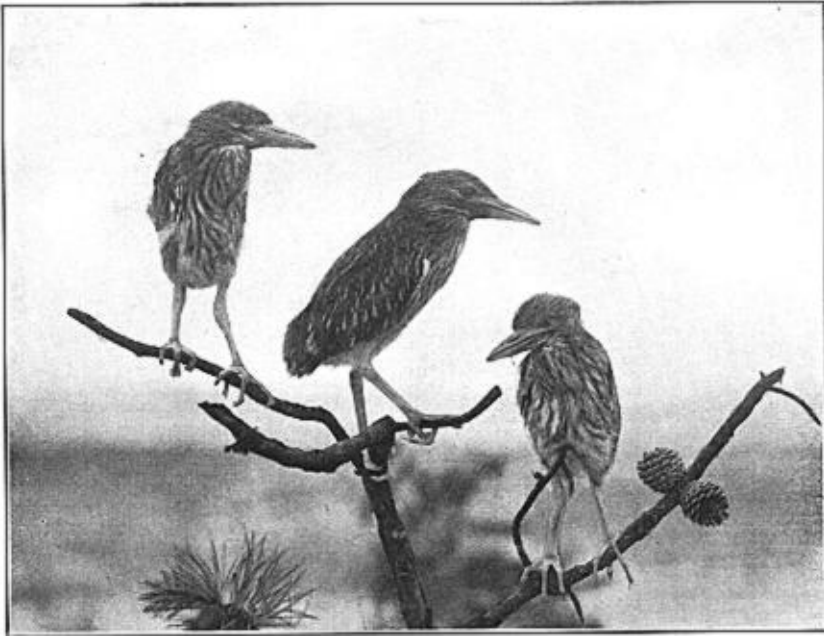
Number	Date	Sex	Locality	Collection
236-8	June 30, 1920	male	Barnstable, Mass.	Bowdoin College
10791	July 11, 1879	"	Marshpee, Mass.	M.C.Z.
3946	" 18, 1871	"	Cambridge, Mass.	Wm. Brewster
3945	August 4, 1875	female	" "	" "
10789	" 8, 1880	"	Wayland, Mass.	M.C.Z.
A513	" 13, 1920	male	Whaleboat Island, Maine	Bowdoin College
A516	" 16, "	?	Maquoit Bay, Maine	Bowdoin College
1640	" 19, 1894	female?	Chateaugay Lake, N. Y.	M.C.Z.
10188	" 20, 1879	female	Rye Beach, New Hampshire	Wm. Brewster
60518	" 24, 1912	male	Rowley, Mass.	M.C.Z.
16012	September 11, 1871	?	Ogden, Utah	"
10790	October 1, 1882	female	Wareham, Mass.	Bangs
29275	" 29, 1886	"	Tarpon Springs, Florida	Wm. Brewster
20842	December 23, 1907	"	Bolson, Costa Rica	Bangs

¹ Wetmore, Alexander, 1920, *The Function of Powder Downs in Herons*, Condor, vol. 21, pp. 168-170.



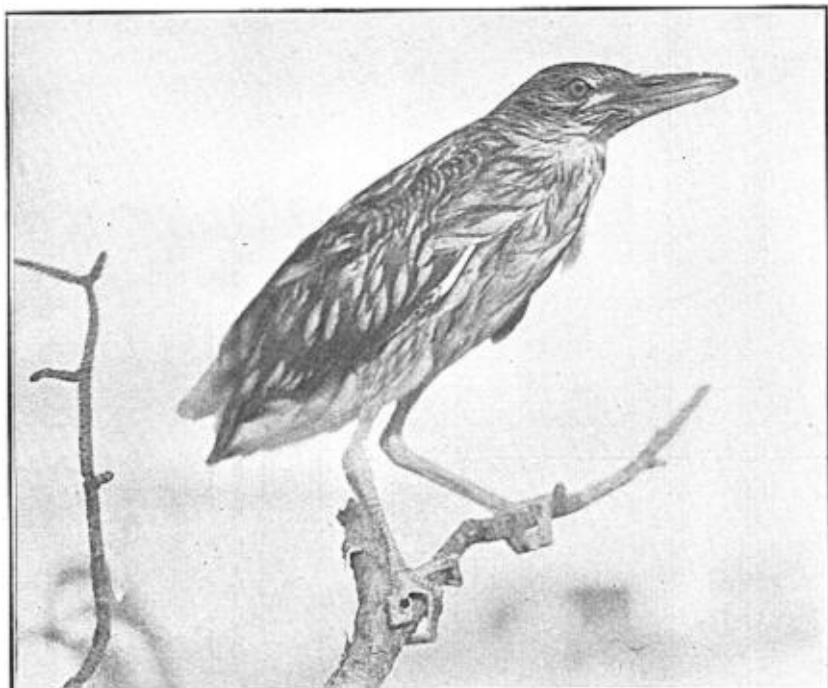
YOUNG BLACK-CROWNED NIGHT HERONS.

