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### NESTING OF THE WOOD DUCK IN CALIFORNIA

(WITH 26 PHOTOGRAPHS)

By JOSEPH DIXON

(Contribution from the Museum of Vertebrate Zoology of the University of California)

**I**N STUDYING the habits of the Golden Beaver in the San Joaquin and Sacramento valleys, the writer has had during the past four years an unusual opportunity to study also the habits and breeding of the Wood Duck (*Aix sponsa*), which, interestingly enough, proved to be a common resident duck there. Much conflicting information has been published regarding the breeding of this duck, and the writer decided to take pains to obtain some first-hand facts regarding certain points in question. Consequently special effort was made to locate nests; and, fortune favoring, the author has been able to study and to keep record of seven nests during a single breeding season. By taking water, food, note-book, binoculars, camera and sleeping bag, the observer was able to remain for days at the nest trees. In three instances the departure of the young ducks from nests in the trees was witnessed and actual photographs of this interesting incident were secured. By remaining in hiding within twelve feet of a nest, the observer was able to study and to photograph the female as she entered and left her home. All observations and photographs here presented are of individuals living entirely under natural conditions, *in the wild*.

The relation between the Wood Duck and the Golden Beaver is much closer than casual observation would indicate. The beavers, by building dams, form shallow ponds along many old river channels and sloughs. As these dams are raised by the beavers the depth of the water in the resulting ponds increases so that much brush and certain kinds of trees are killed by being drowned out. Thus, ponds (see fig. 12) choked in places with brush and trees that have been killed or gnawed down by the beavers, provide ideal living quarters and cover for such species of birds as the Wood Duck. These ponds, made possible by the beaver, soon disappear when the beavers are removed. As evidence of this interrelation the author, on November 1, 1921, counted 51 Wood Ducks on one secluded beaver pond less than five acres in extent. At that time 65 additional Wood Ducks were counted in another beaver pond some three miles distant. A third beaver pond brought the total up to 150. Investigation showed that 75 per cent of the Wood Ducks which winter in a region covering fifteen square miles of river bottom were concentrated in these three beaver ponds, the total area of which was not in excess of twenty acres. However, one should not make the mistake of thinking that Wood Ducks are abundant throughout California because 51 individuals have been counted in one pond and 65 in another. It must be borne in mind that this represents an unusual concentration of the birds, as will presently be shown.

In addition to providing suitable shelter, the beaver ponds make possible the growth of cattail, tule, California waterweed, and a minute, white-blossomed, aquatic plant, the water buttercup, which provide vegetable and insect food much relished by the ducks. Another attractive article of food, which becomes available in October and November, is found in the large, elongated acorns of the Valley Oak, which species of oak grows in dense groves in the vicinity of beaver ponds. These acorns (see fig. 15) sometimes attain a length of two and a quarter inches, while the shorter, stubby ones sometimes have a diameter of three-quarters of an inch. Though seemingly much too large to be swallowed by a Wood Duck, these acorns are nevertheless eaten in quantities. The abundance of acorns would account in large measure for the concentration of Wood Ducks which was noted in November.

In the region under discussion, near the confluence of the San Joaquin and Merced rivers, wood ducks begin to arrive in force in October. The number increases through November and December, reaching its maximum in January. By the middle of February the Wood Ducks begin to scatter out and, by March 15, only fifteen individuals were to be counted in one pond, and this, on May 2, contained but a single pair. In the beaver pond where 51 wood ducks had been counted on November 1, 1921, not one could be found the second day of the following May. At this latter date only one pair could be found in an adjacent beaver pond which had been thronged with Wood Ducks the previous fall. It is believed that in 1922 not more than five or six pairs remained to breed in the region where at least 150 Wood Ducks were present during the winter preceding. In 1923 the birds which bred locally had increased so that seven nests were found in the same territory hunted over the previous year. Six of the seven nests were found in an area one square mile in extent. According to the testimony of reliable men who have been born and reared in that locality, the number of Wood Ducks which remain through the summer has always been few compared with the number found there in winter. It is obvious that many of the Wood Ducks which winter in this locality are migrants from elsewhere and not local birds which have been raised there. Investigation by the writer has shown that at present the Wood Duck is increasing in numbers in California.

As the nesting season approaches, the Wood Ducks which remain in the region not only scatter out but, in many cases, seek nest sites close to human habitations. Individuals that have reared broods under man's protection, often unwittingly given, appear to appreciate the value of "sanctuary" and return to the same nest, year after year. This feature has been noted by various writers and is of too regular occurrence to be merely accidental.

As evidence that Wood Ducks actually prefer human association during the nesting period, the writer points to the fact that out of 12 nests found during two seasons, 10 were near inhabited farm houses or beside well-traveled roads. It has been suggested that this might be due to the fact that the Wood Ducks which nest about farm houses would be the ones most in evidence and hence most easily found, whereas those that nest in swamps and river bottoms would escape detection. However, in the present instance extended search in the swamps failed to reveal the presence of either Wood Ducks or their nests *during the breeding season*, and this in spite of the fact that search was made in places where the birds were common during the winter time.

In the writer's estimation the factors which operate to influence the Wood Ducks to nest near human habitations are: protection from natural enemies and the presence of suitable nest sites. In one instance a raccoon was actually seen by a ranchman,



Fig. 12. BEAVER PONDS FULL OF DEAD AND FALLEN TREES ARE THE CHOSEN HAUNTS OF THE WOOD DUCK.



Fig. 13. IN MAY, 1923, FOUR NESTS OF THE WOOD DUCK, ALL CONTAINING EGGS, WERE FOUND IN A DISTANCE OF 100 YARDS IN THIS ROW OF OLD GNARLED WILLOWS.



Fig. 14. THE TWO CENTRAL DEAD WILLOWS EACH CONTAINED A WOOD DUCK'S NEST. THE TWO NESTS WERE NOT OVER 30 FEET APART.

