

DAILY LIFE OF THE AMERICAN EAGLE: EARLY PHASE  
(CONCLUDED)<sup>1</sup>

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*Plates II-IV*

*11. Building of First Steel Tower.*

When eyrie No. 5, which succeeded the Great Nest, was found to be favorably placed for our purposes, we decided to try the novel experiment of building a steel tower beside it and at a more favorable working distance.

This unique tower was erected<sup>2</sup> in the winter of 1926 and under great difficulties, due in part to the tempestuous character of the weather, but also to unforeseen complications that arose regarding the use of the land that our tower was to occupy; and for three critical weeks the work of building was held up. It is an interesting fact that the eagles had already begun their seasonal building operations before our own could be gotten underway; and that from February 17, when this tower was begun, until its completion on March 6, these birds were prevented from following some of their strongest impulses. Nevertheless, they remained in the vicinity, and were daily seen by the workmen. Equally remarkable was the fact that on March 7, the day after the workers had departed, and the noise of their hammers no longer resounded through the grove, the old eagles promptly returned to their interrupted tasks, and brought in an abundance of sticks, corn stubble and dead grass, the last of which they would gather in their talons as they swept low over a field.

This tower was eighty feet tall, and was surmounted by a railed platform, nine feet square, designed to carry a tent or blind of sufficient size to accommodate two persons.

*12. Early Phase of Nest Life.*

Having described the hatching of eagles under artificial conditions and considered other pertinent matters, we are now ready to

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<sup>1</sup> Inadvertently the second part of this paper (Auk, October, 1932) was marked "concluded"—Ed.

<sup>2</sup> By Western Reserve University, under the superintendence of Mr. H. A. Headline, then in charge of construction at the University.



UPPER: SHOWS UNEQUAL SIZE OF THE TWO EAGLETS.

LOWER: THE FEMALE OCCUPYING THE NEST PERCH WHICH WAS PREPARED FOR HER.

follow the history of the young eagle in a state of nature which, needless to say, is far better suited to its needs than any conditions which we can offer as a substitute.

In an earlier paper, dealing with the later weeks of life in the eyrie, much was said of the eagles' custom of guarding the nest and of reconnoitering it, of seldom being together with their young, and of almost never making an empty-footed visit to their eyrie. During the first three weeks, while the eaglets are in the natal down stage or beginning to pass out of it, all this is changed. One or both eagles are likely to be at the nest all day long, whenever behavior is free; their chief aim being to keep the young constantly in sight. Much of their guarding is then done upon a nest-perch, or a part of the nesting-tree immediately over the nest, when such is available, and no reconnoitering is then necessary. They come to the family abode not only to deliver and dispose of the prey, but to inspect, guard, brood or shield from the fickle elements, their tender offspring, who at that early stage are quite as sensitive to excessive heat and humidity as to extreme cold.

At the Great Nest four branches, available for perches, arose on the east, west and north sides. Many times in former seasons in the months of June or July, I had hoped to see the taller east and west branches decorated by these eagles, but was never gratified, for they kept invariably to the low stub on the north, which served as a nest-perch. In April, however, every available branch of the nest-tree was in daily use, and after the young had been fed, an old eagle would sometimes stand on the nest, even though its mate were guarding close by, for half an hour at a time. There is also to be noticed the added attraction of food in the eyrie, especially during those early weeks, for though an eagle bring nothing at a given visit, their larder is apt to be well stocked, and they help themselves freely to whatever it contains. I saw no evidence that food is ever cached at any other place than the nest. At feeding time a selective process in respect to food always goes on, and the rejects or larger pieces, more numerous now than at a later stage, fall by right to the older mouths.

In the winter of 1923-24 the eagles were absent from Vermilion for about three weeks,—from early to late February, laid their eggs, as estimated, from March 9 to 12, and three eaglets were

hatched on April 12-15; but owing to the inclemency of the weather the tent was not made fast on the tower until the twenty-third of the latter month. In twenty-five minutes from the time of closing the tent on that day the mother eagle was on the nest-perch. At that juncture a large sheepshead could be seen lying on the eyrie, and a bloody end showed where its head had been eaten away. The eagle had an eye on that fish, and in a few minutes she was passing up bits of its flesh to the eaglets, then from eight to ten days old. She was shortly joined by her mate, and for a quarter of an hour both were engrossed in helping their young as well as themselves.

The eaglets crawl freely about their nest, making free use of their down-covered wings, and as they sit with up-stretched necks they quickly sense their parents whenever they are near. At this early time also begins that flapping of their downy wings, which later takes on the semblance of a daily routine of exercise of far reaching significance,—a prelude to the acquisition of the power of independent flight. The impulse is no doubt instinctive, but doubtless also practice makes perfect. As in the domestic chick, pecking at objects of all sorts which arrest their gaze is a definitely inherited instinct.