1. Seventeen and eighteen days old.
2. Twenty and Twenty-one days old.



YOUNG BLACK-CROWNED NIGHT HERONS.

1. Birds of two different broods. Left to right, 24, 32 and 22 days old.
2. Twenty-two days old.
3. Twenty-six days old. A bird that had not been handled regularly and hence exhibited fear, such specimens as a control showed that the handling in no way checked development.



YOUNG BLACK-CROWNED NIGHT HERONS.

1. Bird in juvenal plumage, 44 days old.

2. Birds in juvenal plumage, about 36 days old.

Number	Date	Sex	Locality	Collection
42592	January 23, 1891	male	Swan Island, North Carolina	M.C.Z.
42593	" 25, "	female	"	"
42591	" 23 "	male	"	"

It will be noted that no birds in this series of juvenals were collected during the months of February, March, April and May. A caged bird as already mentioned lived until February 23 in juvenal plumage. It is evident from a study of these skins and those of the first nuptial to follow that a post-juvenal molt does not take place at the end of the breeding season and that the first nuptial plumage is acquired during the months from January to May. The plumage worn during the first winter is that of the juvenal.

FIRST NUPTIAL PLUMAGE

The description of the first nuptial plumage is based upon an examination of the following specimens.

Number	Date	Sex	Locality
1	May 29, 1921	female	Whaleboat Island, Maine
5	" " "	male	" " "
6	" " "	female	" " "

Collection of the Museum of Comparative Zoology

41030	March 1900	?	Eau Gallie, Florida
38915	May 19, 1890	male	Dry Tortugas, Florida
3943	May 2, 1871	male	Belmont, Mass.

Collection of A. C. Bent, Taunton, Mass.

7202	January 20, 1914	male	Westport, Mass.
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The first nuptial plumage is acquired, judging from the above specimens, by a partial molt between January and May. The time of this molt probably depends on the relative age of the bird. The post-juvenal or the first prenuptial as it should be designated in this case is partial and does not include the primaries, secondaries, coverts or remiges. The description is as follows:

Crown hair brown or Chaetura drab, streaked with light buff or warm buff, feathers of the side of the head and neck forehead streaked with white, those of the neck streaked with mouse gray. Back bister and in some specimens it approaches sepia. No streaking present in the feathers of the back as is present in this

part of the juvenal plumage. The greater and lesser wing coverts, primaries, and secondaries, and remiges same as in the juvenal except that they show the effects of wear. The prevailing color of the quill feathers is drab gray or light drab. Chin and middle throat white. Breast white with broad streaks of gray through the vanes of each feather, the gray is more pronounced in the feathers on the lateral portions of the breast. The belly is streaked with white and pale drab gray.

The colors of the iris and the naked parts of the bird are given in table of color changes. The detailed measurements of the birds in first nuptial plumage collected at Whaleboat Island are shown in the following table.