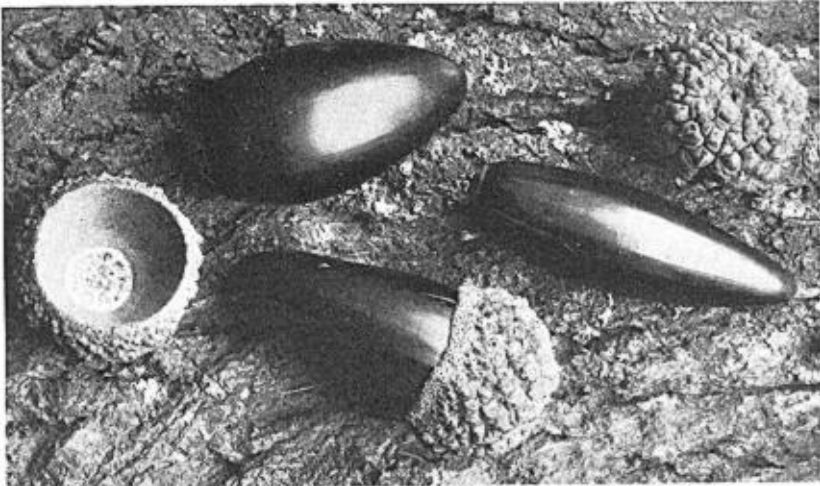


Fig. 15. ACORNS OF THE VALLEY OAK (NATURAL SIZE). IN SPITE OF THEIR LARGE SIZE THESE ACORNS ARE SWALLOWED IN QUANTITY BY WOOD DUCKS.

at daybreak, to climb up to a Wood Duck's nest where it frightened the brooding female from her nest and destroyed part of the clutch of eggs, thereby causing the Wood Duck to abandon her nest. In protecting his chickens from predatory animals, the rancher at the same time protects Wood Ducks which nest nearby. Ducks which nest near farm houses are thus less liable to suffer from depredations of four-footed enemies than those that nest out in the river bottoms where coons, cats, and skunks are numerous.

It is probable that Wood Ducks nest along fence rows beside roads because of the fact that in the old willow trees, which were originally fence posts, there are numerous natural cavities suitable for nest sites. In one row of old willow trees four nests of the Wood Duck, all containing eggs, were found May 30, 1923, in a distance of 100 yards. (See fig. 13.) In this case two dead willows standing within 30 feet of each other each contained a nest with eggs. (See fig. 14.) The cavities in road-side trees are in most instances so large that the duck can easily escape in case of attack, whereas if the opening be small there is much greater danger of the brooding female being captured on the nest by a coon even if the nest is placed well up in the tree.

There is good reason to believe that the period of incubation is the time of greatest danger to the Wood Duck as a species. For a period of from 30 to 33 days the female together with her eggs or downy young, the sole means of perpetuating the race, are confined day and night in a narrow cavity. Escape for the mother is possible only through the one entrance to the nest, which is often so small that the duck is able to squeeze through only with difficulty. At such times, when the female is brooding, the author has found by a study of muddy footprints that coons (fig. 16) habitually climb many of the larger trees, one after another, and investigate the larger cavities. It is obvious from tracks that the coon locates the duck on the nest by the sense of smell. In fact the brooding duck is out of sight entirely in most instances. Under such nesting conditions the "obliterative coloration" of the female duck could scarcely serve as a protection from enemies as suggested by Gerald Thayer in his book on concealing coloration (1909, p. 71). It would seem that the color of the bird on the nest, especially in a dark cavity, as in the above case, would be of little importance from a concealing standpoint.

It has been repeatedly demonstrated by the author that a slight scratching on the bark at the base of the nest tree, as of some clawed animal climbing, during the day and especially during the night, will cause the brooding female Wood Duck to leave the nest in haste. With one female it was found that if one or more persons spoke or whistled as they approached close to the nest the brooding bird would fly directly away from the nest when flushed. However, if the same person sneaked up quietly to the tree and scratched on the bark the female would drop from the nest directly down into a pool of water beneath the tree and there splash and flop about, dragging a make-believe broken wing and otherwise making every effort to divert the attention of the (supposed by her?) predatory animal. This ability of the female to distinguish between the sound of the human voice and the scratching, as of a climbing animal, was tested repeatedly by various people and the reactions of the duck were always as above noted.

Investigation has shown that in parts of California, irrigation ditches are commonly constructed beside roadways and along property lines. Thus, roadside trees are often near artificial waterways. Out of 12 Wood Duck nests examined, 10 were

directly over water. This is an advantage in that when the ducklings scramble out of their nest they flutter directly down into the water where they are able to take care of themselves, and so are relatively safe.

Out of 12 nests, 9 were in willows, 2 were in cottonwoods, and one was in a valley oak (see fig. 17). In the locality explored, willows are, of all trees, the ones most frequently found growing in or overhanging the water, and since the larger willows have many natural cavities they are the trees most frequently chosen. Ten of the nests found were less than 15 feet above the water. The extreme heights of 12 nests were 6 and 30 feet, respectively. Seven of the 12 nests were from 6 to 12 feet above the ground or water.

Of 12 nests, 9 were in natural (that is, rotted out) cavities and 3 were in old flicker holes (see fig. 18) that had been more or less enlarged by the decay of the wood. The greatest depth of any nest cavity from the entrance was 30 inches, the least was one inch, and the average was 15 inches. For height of nest above ground, size of entrance to nest, and dimensions of nest cavity the reader may consult the accompanying table.

DIMENSIONS OF NEST CAVITIES USED BY WOOD DUCKS

Nest	Height, in feet, of nest from ground	Size of nest cavity, in inches			Size of entrance in inches	
		Length	Breadth	Depth	Width	Height
1	7	18	6	18	6	10
1a	15	7	7	20	3¼	3½
2	9	8	10	12	3¼	6
3	8	14	10	8	3⅞	8
4	12	10	9	10	6	10
5	6	6	5	16	4	5
6	10	6	5	10	3½	4
7	8	12	10	30	8	10

Where old flicker holes were used for nests by Wood Ducks it was found that in each case the original entrance had been enlarged by the wood rotting away. I do not believe that a Wood Duck could squeeze through a flicker hole of ordinary size. Three and one-eighth inches is the width of the smallest opening I have seen a Wood Duck enter, and in this case the opening was vertically long though narrow. In one instance where the entrance to the nest was small as well as rough and irregular in outline, the female duck in squeezing through the opening had cracked the shell of one egg while it was still in the oviduct. The cracks were glossed or sealed over by the time the egg was laid, and the accidental cracking of the shell had not impaired the fertility of the egg which contained a well developed embryo. Major Allan Brooks tells me that he has found eggs of the Buffle-head in British Columbia that had likewise been cracked by the females squeezing through a small nest entrance.