They peck at the prey long before they learn to hold it in a talon, and bring their scimitar into effective use. Even when the trick has been done at the age of about four weeks the action will have to be repeated many times before it is a permanent acquisition. Perhaps this explains why the infantile practice of bill-to-bill feeding is continued up to the very end of nest-life, as if it were a concession to young who are slow to learn, and therefore a factor of safety in their up-bringing.

On one of her frequent visits, the female Eagle brought no food, but spent a half hour in rearranging some newly acquired nest-material, or stood at attention, watching, but evidently not much disturbed by, a tractor that was snorting in an adjacent field. Meanwhile, the three eaglets lined up before their parent for another meal and, being placed favorably for me to count the offerings, I was able to keep an accurate score which, in the course of ten minutes, stood as follows: No. 1, 39; No. 2, 8, and No. 3, 11, the largest and most responsive bird that was nearest

the parent, getting the most, according to a rule which I have never known to fail. When the feeding was over, she made the customary tour of the eyrie, planting her taloned feet with the utmost care, until pausing in this instance at the nest-front. Then spreading her legs she took the little brood under her body, even helping them to the right places with her bill. Having settled herself to brood, the male would usually take his guarding post on the nest-perch, and we would then have a picture of domestic aquiline tranquillity that was to be many times repeated during the week when I was able to follow closely the course of events.

Though at this station I was eighty feet away, the sound of the Graflex shutter would often send them both off to their high tree-perches, but this sort of disturbance, usually many times repeated in the course of a day, caused but a slight ripple in their activities, and in a few moments both birds would be back at their posts. The caution of either one, however, never for long abated, and the female in the instance just noted, did not go at once to her eaglets, who crawled to her on 'all fours.' When the brooding was resumed the young were usually restless and a grayish white head was continually popping out from under the maternal coverlet.

At the time of which I speak a crow had the temerity to settle into an adjoining tree, but with her mate standing guard the brooder only turned her head in his direction and ruffled her feathers. When at 5.30 p. m., I was preparing to leave the tent and the female had been over her young for nearly one and three quarters hours, she rose, walked over to the remains of the sheephead, followed by her crawling brood, and the process of feeding was resumed. While this was going on the male eagle, who had been fishing in the lake, returned with another capture, and at once joined his mate in the common feeding task. Time and again, when the female had torn off a piece of the flesh, the male would take it from her and offer it to an eaglet; or both together would bend low and jerk off other bits and give them to the eager nestlings; and once I saw the female draw out a piece of the intestine, and hold it up to one and another young bird, but to no avail. The male then seizing it from her bill, tried his hand, but on meeting with no greater success, settled the question by swallowing the tidbit himself. In another moment this act was repeated, but the other way around, this time the male having taken the initiative.

Towards six o'clock, when this repast was over, the male flew up to the nest-perch, and his mate for the third successive time went to her brooding, but in doing so raked up with her bill the earth and dead grass all about her body, as if in preparation for the night. She had been continuously at the nest for over two hours.

On the morning of the following day, having surprised the female eagle at the eyrie, she did not leave their tree, but took a post on one of the branches over the nest. This was a good sign as showing that she was becoming reconciled to my movements. At a later time the male left his tall tree-perch, and landing in a stiff breeze on another upright branch over the eyrie held to this swaying pinnacle for nearly half an hour before dropping down to the nest; or, they would often balance the picture with an eagle on either branch.

Facing the breeze, as was ever their habit, the brooding mother would sometimes rise, pick up and swallow a small object, probably a stray bit of food, and then settle down more contentedly; or, bending low she would arrange the nest-materials more to her liking, drawing some objects towards her and pushing others away; and once a stick was seized, carried a few steps and dropped. If the sun were hot the brooder presented a picture of mild discomfort, when her lower mandible drooped; or, she would rise and expel the air from her lungs in a comfortable yawn.

At this early period, provided always that there was untrammelled freedom of action, brooding followed the feeding sessions with great regularity, and by both sexes, though more constantly by the female. Any sudden shower or weather-change would also summon an old eagle to the nest for this purpose. During the first fortnight the brooding fever reaches its height, but gradually abates after the young are in the second down-stage. Night-brooding, as we ascertained, lasted in some seasons from three to four weeks, or, in certain cases even longer. As the young increase in size the regular brooding shifts into the shielding attitude, when the parent, with drooping, half-spread wings, merely stands over the young to protect them from excessive heat or humidity, or to fend off the rain and hail. At times the brooding mother would leave her charges for a few minutes, as if only to stretch her wings, and after flying past her guarding mate on his perch she would immediately return.

One day when the female, having left her mate on his guarding perch, came to the nest to brood, I timed the turnings of her head—that index of circumspection, which is so marked and useful a trait of a bird-of-prey, especially in a human environment. She made forty-eight turns to right and left in the course of ten minutes, or about five to the minute, but the head was never moved quite through 180°. The forward position of head to the wind was sometimes maintained for two minutes, when right and left turns would follow rapidly, and but seldom was there a tilt to the sky. Perhaps this indicates the average degree of watchfulness under favorable conditions. These turnings are evidently caused by auditory and visual stimuli, and when suspicion is aroused the movements are greatly accelerated, but, if the source is not discovered and the feeling allayed, beating a hasty retreat is in order. Should any of the young momentarily stray from the parental breast, attention is directed to them until they are again under the sheltering wings.

