

A LIFE HISTORY STUDY OF THE
CEDAR WAXWING (BOMBYCILLA CEDRORUM)

by

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INTRODUCTION

This life history study of the cedarwaxwing (Bombycilla cedrorum) was made in the vicinity of the University of Michigan Biological Station near Cheboygan, Michigan. During the 1940 summer session, June 25 to August 20, twelve nests were found on the station grounds. Of these, the activities of nine nests were carefully recorded and charted; and four nests were observed closely from tower blinds placed three or four feet from the nest. The material in this paper is mainly based on the complete nesting data from nests 2 and 3, and supplemented by observations on the other nests.

I am deeply indebted to Dr. Olin S. Pettingill Jr., Carleton College, Northfield, Minnesota, for the valuable guidance he gave me during this life history study. I gratefully acknowledge the helpful suggestions and advice of Dr. Theodora Nelson, Hunter College of the City of New York.

GENERAL NOTES

DESCRIPTION OF THE BIRD

As the Beau Brummel of the bird world, the cedarwaxwing is a slim brown to olive-brown bird with a pronounced black mask running through the eyes. The underparts of the adult bird blend into a pale yellow on the abdomen; the crissum is white. Banded with a bright yellow tip, the gray tail of this bird is quite distinctive. The secondaries of the gray wings may, or may not, be tipped with red wax; it is unknown to me whether this factor

is important in determining the age of the bird. The male bird may be distinguished from his mate by the heavier black marking on the chin, and by his trim, unruffled appearance. Since the female is burdened with the brooding of the eggs, her breast and flank feathers are always mussed up, and she may easily be differentiated from her mate. The young birds of this species are unique with their pale yellow underparts heavily mottled with brown. They have no red wax on their primaries up to the thirty-second day.

THE SONG

The song of the cedarwaxwing brings up an interesting question. Is it actually a song, or does this bird express itself with the utterance of a lisping sound? Since the song during courtship is no different than the expressions made during the "offbreeding" season, I am led to believe that the bird is songless as Saunders (1932 p.155) maintains; and that "the chief song or sound is a long, drawn out, high pitched whine, 'eeeee'." The hissing callnote does not seem to be a courtship characteristic, since it was continued throughout the nesting activities of the birds as an expression of relationship.

THE RANGE

Quoting Chapman (1940; p.425-426), the cedarwaxwing "breeds from central British Columbia, northern Ontario, and Cape Breton Island south to northwest California, Kansas, northern Arkansas, North Carolina, and northern Georgia; winters throughout nearly all of the United States and South to Cuba,

Mexico, Lower California, and Panama; accidental in the Bahamas, Bermuda, Jamaica, and British Isles."

TERRITORY AND COURTSHIP

This study was carried on during the summer months only, so the dates of arrival of the males and females has not been determined.

TERRITORY

The territories of the twelve pairs of cedar waxwings under observation were not determined. In fact, my observations lead me to believe that there may not be a strong territorial establishment by these birds. [Although the birds are most usually seen in pairs in the region of the nest, there is evidence that the waxwing may be polygamous.] While I was trapping the adult birds of Nest 9, for purposes of banding for future work, I caught three adult birds attempting to feed the young, which were serving as bait in the spring-trap.

In addition, I frequently saw three or more waxwings feeding in the same fruit tree during the breeding season. This point may have little significance, when we consider that the tree may have been outside of all breeding territories. [If territorial divisions were recognised by the waxwings, it is inconceivable that such compatibility would be possible.] During my observations I never observed fights by defending males over their territories.

Considering the other side of this question, the evidence that there is territorial determination by waxwings is

twofold. First, Nest 2 was at the northwest side of the area inhabited by the birds, since they always approached and left toward the southeast. Also, on one occasion the brooding female was much disturbed by the whining of two males overhead, though no combat incurred between these males, as they lisped back and forth at each other.

The study of territories was hindered by the abundance of unbanded birds, which could not be followed successfully. We may conclude that cedarwaxwings do have territories, and that there is the possibility of the polygamous element entering into the territorial determination.

COURTSHIP

Courtship displays such as the waxwing dance and berry passing activities mentioned by Crouch (1936; p.2) were not observed. Undulating flight and chasing activities did occur during the breeding and nest building activities, when the the birds were observed pursuing each other in broken flight, as they left to gather nesting material.

Although courtship displays usually cease with the laying of the eggs and increased cares about the nest, an activity was observed, which might be considered as a continuance of courtship behavior. When the male finished feeding the incubating female, the pair would engage in an affectionate session of bill clicking and food passing. The female, having been fed by the male, would pass the last bit of food back to him ; and in a mood of billing and mouth tugging, he would return the morsel, until it was finally eaten reluctantly by one

of the birds. Grasping and tugging on the bill of the mate was a common occurrence. In discussing the reason for this activity, Lack (1940; p.173) says, "the main function of courtship feeding is not food, it might be classified as a type of 'symbolic' display, i.e., in which an act normally playing some other part in bird behavior is introduced into display." He regards the billing of the waxwing as incipient courtship feeding.

THE NEST

GENERAL HABITAT

The cedar waxwing prefers open woodlands for its nesting site, frequenting areas where the forest growth gives free access to the berry bushes and trees, which the bird uses during its feeding activity. The open park area of the Station provided an ideal habitat for waxwings; so that twelve nests were found in an area six hundred yards long by two hundred yards wide.