During the latter part of March and the first part of April mated pairs of Wood Ducks were frequently seen to alight in tall cottonwoods near a certain farm house. They were also noted to be particularly interested in certain old gnarled willow trees. Both male and female ducks were observed to fly into the trees and the male duck was observed to enter several cavities while the female sat on a nearby limb and looked on. Although the drake led in the search for a suitable nest site, the final choice was always made by the duck. A certain amount of prospecting for a suitable nest site was indulged in apparently as a part of the regular courtship, the drake being most attentive to his mate at that time. Even where the same cavity served as a nest season after season, the drake always spent considerable time in investigating other hollow trees nearby. It is possible that the drake was a new mate each



Fig 16. THE RACCOON IS THE MOST INVETERATE "COLLECTOR" OF WOOD DUCK'S EGGS KNOWN. MUDDY FOOTPRINTS AND OCCASIONAL HAIRS ON THE ROUGH BARK SHOW THAT COONS REGULARLY EXPLORE THE LARGER CAVITIES IN WILLOWS.

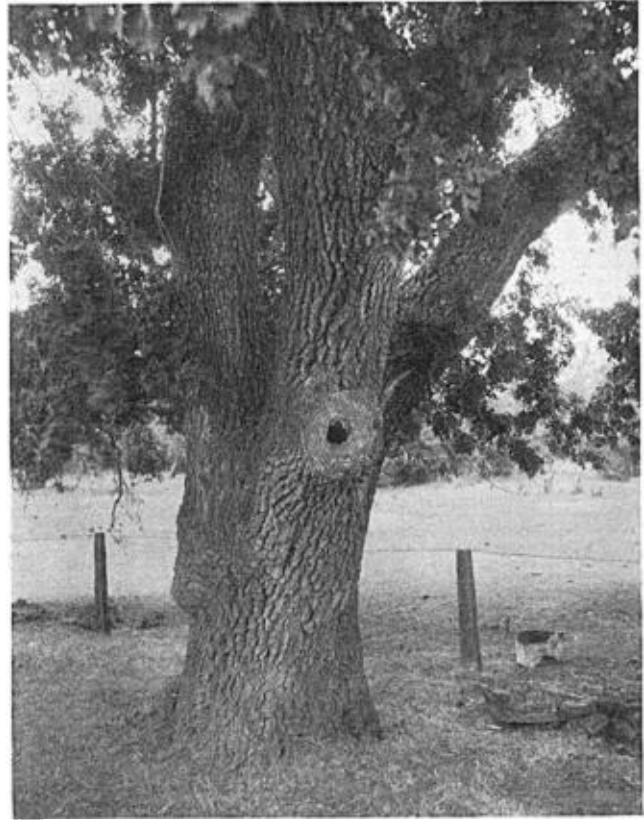


Fig. 17. OUT OF 12 NESTS ONLY ONE WAS IN AN OAK. THIS NEST WAS IN PLAIN SIGHT ON A WELL-TRAVELED ROAD. IT WAS 6 FEET ABOVE THE GROUND AND 60 YARDS FROM THE NEAREST WATER.

season and that he did not know the location of the old nest, as did the female, or it may have been mere nest time propaganda on the part of the male.

In one instance a certain hollow willow (see fig. 19) has been occupied by a pair of Wood Ducks for seven consecutive seasons. While definite proof is lacking, certain characters, such as the unusual tameness of the female, lead one to believe that the same duck used this nest during all these years. Whether she mated with the same male each year is an open question. Since the drake does not assist in incubation, being in fact never seen to enter the nest cavity after the first egg is laid, it is very difficult to establish the fact that he is or is not the mate of the duck that laid the eggs.

In four instances where I have had opportunity to keep a close watch, the drake did not forsake his brooding mate although casual observation would lead one to believe that he did. In known instances, the drake retired each morning to a chosen pond rimmed with a dense growth of green water weeds and shadowed by clumps of willows. Here he remained hidden in the shade during mid-day, being apprised of the approach of any intruder by the warning cries of numerous Brewer Blackbirds that nested and perched in the willows (see fig. 37). Late in the evening and sometimes early in the morning the drake was seen feeding or flying about with his mate, or perching in the nest tree. When the duck was frightened from her nest she was often seen to fly directly to the pond where the drake was in hiding; and in a few minutes both birds would return to the nest, the female always leading. I have thus seen the female go off and return with her mate many times. It was obvious that she knew where he could be found in time of need and that the marital tie was not yet completely severed.

Regarding the so-called concealing coloration of the Wood Duck, it has been my experience that this bird escapes notice primarily by keeping quiet and selecting shaded perches under or amid dead limbs or brush (see fig. 20). This preference for keeping in the shadows was well shown by one female which perched regularly on a certain limb in the morning when this perch was in the shade; while during several days' watch this bird never used the same perch in the afternoon when the sun shone on it. A certain drake and his mate were noted many times in a shaded pond under a clump of dense willows (see fig. 21). This was their favorite feeding and loafing ground. When the female was on the nest, the male could be found in hiding under the willows at almost any hour of the day. Even after the male had acquired the eclipse plumage he still remained in hiding in this same pond, where on various occasions I flushed the female and her brood of growing ducklings.

If the brilliant colors of the male match the brilliant yellow and green "water pictures" of his summer surroundings, as Thayer would have us believe (plate IV of his *Concealing Coloration*), why does the drake assume the dull-colored eclipse plumage at the very time when such aquatic vegetation is most brilliant? Conversely, the male is in his most brilliant plumage during the fall and winter, when the water-lilies are gone and the Wood Ducks' surroundings are dullest colored!

I have never seen the drake present when the ducklings left the nest. On one occasion, about 12 hours before the young departed, the female deliberately left the nest and returned in 10 minutes with her mate. This drake followed the female about and even tried to alight within 6 feet of the nest. He then flew away and was not in sight when the young finally left the nest.