One day during a high wind, when the nest-tree swayed, the tower shuddered, and the tent made sounds that suggested a gale at sea, the female eagle crouched low over her young, while her mate clung precariously for the space of two hours to what we called 'the broken tree-perch.' The eaglets kept close to their warm haven of refuge and, after having brooded them for one and a half hours, the mother went off to join her mate on his broken tree perch. Failing to make a landing, she tried the tall perch, but, as this was even more difficult, she returned and resumed her brooding functions at the nest. Presently the male left the insecurity of his perching tree and departed, as I supposed, in search of prey; but in five minutes he was back, and carrying in his talons not a fish, but a stick, which was dropped on the eyrie. Again he went away to an adjoining field, and swept low over it with talons down, as if in search of living prey, but returned empty-footed to his unsteady perch.

Many times I have been impressed by the behavior of the mother eagle when rain or hail descended upon her down-clad young. As I approached the woods one mid-May morning the female eagle was on the nest, and whether because of seeing me or not, she presently withdrew to a tree-perch. Then, just as I entered the



MALE EAGLE AT NEST No. 5.  
MAY, 1926.



MALE ON TALL EAST UPRIGHT. IN LATER NEST LIFE THE SHORT  
PERCH WAS USED.



grove a brisk shower started, and the eagle at once returned to her young ones. Frightened at my ascent of the tower, she was off again, but as the shower continued, returned, in a few moments after I had entered the tent. She stood facing the wind and rain, with half-open wings, and afforded good shelter for the month-old eaglets huddled beneath her. In a few minutes this shower passed, and as the sun broke out she went back to her perching tree and spread her drooping wings to dry, in precisely that attitude assumed in times of great heat and humidity. Now, a quarter of an hour had hardly passed before the clouds again closed in and darkened above us; another downpour was under way, and the faithful mother sped back to her charges, and there she remained fending them with her stalwart body until this final shower was over.

The male eagle once attracted my particular attention by landing on the front of the nest, facing around to my tent, and seemingly freezing in his tracks. He hesitated so long as to leave me curious to know how long he would maintain this unusual attitude. That eagle never once turned his head or lifted a foot for forty-eight minutes; and during all that time he seemed completely oblivious of his young, who moved about him, even crawling between his legs, as if wanting shelter. When his confidence had at last been painfully restored, he walked to the far side of the eyrie, planted his talons on a fish and proceeded to feed his young.

As at later stages of nest-life the eagles now entered their eyrie with their prey held in either one or both talons, and if it were a living and still active fish it was struck and held almost immediately after it touched the nest. A small snake, a small fish, or the tail-end of a large one, however, are sometimes carried and delivered in the bill but, strange to say, I had not noticed this until it was revealed in the motion picture film. The following incident<sup>1</sup> shows how adroit the eagle can be in shifting his burden from talon to bill while in the air. At Brownhelm Bay a lake-lawyer or eel-pout had been thrown out of a fisherman's net; and, although numerous gulls were circling overhead they apparently paid no attention to the floating fish, or perhaps they spied a distant enemy who had already marked it as his own. At any rate, an on-coming eagle seized the fish and bore it aloft, but had risen hardly forty feet

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<sup>1</sup> As related to me by Mr. C. J. Ranney, of Lorain, Ohio.

when he lowered his head and quickly transferring the fish from talon to bill, made off with the prize securely held in his mandibles. The eagle, like many other birds, is very 'handy' with both bill and feet.

One evening, towards six o'clock, in April, the male eagle came to his eyrie and fed the young for half an hour, when he was joined by his mate, and both continued for some time, or until a blast of dynamite in the neighborhood sent them off in a panic, but the female, ever the more constant in parental duty than her mate, was back in a short time and continued to dispense the food until ready for another session of brooding.

At least one pair of House Sparrows have been found living in the sides of the different nests of the eagle, at which any extended observations have been made, and they always requisitioned the eyrie for eagles' down and other feathers, but only very rarely were they seen to get any of their food from that quarter. When about five weeks old the young eagles would resent the presence of the little sparrows, and would rise up and hiss at them when they ventured into the nest. A White-bellied Nuthatch, whose presence was more than once noticed in the eagles' tree, came down to the nest, hopped along the rampart of sticks and thence to the central grass-bed, and snatching up a few crumbs as if they were forbidden food, made off in haste.