Date.....	May 29, 1921	May 29, 1921	May 29, 1921
Sex.....	female	male	female
Length (centimeters).....	65.3	66.4	65.6
Bill.....	7.1	7.4	7.5
Gape.....	10.5	10.9	10.6
Eye to tip of bill.....	9.2	9.6	9.6
Tail.....	10.8	11.5	10.9
Wing.....	29.8	31.1	30.4
Sixth Primary.....	19.2	19.8	19.5
Sixth Secondary.....	17.4	17.7	17.6
Extent.....	112.6	117.4	113.3
Tarsus with third toe.....	17.3	18.2	17.8
Toe-toe.....	13.6	14.5	13.9
Front middle or third toe....	9.1	9.2	9.1
Third toe nail.....	1.4	1.4	1.5
Hind or first toe.....	4.9	5.1	5.0
First toe nail.....	1.7	1.9	1.8
Weight (grams).....	833.4	846.5	861.8

Birds of the first nuptial plumage were common in the Sandy Neck rookery when I arrived there June 17, 1920, a time when there was no difficulty in confusing this plumage with the juvenal. I also found birds in the first nuptial plumage when I visited the Whaleboat Island colony the last week of May, 1921. Here for the first time I saw birds of this plumage active in nest building and incubating eggs. All the breeding birds of this plumage observed at Whaleboat were mated with birds of the second or of the adult nuptial plumage (I cannot distinguish the two latter plumages in the field), except in one doubtful case in which I

think both birds were in the streaked first nuptial plumage. To verify the supposition that the birds of this plumage were sexually mature three specimens were collected on May 29, in which the gonads were fully developed and functional. The largest ova of the two females (see preceding table of measurements) were 2.4 and 2.6 centimeters in diameter respectively, showing that they were nearly ready to burst from the follicles.

SECOND WINTER PLUMAGE

The specimens of the second winter plumage which were examined are as follows:

Number	Date	Sex	Locality
15027	August 11, 1895	female	Honolulu, H. Ids.
35083	September 1863	female	Western Mexico
4703	May 13, 1910	male	Canton, Mass.
3435	August 4, 1892	?	?
3332	July 4, 1908	?	Barnstable, Mass.

The specimens 15027 and 35083 are in the collection of the Museum of Comparative Zoology, Cambridge, and the others are in the collection of A. C. Bent, Taunton, Mass.

Specimen 15027. Crown greenish slate-black approaching somewhat the color of that found in the second nuptial plumage. There are many new feathers some only partially unsheathed. Sides of the head, neck and underparts similar to that found in the first winter plumage. The interscapular regions with numerous feathers in the process of unsheathing, the unsheathed parts of the new feathers dark olive green, Rectrices of 15027 and 35083 all new. Primaries, secondaries and tertials in a transitional state, both new and old feathers represented. The underparts in specimen number 35083 are white as in the second nuptial and contain no streaking such as is present in the juvenal and first nuptial plumages. This specimen collected in September is much more advanced than 15027 which was collected in August, with the exception of the crown which still has many of the brown feathers characteristic of the first nuptial plumage (second summer).

Specimen 4703. This specimen though it was collected in May represents the second winter plumage. It is a much belated plumage change.

Crown clove brown, the feathers very much lighter in color at the bases and with light, narrow median streaks involving the shafts and bases of the barbs. A few of the dark greenish black feathers characteristic of the second nuptial plumage (third summer) have appeared in the crown. Auriculars and sides of the head streaked with hair brown and buff. Back Prout's brown to mummy brown. The tips of the feathers of the first nuptial have worn away. A few dusky green feathers have appeared in the scapular region. The wing coverts are very much frayed and worn and since up to this time I have seen no signs of molting of these feathers, it is probable they are the same feathers worn by the juvenal. Many of the feathers have undergone such great wear that the large terminal spots have disappeared. The primaries and secondaries are also old and very much worn, but the tail feathers are new. The latter are drab in color. New feathers appearing in the region of the tail coverts light mouse gray. Throat white, some of the feathers with fuscous edgings. Feathers of the neck and underparts with median streaks varying from pale olive-buff to cream-buff, the edges of the feathers hair brown and chaetura drab. The colors in the region of the lower neck much darker. On the belly the brown and drab replaced by paler tones of gray.