At 5 o'clock on the morning of June 22, 1923, I was sitting in a blind 12 feet from the entrance to a Wood Duck's nest, waiting for the young to come off. I had just looked into the nest and had seen the female brooding, while several



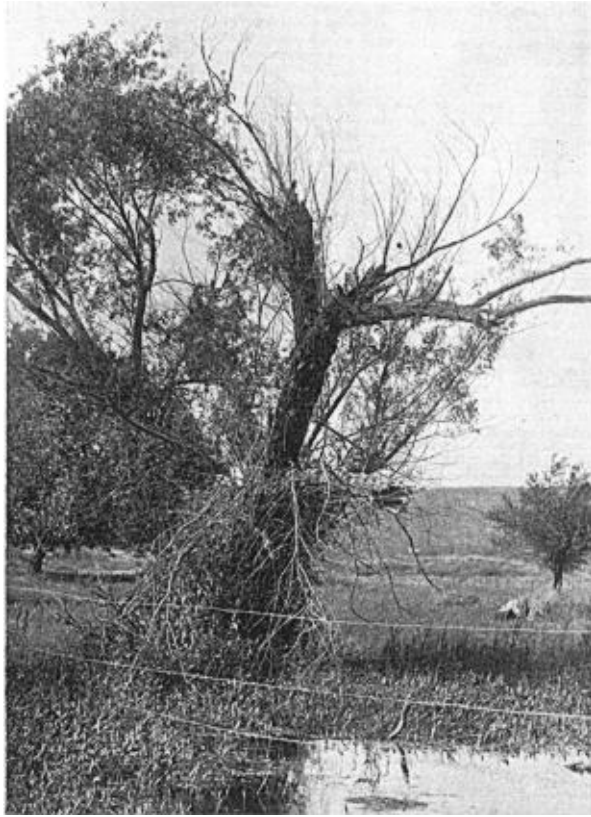


Fig. 18. A TYPICAL NEST IN AN ENLARGED FLICKER HOLE. OUT OF 12 NESTS 9 WERE IN NATURAL CAVITIES, AND 3 WERE IN OLD FLICKER HOLES.



Fig. 19. THE WILLOW IN THE LEFT FOREGROUND HAS SERVED AS A NEST SITE FOR A PAIR OF WOOD DUCKS FOR 7 CONSECUTIVE SEASONS.



Fig. 20. WOOD DUCKS OF BOTH SEXES HABITUALLY PERCH IN THE SHADOWS, WHERE THEY ESCAPE NOTICE BY REMAINING MOTIONLESS.



Fig. 21. THIS POND, WITH ITS DENSE WILLOWS AND PATCHES OF WHITE WATER BUTTERCUPS, WAS THE HIDING PLACE OF THE MALE EVEN AFTER HE HAD ACQUIRED THE ECLIPSE PLUMAGE.

ducklings played around her and one sat on her back. Barely had I returned to the blind when the drake flew in and perched on a dead limb 25 feet above my head. After peering intently at the nest entrance for 3 or 4 minutes he gave the "nest call" several times. Aside from being a little louder and harsher, this call was identical with the "nest call" of the female. Receiving no response, the male then flew to, and perched flicker-like at, the entrance. He then cautiously peered into the nest and then, catching sight of the camera in the blind, flew away before I could release the shutter. Although the drake returned, flew about the nest tree, and even perched in a tree nearby, he was not in the vicinity when the ducklings left the nest and took to the water.

Regarding the eclipse plumage of the male, it was found that in general this dull-colored coat was acquired about the time that the young Wood Ducks left the nest. The last drake seen in full nuptial plumage was noted June 1, 1923. On June 21, I again visited the nest site where this male had been seen, and at 5:30 in the morning found the drake, the duck, and the full number of ducklings busily feeding in a thick mass of water weeds near the center of a favorite pond about 200 yards distant from the nest tree. On that date, the male was well into the eclipse plumage, at least as regards body feathers. It was difficult, when the ducks were feeding, to distinguish him from his mate at a distance of 50 yards. One probable reason that Wood Ducks in the eclipse plumage are so rarely reported is due to the fact that under ordinary conditions in the field the average person would easily mistake the male for a female. In other words, from the last of June until about the first of September all the adult Wood Ducks *appear* to be females. The male which was seen to alight at the entrance of a nest which contained a female brooding young on June 22 was well into the eclipse plumage. Both drakes above mentioned were able to fly and as far as could be seen had not as yet lost any primary wing feathers.

The time of nesting and the number of eggs in a clutch is shown in the following table.

DATA RELATIVE TO THE NESTING OF WOOD DUCKS IN CALIFORNIA

Date of Record	Eggs in Set	Incubation
April 13, 1922	12	began April 9
April 14, 1923	13	hatched April 15
April 30, 1923	14	began April 30
April 30, 1923	14	began April 30
May 3, 1922	10	one-third
May 19, 1923	14	began May 19
May 20, 1923	10	fresh
May 30, 1923	10	fresh

Fresh eggs have been found as early as April 1 and as late as May 30. The average number of eggs in eight nests was 12, with 10 and 14 as extremes. One egg is laid each day until the set is complete. Usually the eggs are laid during the forenoon, but in one instance the female laid her eggs regularly during the late afternoon or evening. The eggs of the Wood Duck are frequently infertile. Out of one set of 12 eggs only 5 eggs hatched. In another nest which originally contained 14 eggs, one egg was broken during incubation, 4 eggs were infertile, and 2 young died in the shell, so that only 7 eggs hatched. Out of 97 eggs contained in 8 nests only 51 were definitely known to have hatched. Two nests were destroyed by predatory animals and two more were abandoned by the ducks, due to fright.

This figures 6.4 young per nest. It is a common fallacy to figure the rate of reproduction of a game bird according to the number of eggs laid rather than by the number of eggs which hatch.

The following two accounts, one of an unusually tame female and the other of the usual timid type, afford a basis for comparison and are here given in detail.

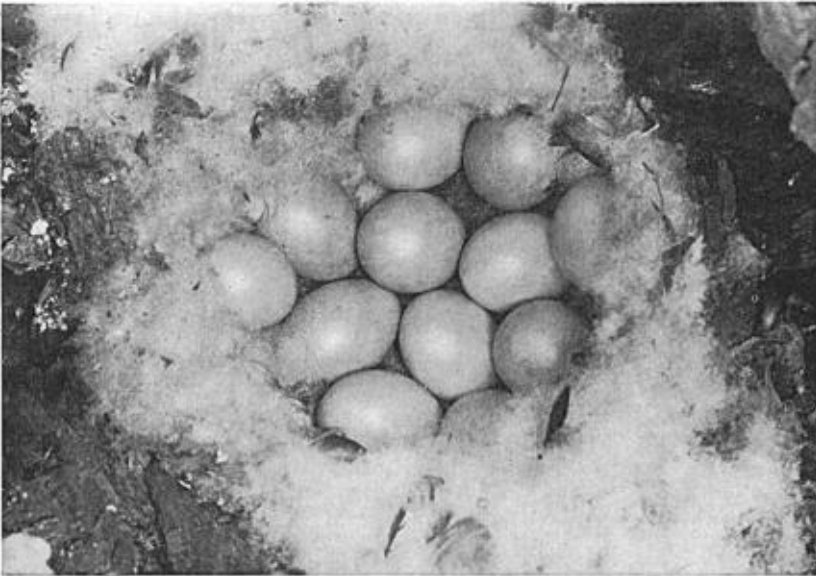
In 1922 the "tame" female made her nest in a natural cavity, seven feet up, in the main trunk of a large willow. This tree had originally been one of a row of fence posts that had taken root and grown (see fig. 19). The top of the original post had rotted away, forming, in time, a warm, dry, natural cavity eighteen inches long, six inches wide, and eighteen inches deep. The top of this cavity had been accidentally roofed over by a number of one-inch redwood weir boards that belonged to a headgate of an irrigation ditch which ran beside the tree.