So many unexpected visitors came into the eagles' tree, and into the eyrie or about it, that Mr. Shipman and I kept a record of them, with the result that in 1929 we had a list of upwards of a dozen birds, aside from those already mentioned, including the Baltimore Oriole, Scarlet Tanager, Ruby-throated Hummingbird, Red-headed Woodpecker, and Tufted Titmouse, not to speak of the Kingbird, who with the Gnatcatcher was more than a casual visitor, for they came neither out of curiosity nor from a desire for food. As already suggested they evidently regarded the eagles as trespassers upon their preserves, but I have never seen any resentment shown by the big birds in one case more than in the other. I am not certain, however, but that certain feathers, found in the ruins of nest No. 5, did not come from one of these bold little fly-catchers. One day when the female eagle left her tree-perch a Kingbird saw her, and immediately gave chase. As she ascended

to five hundred feet or more this persistent heckler followed, but when she majestically rose to over a thousand feet, the intrepid flycatcher was obliged to acknowledge defeat and to go back to mother earth.

The twenty-ninth of April, the last day I was able to spend on the tower in 1924, furnished an excellent illustration of more or less coöperative aquiline behavior; but to describe the activities of that day in full would involve too much repetition. The male eagle, after having fed his young for twenty minutes in the course of the afternoon, began to dig into the nest from time to time, taking mouthfuls of earth and shifting them to other places, as if bent on smoothing out the inequalities of their bed, and arranging everything to accord with his taste. Occasionally he would pause to look over his eaglets who lay stretched before him. For fully forty minutes the bird, when not looking about and listening, was engaged in this mild form of activity. During all this time the female had been resting on her broken tree-perch, when suddenly she gave an emphatic chitter. The male's attention was arrested at once, and when in a moment she made straight for the nest, he, chittering in turn, hopped up to the nest-perch, thus leaving a clear field for his mate. She began at once to rearrange the materials on the surface of the eyrie to suit her own taste, before a start was made in feeding the young, but she had much difficulty in getting rid of a spear of grass that had stuck in her mouth or throat. Then she, in turn, looked their young over, and snapped at the flesh flies which swarmed over the remains of their food. After having settled down, she dug into the loam of the nest and shovelled it by the mouthful about her on all sides and about the eaglets that were resting under her body, pausing only to shake out the particles that lodged in her mouth.

At another time and at another nest, when the eaglets were in the second down-stage, and were caught in a sudden rain, the mother eagle came hurrying to the nest and quickly gathered the sizable youngsters, as well as she could, under her feathers. In a few minutes an unusual sound came from the ground below, and the old eagle started up and went off in all haste. Upon lifting the trap inside the tent I saw at once that the cause of the disturbance was a cow that was rubbing her sides against a steel upright of the

tower. It is the unusual, whether in sight or sound, which arouses the suspicions of the eagle, but had this familiar rural divinity been in full view no notice would have been taken of her. There were times when the eagles were quite indifferent to sounds made by the camera or to any others which came from the tent. A single sharp report, which punctuated the silence, was more disturbing than a succession of similar sounds, and though the eagles undoubtedly heard the clicking of the motion picture camera, from the first they never seemed to notice it.

We could drive into the woods with a team of horses without putting up the eagles from nest or perch, but they were wary of any foot traveler, and when we hoisted up our baggage or stood on the tower outside of the blind, they would circle about us for some minutes, working their mandibles or hissing out their protests, but never came nearer than twenty feet and quieted down as soon as we were out of sight. When two observers were working and one left the tower, the bird at the nest, as a rule, would leave for a tree-perch, but return as soon as he was well out of the woods. It only rarely happened that one of us could climb the tower without causing a noticeable ripple in their domestic affairs, yet in all such matters the sensitiveness of these Vermilion eagles, that of the male being the most acute, certainly varied from day to day. For our purposes clear windy times were always the best.

I have spoken of the chitter note of the eagles being used as a signal in making the shifts in brooding or incubating, or as a note of alarm, but it serves other purposes, such as warning or perhaps notification, of the initiation or performance of some act, for the eagles usually chitter when they leave, or return to a perch or when they reconnoiter the nest. In the latter case it is perhaps a warning, for they chitter when a trespasser is chased away.

Notwithstanding the many days and weeks spent with these eagles I have only once or twice seen them to good advantage when making their famous ear-splitting screams. This once happened when I was taking motion pictures of the female on her tree-perch, one hundred feet away, and the scream was occasioned, I think, by a distant glimpse which she got of her mate, who was at that time recreant to his domestic duties. Bending down somewhat, the head is gradually elevated until, at the climax of the

scream, it is directed to the zenith and nearly or quite touches the back. I was both surprised and delighted to find that this attitude, which is rarely seen outside of a zoological garden, had been accurately reproduced on a beautiful Greek coin of Agrigentum over two thousand years ago.