Specimen 3435. This specimen is in a stage of plumage change much further advanced than the one just described. In the dorsal plumage many dark greenish black feathers have appeared. The wing coverts are new and the primaries and secondaries are in a state of molt, there being both new and old feathers and some are lacking. Otherwise this bird is similar to number 4703.

Specimen 3332. This specimen of Mr. Bent's collection has advanced much more than any of the others to the plumage of the second nuptial or third summer. Crown, neck and underparts as in the second nuptial, but the coverts and the wing and tail feathers are still in a transitional state, feathers of both plumages being present.

That the above plumages do not represent the first winter plumage as proposed by some ornithologists is evidenced by the fact that the birds kept in captivity never assumed such a plumage during the first winter and furthermore sexually mature specimens

have been secured in the first nuptial plumage described, a plumage which precedes the one I have designated as the second winter plumage. Since the second winter plumage as above described is represented by very few specimens in the collections I have examined I cannot be sure of the details but it is evident that the transition from the streaked juvenal plumage is brought about by a partial molt in the late winter or early spring and by a molt which involves all the large quill feathers of the wings and tail, in the fall of the second year.

SECOND NUPTIAL PLUMAGE (THIRD SUMMER)

The description of this plumage is based on the study of eleven specimens contained in the collection of the Museum of Comparative Zoology which also comprises the collections of Mr. Brewster and Mr. Bangs. It should be noted that all the birds representing this plumage were collected during the breeding season, May 2 to August 31, not one of them being collected during the winter months. The specimens are as follows:—

Number	Date	Sex	Locality
41905	May 2, 1887	male	Illinois.
55564	May 9, 1886	female	Barnstable, Mass.
42596	June 24, 1875	male	Illinois.
19067	June 27, 1888	male	Shelter Island, New York
19068	" " "	male	" " " "
19069	" " "	female	" " " "
19072	" " "	female	" " " "
1100	July 11, 1879	female	Marshee, Mass.
10793	July 20, 1879	female	" "
10792	" " "	female	" "
3944	August 31, 1875	female	Cambridge, Mass.

The bill, feet and the plumage of the underparts of these birds are similar to that of the adult. Crown dull blue-green with a metallic lustre somewhat like that of the adult but the area of the dark color is restricted. The posterior part of the frontal band of the crown tinged with brown, a mark which is not present in the adult birds. The wing coverts are drab or hair brown shading to a deep mouse gray in the scapular region. The scapular and interscapular feathers tipped with deep quaker drab, some of them with a slight greenish or bluish metallic lustre. The

skins, numbers 19068 and 19069, have a back plumage which more nearly approaches that of the adult but all of the skins of this plumage in the series can easily be distinguished by a duller color and brownish effect as contrasted with the bright greenish or bluish metallic lustre of the adults. The coverts and tertials of the second nuptial are light drab or drab as compared with the light mouse gray of these parts in the adult. The plumes are generally lacking, but if present are shorter than the plumes of the adults. Though there are striking differences between the second nuptial and adult plumages which can be recognized in the laboratory, it is difficult to differentiate them in the field. Indeed I was not aware that such a plumage existed until a comparative study was made of a large series of skins. The third winter and adult nuptial plumages are the same.

THE ADULT PLUMAGE

The adult plumage of the Black-crowned Night Heron is acquired in the autumn of the third summer after the bird has passed through the following plumages:

Natal	}	First summer
Juvenal		}
First winter	Second summer	
First nuptial	Third summer	
Second winter		
Second nuptial		
Adult winter		
Adult nuptial		

In the following table are the detailed measurements and weights of two adult herons collected July 13, 1920, at Sandy Neck, Mass., and three at Whaleboat Island, Maine, on August 13, 1920.