The first egg was laid in this nest on April 1. One egg was laid each day until twelve eggs completed the set. Incubation began April 9. No nest material other than the down and a few stray feathers from the body of the female was in evidence. The eggs were laid on the soft, dry, rotten wood that covered the floor of the nest cavity. The nest proper was twelve inches long, ten inches wide, and five inches deep, outside measurements. The corresponding inside measurements were six, five, and three and a half inches. The twelve eggs were arranged in one layer. When the brooding female was frightened from the nest they were left uncovered (as shown in fig. 22). When unmolested she always carefully covered the eggs with down before leaving the nest (see fig. 23). This precautionary measure helped to keep the eggs warm while the female was off feeding and also kept the eggs from the prying eyes of numerous California Jays that regularly searched the willow row for eggs of other birds. The ease with which these jays find and destroy hen's eggs shows that they could easily despoil a Wood Duck's nest if they found one.

Soon after the female Wood Duck began to incubate her eggs some people living nearby lost a tame duck that "hid out" on her nest. One of the smaller children of the family found the Wood Duck nesting in the tree, reached in, picked her up and carried her in triumph to his mother, saying, "Mother, here is that duck that we lost." The mother of the boy replied, "Oh! No! that is a Wood Duck. You must turn her loose so that she can go back to her nest." This was done and, to everyone's surprise, the bird did return to her eggs that evening. Several days later I visited the nest, at 7 o'clock in the evening. An hour previous to this visit the female had been absent and the eggs carefully covered with down, but now, upon my reaching into the nest cavity, the female was found at home. She uttered a low, hissing note when stroked with my bare hand and tried to peck at and bite my fingers. She did not attempt to leave the nest but stood her ground.

The nest was visited by me the following morning at six o'clock. The brooding duck made no effort to escape even when I moved some of the boards above the nest to one side and photographed her on her nest (see fig. 24). The only movement that she made during the two-minute exposure was to occasionally blink an eye.

The nest of the second Wood Duck was found in a dead willow stub, 15 feet above the ground, in what had been an old flicker nest. Entrance had been gained through a hole in the upper part of the snag and not through the flicker hole, which was in firm wood. The nest cavity was twenty inches long and less than eight inches in diameter. No grass or leaves had been used in making the nest, which consisted entirely of down and feathers from the female. Although the nest tree was heavily infested with ants, these insects did not appear to molest the brooding bird. On May 3, 1922, this female was not on her nest at 6 o'clock in the evening,



**Fig. 22.** WHEN THE BROODING BIRD WAS FRIGHTENED FROM THE NEST, THE TWELVE EGGS, WHICH WERE ARRANGED IN ONE LAYER, WERE LEFT UNCOVERED AS HERE SHOWN.



**Fig. 23.** WHEN UNMOLESTED, THE DUCK CAREFULLY COVERED THE EGGS WITH DOWN WHEN SHE LEFT THE NEST. THE DOWN KEPT THE EGGS WARM AND ALSO PROTECTED THEM FROM PRYING EYES OF PREDATORS. POSITION OF CAMERA THE SAME AS IN FIG. 22.

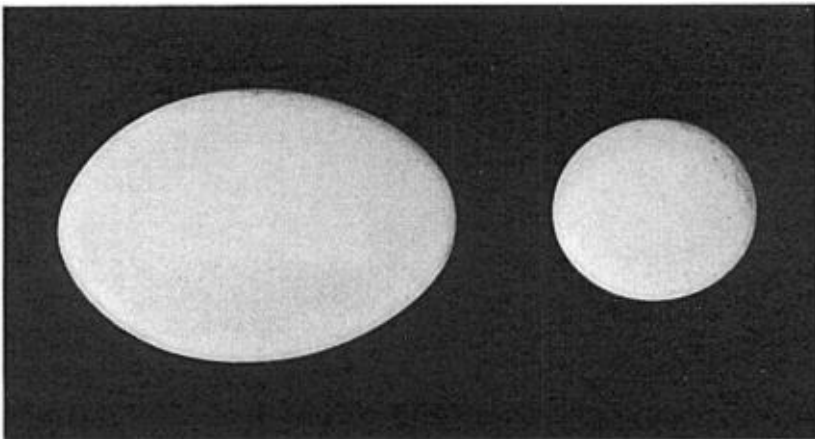
at which time the eggs were completely covered with down. When I again visited her an hour and a half later, the female flushed easily but returned to her nest in ten minutes. She circled around the nest a few times and then lit on a small limb about three feet from the entrance to the nest. Here she balanced herself gracefully on a rather insecure perch, and craned her neck, watching me as I lay concealed in the grass thirty feet distant. The eyesight of this female was good, in the gathering darkness, far better, I should judge, than average human sight; she obviously detected a slight movement of my hand, while I had difficulty in following her movements even though she was outlined against the sky. After watching me for a few minutes she fluttered with amazing ease through a tangle of small branches and scrambled down the entrance into the nest. The following morning this female was seen flying about, with her mate, near the nest. In the evening she arrived with her mate, both birds alighting in the branches of the nest tree. The female refused to return to her eggs, although watch was kept, at a distance, until ten o'clock that night. The set of ten abandoned eggs, all about one-third incubated, was collected, together with the down, for the Museum of Vertebrate Zoology.