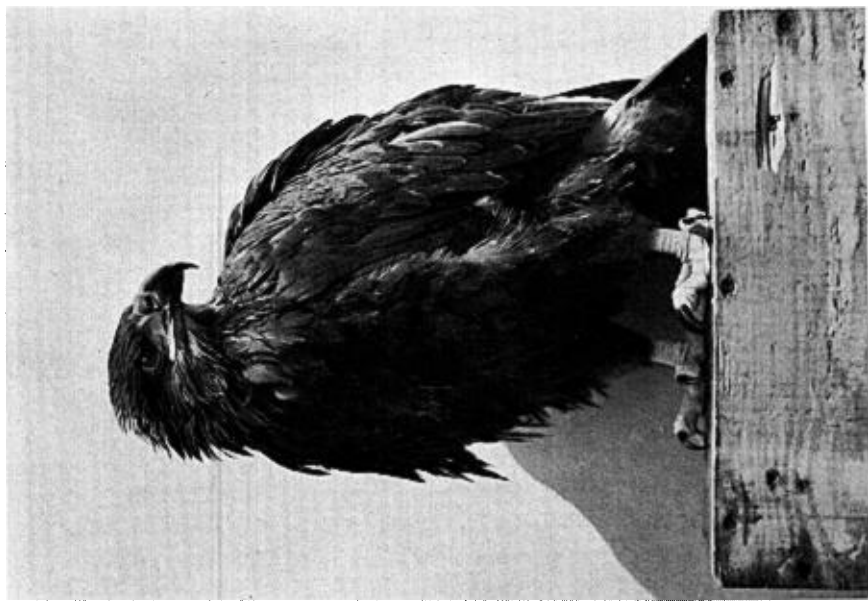
When a yellow perch was one day dropped on the eyrie, and soon began to show signs of life by flopping about a little, one of the eaglets crawled up to it and pulled at its pectoral fins. This stimulated the perch to another struggle, but it was the last. While watching this young bird which finally lay down on the fish, for it had not yet learned to coördinate the action of bill and talon, my attention was diverted to the other eaglet. It was shaking its head, apparently in a hard struggle to get rid of a casting, which I think, was disgorged in the grass of the nest. Fresh castings, whether of old or young eagles have been but rarely found, but in a number of instances they have contained leaves or leafy fragments of plants, and one described in a former paper, was composed almost wholly of vegetable material.

Nevertheless, as already indicated, I believe that this vegetable matter is eaten incidentally and chiefly by the young or immature birds. When at Grand Pelée Island a number of years ago we disturbed an eagle on the nest, it rose and as it circled a hundred feet or more above us let fall from its mouth a small body, light in both weight and color, which floated down in the midst of dense foliage, and although we were unable to recover it, it had more the appearance of a casting of feathers than of a solid piece of food. A casting of one of our young eagles that was reared in a cage, the floor of which was bedded with excelsior, is composed wholly of that material.

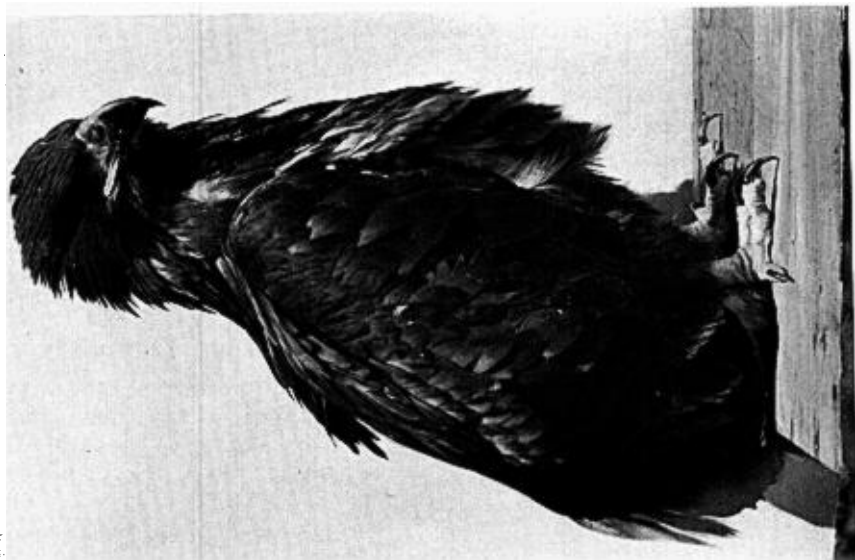
It was not until 1928 that we began to notice that a large proportion, certainly one-half or more, of the fish that were brought in from Lake Erie, had been taken alive; but such captures had, no doubt, been just as numerous in former years. The movements of the eagles, particularly when entering the eyrie with prey, were often too rapid for the eye to follow, and if the observer were manipulating a motion picture camera at the critical moment, only that instrument could be trusted to tell the true story. Many incidents, similar in all but unimportant details to what follows,