MEASUREMENTS OF ADULT BLACK-CROWNED NIGHT HERONS

Date.....	July 13, 1920	July 13, 1920	Aug. 13, 1920	Aug. 13, 1920	Aug. 13, 1920
Sex.....	male	male	male	female	female
Length.....	68.3	67.5	65.5	66.4	65.5
Bill.....	8.4	8.3	7.6	7.9	7.1
Gape.....	11.7	11.2	11.1	11.0	11.2

Eye-bill.....	10.7	10.3	9.9	9.7	9.7
Tail.....	12.1	13.1	12.7	12.3	12.0
Wing.....	32.8	33.6	32.7	32.1	31.1
Sixth Primary.....	21.5	21.9	23.9	19.9	20.1
Sixth Secondary.....	16.6	18.4	18.6	17.8	17.9
Extent.....	119.2	117.5	119.0	117.0	114.1
Tarsus with 3rd toe..	19.1	18.1	17.9	18.0	17.8
Toe-toe.....	15.4	16.1	14.4	13.6	13.8
Third toe.....	8.8	8.8	8.9	8.6	8.5
Third toe nail.....	1.7	1.5	1.5	1.4	1.2
First toe.....	4.8	4.9	5.4	4.9	5.0
First toe nail.....	1.5	2.1	2.1	1.8	1.7
Plumes.....	broken	20.2	18.5	16.8	17.5
Weight (grams).....	1007.00	1014.0	785.0	727.20	884.00

In addition to the adults included in the preceding table of measurements the following adults have been examined.

Number	Date	Sex	Average length of plumes	Locality
10187	January 25, 1879	female	15.2	Watertown, Mass.
10186	February 1, 1879	male	19.8	" "
42594	February 14, 1888	male	18.5	Currituck, N. C.
41031	March 1900	?	none	Eau Gallie, Fla.
20841	March 25, 1908	?	none	Bolson, Costa Rica
15540	April 3, 1907	female	16.1	Wareham, Mass.
3942	April 21, 1870	female	13.5	Belmont, Mass.
80709	May 6, 1917	male	21.6	Essex, Mass.
818	May 20, 1888	female	16.8	Wareham, Mass.
19070	June 27, 1888	female	none	Shelter Id., N. Y.
19071	" " "	female	16.9	" " " "
19066	" " "	male	16.0	" " " "
16379	July 1892	male	11.7	San Jose, Costa Rica
1099	July 11, 1879	male	17.3	Mamplé, Mass.
31241	September 29, 1880	male	16.4	Uruguay
18137	October 19, 1887	male	17.3	San. Jose, Lower Cal.
18138	" 24, "	female	none	" " " "
29274	December 8, 1886	male	17.6	Desota County, Fla.
73186	December 17, 1892	male	broken	Kissenum, Florida

In the study of the above series of skins I find there are two periods of molt and feather renewal. A partial molt takes place in the spring and early summer which includes the body plumage but not the quill feathers, and a molt in October-December involving the primaries, secondaries and rectrices.

PLUMES

The average length of the plumes in the above series of skins is 16.8 centimeters. The average of the plumes of the females is 15.7 and that of the males 17.3 centimeters. From these measurements it would seem that the plumes of the males are longer than those of the females, but this series of skins is not large enough to form the basis of any general conclusion. Specimens 10187, 10186 and 42594 have plumes all of which are partially encased in sheaths indicating their appearance to have been recent. Two specimens collected in March have no plumes. Since these include all of the specimens of the series collected during January-March it is apparent that the molt and renewal of the plumes takes place during the first three months of the year.

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Bowdoin College, Brunswick, Me.*

NOTES ON DONACOBIOUS.

BY LUDLOW GRISCOM.

I. THE STATUS OF *Donacobius albovittatus* LAFR. AND ORB.

IN 'Novitates Zoologicæ,' Vol. 21, 1914, p. 158, Dr. C. E. Hellmayr showed that the type specimen of this species was "quite a young bird in fluffy plumage, and agrees in every respect with a skin from San Esteban, Venezuela." He, therefore, did not have the slightest doubt that the birds with white eyebrows were merely the young of *D. atricapillus*. He further stated that he had not seen any adults from Bolivia, but did not think them likely to differ from the Brazilian race, since specimens from Paraguay and southwest Brazil were practically identical with those from more northern localities. Exactly the same conclusions are advanced in a recent study of d'Orbigny's types (Nov. Zool., Vol. 28, 1921, p. 242).

While no one could question the soundness of the reasoning advanced above, it is a matter of interest that the American Mu-