It has been recorded that "twigs, grass and leaves" are used by the Wood Duck as nest material. A careful examination of all nests found, brought out the fact that in no instance had any nesting material, other than down, been carried into the nest cavities by ducks. In every instance rotten wood, bits of bark, twigs, and dead leaves had fallen naturally into the nest cavity. By actual experiment, it was found that if the larger obstructing chunks of bark and wood were removed, a pair of Wood Ducks would accept certain cavities as nest sites, whereas when this was not done, these particular cavities were investigated but "passed up" by the ducks. Ordinarily the female scratched the bark and bits of rotten wood away from the center of the cavity, thus forming a depression two or three inches deep. This nest she lined with down plucked from her breast, as was verified by catching and examining a brooding female. Sometimes a goodly amount of down is deposited as the eggs are laid. In one instance a nest containing 10 fresh eggs, which the duck had not yet begun to incubate, contained also a large amount of down. At the other extreme, one nest contained very little down; but all the nests examined contained some down. There is a tendency for the down to felt together and to decrease in bulk as incubation approaches completion.

It has been stated that species of birds which nest in cavities lay, as a rule, white eggs, the color of the egg supposedly being of little importance under such circumstances. If the eggs of the Wood Duck were really "protectively" colored they would be nearly black instead of the color of old ivory which makes them so conspicuous in the dark nest cavity. The female Wood Duck protects her eggs from prying eyes by covering them with a blanket of down when she leaves the nest to secure her food. In addition to concealing the eggs, the covering of down also tends to conserve heat and so keep the eggs warm. In two instances, while the female was off, I inserted a thermometer among the down-covered eggs. In the first instance the female had been off the nest about one hour and the temperature in the nest was 89°. In the second instance the female had been off close to three hours and the temperature was 83°. Both nest temperatures were 4 or 5 degrees higher than that which prevailed at the time just outside the nest. In one instance a female was frightened off her nest at 8 o'clock in the morning. I promptly covered the eggs with down, since the female in her hurried flight had no time to do this. Although the female remained off the nest all day and did not return to her eggs until 8 o'clock that evening, all 13 eggs in the nest hatched two days later.



**Fig. 24. A "coon's-eye" view of a Wood Duck on her nest. On account of the depth and darkness of the nest cavity a 2-minute exposure was needed to secure this photograph.**



**Fig. 25. EGGS OF THE WOOD DUCK, NATURAL SIZE, SHOWING EXTREMES IN SIZE AND FORM.**

The color of many eggs of the Wood Duck are suggestive of old ivory. The shell is hard, close-grained and of moderate polish. Certain eggs tend toward an ovate form (see fig. 22). In one set the eggs were quite slender; and in this set we find almost as great extremes, 55.0 and 37.0 millimeters for length and breadth respectively, as was found by Bent (Life Histories, 1923, p. 162) in examining a series of 99 eggs. His longest egg is given as measuring 55.5 millimeters and the narrowest 37.3 millimeters. In one instance two runt eggs, both infertile, were found in a set of otherwise normal eggs. Two extremes in size and form of eggs are illustrated by fig. 25. After weighing a number of sets, it is the author's belief that the weight of the egg, allowing for incubation, is a more reliable indicator of its true size or bulk, than measurements of length and breadth.

MEASUREMENTS IN MILLIMETERS AND WEIGHTS IN GRAMS OF 28 WOOD DUCK'S EGGS. \*

Length	Breadth	Weight	
55.0	38.0	42.2	Incubation 1/3
57.0	39.3	46.3	
54.0	38.0	40.9	
54.3	38.3	42.0	
54.5	38.0	41.8	
52.7	37.0	39.5	
51.4	36.7	37.4	
52.0	38.0	40.7	
54.0	38.4	42.0	
58.4	38.0	41.3	
52.5	40.5	47.0	Fresh
52.7	40.4	47.3	
52.0	40.0	46.6	
52.3	40.2	46.5	
52.0	40.3	47.0	
52.0	40.5	47.1	
52.0	40.5	47.2	
50.0	38.0	40.7	Fresh
51.0	39.0	43.0	
50.2	39.3	42.2	
49.6	39.7	42.1	
49.3	38.0	40.5	
52.5	39.4	44.3	
51.0	39.5	43.5	
52.5	39.2	43.7	
51.5	39.0	43.3	
35.7	29.7	22.2	Runt eggs, infertile
29.5	26.5	10.0	

Incubation often begins before the set is complete. For example, one female laid twelve eggs, but she *began* to incubate the day the ninth egg was laid. The period of incubation for the Wood Duck is usually given as 28 to 30 days. However, I found in four known instances that the time which elapsed from the time the female first began to incubate until the young were out of the shell, was 30, 30, 31, and 32 days, respectively.

During the period of incubation the daily program of the Wood Ducks was found to be as follows: My visits to nests, made early in the morning between the hours of 4:30 and 7:30, showed that the female often left the nest, usually about 6 o'clock, to forage. Returning at 7 or 7:30 o'clock, she spent the entire day on the

\* Weights given are of eggs and contents, before the eggs were blown.





Fig. 26. FEMALE WOOD DUCK "HIDING" BY CROUCHING MOTIONLESS LENGTHWISE OF A DEAD BRANCH 25 FEET DISTANT FROM THE CAMERA.



Fig. 27. FEMALE WOOD DUCK CALLING TO HER YOUNG IN THE NEST. THIS PERCH WAS USED REGULARLY WHEN IT WAS IN THE SHADE, BUT IT WAS NEVER OCCUPIED WHEN THE SUN SHONE ON IT.

nest. Between 5:30 and 7:30 in the evening the female again covered the eggs with down and then left the nest, flying directly to the feeding pond half a mile distant, where she re-joined the drake which had spent the day in hiding amid the dense growth of willows and water weeds (see fig. 21). The lower end of this feeding pond was choked with a dense growth of marsh grass, burdock, and water buttercup. Here I watched with binoculars the female as she fed 50 yards distant, but never saw her dive while feeding. Her head was thrust forward and the bill extended horizontally along, just beneath or near the surface of the water, as she swam slowly along. At other times she stopped and daintily picked off green sprigs of the water buttercup. After a hurried meal the female took wing, and she was sometimes accompanied by the drake on her return to the nest. The male spent considerable time, both mornings and evenings, in perching in or near the nest tree after the female had returned to her eggs.

When returning to the nest, the female always led the male. The ducks never flew directly to the nest but always chose certain preliminary perches, usually 50 to 150 feet distant from the nest tree. The ducks nearly always perched side by side amid dead brush or on limbs in the shade (see fig. 20). On one occasion only did I see the ducks perch in the open in the sunshine. When perched near the nest, the female sometimes crouched motionless, blending with the branches so as to escape notice (see fig. 26). At other times she craned her neck and peered cautiously about in all directions (see fig. 27). If nothing frightened her she would, after waiting from 5 to 10 minutes, fly quietly over to the nest tree where she would again sit motionless watching for another five minutes before finally fluttering into the nest.