have been observed in recent years. The female eagle, coming in from the lake, flew up-wind with the quarry held low in her talons, circled the nest, and after coming up into the wind again, landed a large and lively eel-pout or lake-lawyer on one side of the eyrie. The young eagles, probably because of their satiety, made no demonstration or attempted to approach their parent. Thereupon, she dragged the struggling, flopping fish to the front of the nest, holding it so securely in one talon that it was unable to elude her grasp. Then, standing on it, she tore it with her bill, but the fish's struggles did not abate, and when she had wrenched off another piece of its flesh it seemed as tenacious of life as ever. Even after a third blow this stubborn fighter did not wholly give in, but motion now was confined chiefly to its tail. The eagle now dragged her reluctant quarry across the front of the nest to the westerly side, but before reaching that point a piece of the flesh was offered to the older eaglet, who had shuffled on its shanks part way to her. She bent far over to reach its bill, but when neither the first, second nor third offerings were taken she swallowed them all herself. The pierced and much abused eel-pout still had plenty of action left in its tail, as was evident when it was pulled still farther about the nest, and when the eaglets, becoming more active, began to take the food with zest. I have never seen the young eagles attack their struggling prey; and when a large and brilliantly colored goldfish, that had been taken alive, made its appearance, the young held aloof, as if they were actually afraid of it.

After twenty minutes of the sort of action just described, when my motion picture film was exhausted, I paused to replace the motion camera with the Graflex. The eagle, possibly from the silence which followed, at once sensed some cause for alarm, but was plainly puzzled. She stood erect and listened, looked around, at the tent and at the ground; and for nearly half an hour she maintained that alert attitude, but did not stir. The Graflex was ready to be set in place, but I did not remove the black cloth from the tent-window for fear of causing instant dismay. After three-quarters of an hour of this watchful and silent demeanor, she lifted a foot, and planting it again on the remains of the eel-pout, the interrupted feeding was resumed. When the eagle's head was down and in contact with the fish, I succeeded in mounting the



YOUNG MALE, ABOUT 69 DAYS OLD, IN FULL  
JUVENAL PLUMAGE.



YOUNG FEMALE, ABOUT 72 DAYS OLD, IN FULL  
JUVENAL PLUMAGE.

Graflex and removing the focussing cloth without disturbing her. Then I noticed, however, that loose threads from the tent-fabric were dangling in front of the lens, and their removal at an inopportune moment unfortunately caught the eagle's eye. Again she stood up, looked and listened; and after having spent an hour at the nest, she decided that it was best to retire, and went off to a tree-perch, a hundred feet away. America's national bird has learned that caution is the price of liberty, and this lesson is seldom forgotten.

### 13. *Summary and Conclusions.*

The following summary is based upon my experience in a somewhat limited section of the country. I have examined upwards of twenty-five nests of this eagle in Ohio, have had daily dealings with four different adult and twenty young birds, and have made intimate and prolonged studies at three different nests. I have also reared two young eagles, and succeeded in hatching three eagles' eggs, and rearing one of these young to the juvenal stage.

1. The history of the Vermilion eagles covers nearly a century, dating from about 1830 or 1835, during which time six nests have been successively built and occupied, the oldest and greatest (1890-1925), having been destroyed in its thirty-sixth year. Thus far this partnership has been self-perpetuating, and at least three instances are known in which the bereft bird has found a new mate.

2. These eagles spend most of the year in the neighborhood of their nest, but, since they seek a new feeding ground, if only for two or three weeks in mid-winter, they must be regarded as migratory in this section of the country.

3. Twice when the male has been killed, the female left the region, and was not seen again until after 11-14 weeks, when she returned with a new partner. The present female has been mated at least four times.

4. The sexes coöperate, as a rule, very fully in all domestic matters. In 1929-30, however, this was not true of the male, who held aloof from the nest after the first two weeks.

5. The sexes were often indistinguishable, but the female could sometimes be known by her more dependable behavior, or by her greater size. The latter distinction was not very apparent unless



the two were seen together, and references to sex have sometimes been made with misgivings.

6. The male American or Bald Eagle may measure 35 inches, spread upwards of 7 feet and weigh upwards of 8 pounds. The male killed at Vermilion in October, 1930, after the loss of considerable blood reached only the latter weight. The female eaglet, that was killed in the crash of its nest, in 1926, had also attained this weight at the age of only about one month. The adult female may reach 42 inches in length, may spread 8 feet, and weigh upwards of 12 pounds. Mr. James McGillivray stated in a letter that a young eagle that he had reared and tamed, and fed liberally with fish, weighed on November 5, when about six months old,  $17\frac{3}{4}$  pounds.

7. Few realize the lightning-like speed which an eagle can attain in flight or in the thrusts of its talons or bill. We found that at a distance of thirty-eight feet from the front of the eyrie only the most rapid photographic lenses were available for our purpose, and that a speed of  $1/400$  to  $1/500$  of a second was needed to stop the motion of an on-rushing eagle when entering its eyrie with prey.

8. The eyrie is not only a cradle for eggs and young, but also a gymnasium for young eagles, which must master the art of flying before they are allowed to leave it. The top of the Great Eyrie had an area of nearly fifty square feet, and its weight was four hundred times that of one of its fabricators. The eyrie is also the young eagle's flying field for the practice of flight, and its great surface-area is probably correlated with this fact. One of our young eagles made easily a mile in its first venture from its home, and it was soon back again, but only for a brief stay. The eyrie is further the rendezvous and home of the parent eagles for most of the year. They even come to their eyrie after snow has fallen, and bring their prey to it where it can be eaten in peace or shared with their semi-independent young.