In another instance the female duck always perched flicker-fashion at the entrance of the nest (see fig. 28). At a distance of twelve feet the white ring around and behind the eye was very conspicuous. This duck clung easily to the rough bark with her claws and braced her body by spreading her tail and pressing the relatively stiff tail feathers against the tree in true woodpecker style. When this female desired to leave the nest she first peered cautiously out of the nest (see fig. 29). After a number of such inspections she squeezed out of the entrance, which was a tight fit (see fig. 30), and launched swiftly forth into the air (see fig. 31).

On June 1, 1923, I spent the entire day hidden in dense grass 80 yards distant from a Wood Duck's nest. At that distance I could not with the naked eye make out the outline of the female duck as she sat in the shade in a tangle of dead branches near the nest. But by aid of binoculars I could follow every motion of the duck. When I raised my hand cautiously above the grass and moved it slowly back and forth, the duck at once caught sight of it. This experiment was repeated several times from different locations with the same result. On other occasions the birds demonstrated, to my satisfaction, that their eyesight and hearing were better than my own.

The first indication of the eggs hatching became apparent on the 28th to the 30th day of incubation. At this time a section of the shell about the size of the end of a match was pushed up from *within* the egg. This was apparently done by the duckling pressing outward with its bill, which is tipped with a hard calcareous nodule. At the same time cracks appear, radiating from the raised section. Even at this early stage in hatching the duckling inside the egg-shell could be heard peeping faintly. After the first attack the birdling rests and the only notable change during the next few hours is the gradual extension of the cracks in the shell. Three-fourths of the 40 eggs under observation hatched during the night. In one instance an egg which failed to hatch had a hole punched into it from the outside. At first it was thought that the mother had done this in an endeavor to assist the young to escape from the shell; but



Fig. 28. THE FEMALE PERCHED FLICKER-LIKE AT THE ENTRANCE TO HER NEST.



Fig. 29. THE DUCK PEERED OUT CAUTIOUSLY TO SEE IF THE COAST WAS CLEAR.

the punching of the hole may have been accidentally made by a piece of rough wood in the nest. As shown by an examination of the egg shells, the normal method of escape was for the young one to force, with its bill, a row of ruptures completely around the egg so that the egg shell was eventually forced apart in two complete but unequal segments, as though it had been opened from the inside with a can opener.

The hatching of the eggs proved to be a very slow process. In observed cases, 24, 24, and 48 hours elapsed between the time when the first egg was pipped and the emergence of the young one from the shell. It was found that, in nests where all the eggs were pipped about the same time, the time of hatching was uniform and that the downy young had greater vitality than where the reverse was the case. If the first break in the shell was delayed for more than 36 hours it was a sure sign of weakness on the part of the embryo; and in cases where the pipping was long delayed the embryo although fully formed died in the shell. Furthermore, it was found that if the ducklings did not have vitality enough to break the shell themselves, it was useless to do it for them, since "helped" ducklings always lacked vigor and sooner or later were left behind. Nature may seem harsh at times, but she plays no favorites.

Audubon's statement, which has been widely quoted by many subsequent writers, to the effect that the young leave the nest "the moment they are hatched" must be regarded as an example of "literary license." When the young Wood Duck first emerges from the shell it is wet, bedraggled, and scarcely able to hold up its head. The ducklings change wonderfully in a few hours after hatching; but at first the natal down, which is so fluffy and soft in day-old ducklings, appears stringy and hair-like. Each feather seems to be inclosed in an exceedingly thin parchment-like sheath or capsule which breaks away and is loosened by the ducklings preening their feathers while in the nest. This period of preening in the nest is essential to the successful career of the young. By actual observation of three broods, it was from 2 to 5 hours from the hatching of the young until the down was dry and fluffed out. When an intruder approached the nest containing young recently hatched, the ducklings scrambled or dived headlong into the mass of down which lined the nest. They thus became quite hidden from view, and, looking into the nest, one receives the impression that the nest contains only broken egg shells and a mass of down. If the observer remains quiet a few minutes, the ducklings peep forth from the down, and are soon busy tumbling about, pecking at each other's bills, and preening their feathers, which fluff out at an amazing rate.

In 1923 three broods of young Wood Ducks were actually seen to leave the nest. Another brood was watched but slipped out of the nest unobserved while I was foolishly waiting for the female to come and carry them out in her bill. In all three observed instances the young ducks left the nest entirely under their own locomotive power. In no case was any of the young carried out of the nest in the bill or on the back of their mother. I do not wish to imply that the young are never carried out by their mother, because I can readily understand how this method *might* be employed where the nest was high up in a tree and some distance from the water. The question is not whether the female *ever* carries the young, but rather what is the *usual* method of departure of the young from the nest. Various observers testify to the fact that the majority of Wood Ducks nest over or near water. My own experience in California has been that 80 per cent of the nests found were over water. This fact, as well as actual observation, shows that the usual method is for the young ducks, when about 24 hours old, to scramble out of the nest by aid of their own legs and wings. A female duck flying about carrying a duckling in her bill would naturally attract one's attention, and being spectacular would be most likely to be recorded. Further-



Fig. 30. SHE THEN SQUEEZED THROUGH THE ENTRANCE, WHICH WAS A TIGHT FIT.



Fig. 31. AND LAUNCHED SWIFTLY FORTH INTO THE AIR.

more, the actual time taken up in removing the young would be relatively long. Since the female would have to make many trips to and from the nest, the chances of her being seen would also be increased. Where the young depart of their own accord the whole brood was, in observed cases, out of the nest and into the water in less than three minutes; and unless one watches the nest constantly the departure of the young can easily be missed, even when looked for.

The three instances where young Wood Ducks were seen to leave the nest are here described in detail. The first nest was in an old, somewhat enlarged, flicker hole, situated 10 feet up in a willow stub which grew directly over the water (see fig. 18). The ducklings left this nest at 8:30 in the morning, accompanied by their mother. In leaving the nest the ducklings appeared at the entrance *ahead* of their mother, who seemingly encouraged and urged them along. Arriving at the entrance the ducklings took flight readily and fluttered down one after the other to the water ten feet below the nest. The mother then flew down amid her offspring and, swimming off, led the ducklings into a nearby tangle of water weeds. Two days later the young ducks were found feeding and swimming about in a compact flock near the nest tree. When first found they were unattended by either parent but were joined a few minutes later by their mother.

The data for the second brood is as follows. Incubation began April 30 with 14 eggs in the nest. One egg was broken 10 days later. The remaining 13 eggs showed no sign of hatching on May 29 at 6 p. m. Eleven of the eggs showed slight cracks at 10 a. m. on May 30. At 7:30 p. m. on May 31, the female was off the nest feeding, but none of the eggs had hatched. At 8 a. m. on June 1, all 13 eggs were hatched and the young were still wet. The young left the nest at 9 a. m. June 2, when 25 or 26 hours old. This nest was 10 feet up in a large natural cavity of a live bushy willow growing over the water. The entrance of the cavity was only 6 inches above the nest and the young were able to climb out with ease. In this case the young were called out of the nest by the female as she swam about within 50 feet of the base of the tree. This nest call reminded me of the spring call note of the flicker heard in the distance and was recorded on the spot as *kuck, kuck, kuck, kuck, kuck, kuck*, repeated rapidly from 5 to 12 times. As the female called the second time, I looked up at the nest again just in time to see the ducklings scramble to the entrance in single file and then flutter down through a maze of dead branches into the water beneath the nest. One youngster fell clear of the limbs, but the drop of ten feet was eased by the use of the spread tail and wings, so that the impact on the water was slight. Some idea of the extreme lightness of these downy young may be had from the fact that two of them were caught and were found to weigh 16 and 17 grams, respectively. The average weight of 3 adult female Wood Ducks was found to be 615 grams. The downy young, with wings and tail spread, present a flight surface of about 5 square inches, while the adults in flight present about 90 square inches to the resistance of the air. The young thus weigh 3.2 grams per square inch of flight surface while the adults are twice as heavy, weighing 6.8 grams per square inch of flight surface.

The whole brood of young were out of the nest and into the water in less than two minutes by the watch. As soon as they struck the water the ducklings dipped their bills into it, fluffed out their downy feathers and began paddling about. In spite of this activity they kept together in a compact flock. While in the nest, as well as after leaving it, the ducklings kept up a constant low twittering which reminded me very much of the rhythmic flight-song of the Willow Goldfinch. This twittering call served as a means whereby the flock kept together. The mother duck called



Fig. 32. A NORMAL BROOD OF 13 DOWNY WOOD DUCKS.



Fig. 33. THEY PAUSED AND PECKED AT THE WHITE PETALS AND GREEN STALKS OF THE WATER BUTTERCUP.



Fig. 34. ONE DUCKLING SCRAMBLED TO THE ENTRANCE OF THE NEST AND PEERED OUT.



Fig. 35. AND THEN SPRANG, WITH WINGS AND TAIL SPREAD, INTO THE WATER. NOTE THAT THE DUCKLING SPRANG, AND DID NOT FALL, OUT OF THE NEST.





**Fig 36.** YOUNG WOOD DUCK CLIMBING A WILLOW TREE. REPEATED EXPERIMENTS SHOWED THAT THE DUCKLINGS COULD EASILY CLIMB OUT OF THE DEEPEST NEST CAVITIES.



**Fig. 37.** THE DRAKE RETIRED EACH MORNING TO A CHOSEN POND RIMMED WITH WATER WEEDS AND SHADOWED BY WILLOWS. HERE HE SPENT THE DAY IN SECLUSION.

excitedly when she saw the young coming out of the nest; as soon as they had flocked together on the water she called again and the young started and swam in single file through the pond weeds toward her. The female then called the ducklings across the pond into some mats of blossoming water buttercup. Here they swam about with evident delight (see fig. 32); or they paused and pecked at the white blossoms or green filament-like stalks of the water buttercup (see fig. 33). Upon my close approach, the mother fluttered about on the surface of the water in an attempt to distract my attention from the young. Failing in this, she flew across a deep slough and lit in a pasture and again called the young. The ducklings swam after her and joined their mother on the other side of the slough. To my surprise the old duck then abandoned the water and led the ducklings, following in single file, out into the dense grass of a dry pasture where subsequently I was unable to find them.

The history of the third brood of young was as follows. Incubation began on May 19, with 14 eggs in the nest, one of which was broken some time during the incubation period. This was a second laying, the first set of eggs having been broken up by a raccoon. The first eggs were pipped on June 18 at 6 p. m. Twenty-four hours later all 13 eggs were pipped, but the young were not actually out of the shell until 7:30 on the morning of June 21. The young did not leave the nest the day they were hatched, so I slept beside the tree that night; but there was no activity on the part of the Wood Ducks during the night. The female spent the night on the nest; but at 7 o'clock the next morning she slipped out of the nest and flew off for her breakfast. While the female was gone the ducklings in the nest became very active, scrambling about over each other and twittering loudly. At 8:20 a. m. one duckling scrambled to the entrance of the nest, peeping loudly. It stood there for a moment (see fig. 34) and then sprang with wings and tail spread (see fig. 35) directly toward the water which flowed in an irrigation ditch 8 feet beneath the nest. The first duckling had scarcely touched the water when it was followed in quick succession by the remainder of the brood, so that the nest was emptied in less than 3 minutes. The speed of the ducklings when they struck the water was little if any greater than when they sprang from the nest. I can see no reason why they could not flutter down from a height of 30 or even 40 feet just as safely as from 10 feet.

The ability of the young to scramble out of a deep nest cavity in a hollow tree has been questioned by some people. By repeated trials I found that the ducklings were able readily to climb up the nearly vertical trunk of a willow (see fig. 36). So effective are their sharp little claws that the ducklings sometimes fall over backwards, hang head downward by one claw, and then scramble back and regain their upright position without falling. No one who has actually watched a brood of young Wood Ducks scramble out of their nest would question their ability to climb.

After the ducklings left the nest they swam about, keeping together in a close flock and hiding under clumps of sedge at the water's edge. One that I attempted to capture eluded my grasp by diving like a flash and swimming a distance of 10 feet under the water. Had the water in the ditch been deep I would have been unable to catch the youngsters. About half an hour after the young had left the nest, the female appeared, flew around the nest tree, and hearing the twittering of the young, called them to her. The whole family then swam off together down the ditch to a slough where the male had been accustomed to hide. Here the parent ducks tended their offspring and raised them to maturity.

*Berkeley, California, July 17, 1923.*