9. The nest is built by the coöperative efforts of both sexes, and nest No. 5, which was started in ten days after its predecessor had crashed, was completed in four days of strenuous labor. It was framed with sticks and bedded with straw, dead grass, with sometimes a little sod and corn-stubble. The first year's nest is about four feet tall and five feet across. The chosen site, when there is

ready access to food, is held to by habit, and the nest is added to each year until it crashes through its own weight or is borne down in a storm. It is accordingly a composite structure, composed of as many increments as it has seen years of use. Its form, whether cylindrical, bowl-shaped (or broader than tall), or that of an inverted cone, is determined by the angle of spread of the surrounding branches. Nest No. 6 was built around a leading branch eight inches in diameter, which was removed without causing any disturbance to the activities of the old birds.

10. The disposition to build carries over for several weeks after the eaglets are out, and may lead to a renewal of the rampart of sticks and the straw-bed, but is later satisfied by the addition of single sticks, wisps of straw or sprays of foliage. Finally picking up such objects, but only to drop them again, seems to be only a symbol of a once strong but dying instinct to build.

11. Branches of pine and other green vegetation were always brought to the Vermilion nests both early and late in the season, and leaves were occasionally eaten by both adult and young eagles, as proved by their castings, but what significance this may have, if any, has not been ascertained.

12. The eagles at Vermilion tend to choose the oldest and tallest trees for their nests, and the present eyrie (nest No. 6) stands at a height of 87 feet; but a bowl-shaped nest (now abandoned) at Kelley Island, is 6 feet tall by  $7\frac{1}{2}$  feet broad, and the measured distance of its top from the ground is only  $43\frac{1}{2}$  feet. A nest near Fremont, Ohio, is unusual in having been built in the autumn,—late October to early November,—or four months before the usual time in this section of the country; and it is placed in a pin oak, which is so slender at the top that it would be unsafe for a man to climb to it.

13. Insemination took place in one instance while the nest was in process of construction, but behavior indicates that it is not limited to that time.

14. The eggs, 1-4 in number, but most commonly 2, are laid from early March to late April. Externally they are dull white, but on the inside the shell is light blue. One set of two from Florida measured respectively  $2.50 \times 2.12$  and  $2.62 \times 2.06$  inches. They are not always or usually laid in daily succession, and judging

from the difference in development in unhatched eggs or in the size of recently hatched young, the time interval between eggs may extend from three to four days, and perhaps longer.

15. Incubation is by both sexes, the guarding and sitting birds changing places according to a rather definite formula; and if left for only a few minutes the eggs at one nest were scrupulously covered, while at another this was not the case. The normal incubation time is approximately 34-35 days.

16. In three known instances the first bird hatched, coming presumably from the first egg laid, was determined as a female.

17. The enemy most frequently driven off during the period of eggs was the crow, and he may forfeit his life for his temerity. As an index of this, crow's feathers have been found in two different nests. At other times the eagles may permit not only the crow, but many other birds to trail after them without turning to attack; and I have seen an eagle duck its head and eventually change its perch, when pestered by the diminutive Blue-gray Gnatcatchers, upon whose domains he was doubtless regarded as a trespasser.

18. Three eagle's eggs were successfully hatched under hens in 1931. In the first to hatch on April 9, at 3 p. m., it was eighteen hours from the time the shell was pipped to that when the young eagle emerged. Meanwhile the eaglet had rotated in its shell, and cut a chink half way round the egg.

19. The young eagle, when still wet with the amniotic fluid, appears to be light gray, lined with black over the hinder parts of its body; but upon drying off these dark feathers become a smoky gray, and the bird is white only on its head, chin and under parts. The eaglet sits up, cheeps with vigor, crawls restlessly about on its shanks,—now down-covered except for their bare undersides,—uses its wings for support, is eager for food, and strikes with vim at its mates when they appear as competitors. The dark bill and eyes, that open in about four hours, contrast sharply with the almost white head. The upper mandible bears a short, white spur or egg-tooth, which, though an embryonic structure, may persist for over a month. The down is of two sorts, a thick inner coat of feathers plentifully supplied with barbs, and a thin outer layer of long hair-like filoplumes, and the arrangement of this down gives the head a flattened appearance, but only for a short time.

20. This natal down-stage in the first bird hatched lasted about three weeks. In four weeks the bird had increased its original weight eleven times (85-959 g.), and was in the second, thicker, and darker gray, down-stage. At five weeks the young eagle weighed 1998 grams (4 lbs., 5 oz.), and though still crawling on its shanks, could rise to its toes and take a few uncertain steps. In six to seven weeks it was in transition to the juvenal dark plumage-stage, but with evidence of the persistent natal down chiefly on the head and neck, as before.

21. Pugnacity among the eaglets, referred to above, has been noticed from time to time at Vermilion, and in 1928 we lost one young bird, when about a month old but much undersized, from this cause. One of our young eagles, a male, when thirteen weeks old, was also killed by his somewhat larger nest-, and cage-mate, probably a female, now living at the Cleveland Zoological Garden in Brookside Park. Under natural conditions this quarrelsomeness is largely offset by a more friendly disposition and spirit, as manifested in various forms of play, and after the critical first two or three weeks of nest-life the young eagles dwelt together in perfect amity.

22. Of the three towers, one of wood and two of steel, built at Vermilion in the course of this study, the last was erected before nest No. 6 at a time when the eggs were due to hatch, and although this constructive work required upwards of a week, it was done without driving the old eagles away or seriously interfering with their young.

23. The polity of the eagles during the first two or three weeks of domestic life differs markedly from that which prevails at its close. In the earlier period one or both parents are at the nest during most of the day, and guarding, feeding and brooding go on with little interruption. Many empty-footed visits are then made to the nest, and feeding at the family table, which is usually well supplied with food, is common with the old birds.

24. Eighty to ninety per cent of the prey brought to the eyrie, during our stay at Vermilion was fish, which might be taken off the beach, or captured by immersing at the surface of the lake; and in many instances these fish were alive when they reached the nest, although they may have travelled from three to four miles in the

eagle's clutches. This regulation diet was varied by domestic fowl in relatively small numbers, wild birds, rabbits, muskrats, and a few smaller mammals. Fowl were sometimes plucked at the eyrie, but more frequently came in, minus both feathers and head. The rabbit was always skinned either at the eyrie or before reaching it, but small birds were eaten feathers and all. The prey was commonly carried in one or both talons, but a small fish might be held in the bill. The eagle is adept in shifting his prey, when not too large, from talon to bill, when in the air. This eagle was not known to cache any of its prey except on the eyrie, that serves as a common dining table.

25. Feeding the young by the bill-to-bill method, while an old eagle stands on the prey and tears off the flesh with its scimitar, prevails to some extent up to the very end of nest-life. This may be considered as a factor of safety whereby any young bird that is slow to learn is insured the getting of a sufficiency of food from day to day. We found that the young eagle seemed to instinctively recognize the food that lay all about in on the eyrie, as something desirable, long before it was able to get any of it through its own efforts, for the use of the talon, so essential in holding the prey, must be learned by individual experience. Even at the age of five or six weeks the neuro-muscular coördination involved in such actions was often very imperfect. On the other hand, in early life it was nearly always the most vigorous and responsive eaglet that got the first helpings to the food and the most of it, and later the one that seized the prey first had the first chance to satisfy its own hunger. Crouching, squealing, and spreading over the food is characteristic of the older eaglets, and when this is freely manifested they have usually learned to effectively hold and tear the prey themselves.

26. In most responses of the young eagles, as in their preening operations, in stretching, bristling and spreading in heat, or over prey, the patterns of their behavior are indubitably inherited, and they follow the adult models with great uniformity.

27. Nest-life in this eagle lasts from ten to thirteen weeks, and the young, as a rule, take the air voluntarily, the moment the art of flying has been mastered and sufficient confidence has been attained; but during our first season at Vermilion the second and

last bird in the nest was starved and tantalized by food shown but not delivered at the eyrie until, in desperation, it was forced to leave it.

28. The most striking and interesting characteristics of these young eagles, on the score of behavior, are their play with mock-prey, and their jumping and flying exercises, the latter culminating at the age of about nine or ten weeks in trial flights over the nest before they actually leave it. Perhaps the extraordinarily long domestic life of the young eagles is correlated with their need of mastering the art of flying before leaving their first flying field,—the top of their great nest; and perhaps also the size of this practice-field, as already indicated, is correlated with the needs of the juvenals in their daily playing, jumping and flight-practices which extend over several weeks.

29. Young eagles, when once on the wing, do not quickly forget their old home, about which so many associations have been formed for upwards of three months, but return to it frequently, and sometimes remain for many hours before again venturing forth. During their novitiate they go to and from the lake, trailing after their parents, and no doubt hunt and fish with them. For two seasons the semi-independent young formed the habit of using the railing atop of our tower for a perch, after the tent had been taken down; and when they were out of the nest but a few hours they rose freely to great heights and made long flights to all points in the neighborhood. Yet, habit still held them to the vicinity of the old home-tree, and as late as September we have seen the mother eagle take a fish from the lake, and followed by her one surviving offspring of that season, carry it to the eyrie, where no doubt it was shared between them. We have found the young Vermilion eagles remaining under the tutelage of their parents and in the neighborhood of their nest until late in October. I have never seen them driven away from the parental hunting grounds, perhaps for the lack of opportunity to follow their concerted movements in late autumn, but it is a fact that no young eagles have ever been known to return and nest in the immediate region surrounding their first home.

*Cleveland, Ohio.*