THE NEST SITE

Nesting in red oak, red maple, sugar maple, and white pine, this bird showed no apparent tree preference for the nest site. The nests were built at an average of eight feet six inches from the trunk of the tree; rather far out on the limb, where they could find easy anchorage and coverage from the new growth of leaves. The building site was medium in height, being on the average thirteen feet from the ground. The highest nest, which I observed, was in a white pine twenty five feet from the ground; the lowest nest was eight feet high.

THE STRUCTURE OF THE NEST

The waxwing nest is a bulky structure, weighing 30 to 55 grams when dry, designed in cup-like shape, and built rather loosely on the top of a branch. The nest is thus entirely superior to the limb, with a few fibers lacing below, and with the surrounding branchlets woven into the sides of the nest.

For using available materials, the waxwings are remarkably efficient birds, and Chart 1. shows the nest locations and great range of materials, which are used in constructing the nest. The bulk of the nest is made up of grass, small sticks, rootlets, and string; while the lining usually consists of fine grass, pine needles, or moss. Significant observations have been made upon these birds tugging and pulling at the burlap mat on the camp diving board, successfully shredding string for their nests. The birds worked hard on this operation, obtaining and using string as long as thirty inches in the nest structure.

They have been observed tearing apart recently-used oriole and waxwing nests for building materials; probably because of the concentration of available material, rather than for clean-up or sabotage reasons. An average of measurements shows that the nest has an inside diameter of 7.7cm, and an outside diameter of 12.8cm. The depth of the cup is 3.9cm, and the outside depth is 9.6cm.

BUILDING THE NEST

With both birds toiling equally hard, the nest is completed in five or six days. Most of the work was done in the

morning at Nests 2, 3, and 10, and I noted that the male bird undertook an equal share in the activity. The selection of the proper crotch and building the nest base filled the first day of work; then during the next four days, the sides and inside of the nest are completed. The laboring birds leave the nest together to search for material, and return to the nest together to share in the building process. The birds averaged two to seven minutes away from the nest in quest of string and grass; they spent two to five minute intervals working the nest into shape.

The waxwing stands in the middle of the nest and works the material into the nest from the outside by stretching its head over the sides. With rapid and adept sidewise motions of the head, the string or stick is thrust into place, and then tucked in tightly with choppy actions of the bill. String and thready material is woven in a sloppy fashion about the nest. The bird constantly gives the nest shape by rocking rowboat fashion and turning about in the nest to give material the shape of its body.

The nest was completed before the eggs were layed, so that no more nest building activity occurred after the laying of the first egg.

THE EGGS

EGG LAYING

On the sixth or seventh day after nest building began, the first egg was laid, and one egg on each successive day was normally laid, until the clutch of four or five eggs was

completed. Variations from the usual occurrence were noted, when Nest 2 received five eggs in four days, and Nest 10 received four eggs in five days. No explanation can be offered for the first variation; but the hottest day of the season may have affected the laying rate in Nest 10. Plates 1. and 2. show the nest and full compliment of eggs of the cedar waxwing.

THE EGG

The eggs are somewhat pointed, and average 2.35cm long by 1.6 cm wide. The egg of the waxwing has a ground color of gray, with small black and chocolate spots scattered over the surface, generally concentrated at the larger end. As the incubation period progresses, the eggs become darker, especially toward the larger end, due to the development of the embryo.

INCUBATION

The incubation of the eggs is done entirely by the female bird. The male bird spends very little time at the nest, coming in at infrequent intervals to feed the female. During the morning of the fourth day of incubation, the female of Nest 2. fed four times. Once the male brought in food; once she left the nest by herself to get food; and twice the male whistled nearby and she accompanied him on a feeding jaunt. During the male's visit to the nest the aforementioned bill clicking activity occurred.

The desire of the female to incubate becomes stronger as the incubation period progresses. She leaves the nest without hesitation during the first days of incubation, but later on she holds to the nest inspite of an intruder's approach. The bird

in Nest 3. refused to leave her nest until my hand was six inches from the nest. In Nest 2. the bird ignored noises at first, but the approach of the hatching date made her wary of the slamming doors in Blissville, and she was much concerned over the garbage disposal from the parasitology store house and the rattling of trucks beneath the nest.

The attendance of the female seemed to reach the maximum on the twelfth day of incubation and first day of nestling life, though more evidence is necessary to establish this fact. From this time on the female's desire to attend the nest lessens; while the male, who heretofore has been only passively interested, shows a great burst of activity, and assumes the leading role in the care of the nestlings. The male plays the role of food obtainer; he does no brooding.

Observing the female during incubation was like watching a young child attend his easter eggs. The bird characteristically approached the nest by landing on a distant limb, and then hopping through the foliage until she reached the nest limb. She approached the nest cautiously, hopped onto the side of the nest, (see Plate 3.), lowered her breast feathers, and nestled upon the eggs. The nestling consists of a "boat rocking" process of descending over the eggs. Her disarranged and worn appearance due to brooding was a good means to distinguish her from the male.

The bird shifted her position every three to seven minutes, and with almost every shift she turned the eggs. She was fussy with the eggs, and often rose up on her feet to roll them.

While resting on the nest, which she ably filled as Plate 3. shows, the female busied herself by preening, watching the blind, and catching small insects which flew too close. When the day was very warm, the bird was content to stand on the nest and shade it from the sun, rather than nestling down to incubate the eggs. In the heat of the day she ruffled her back feathers to allow cooler circulation of the breeze, and she showed her distress from the heat by panting heavily and twitching her tail in rhythmic motions.

When the bird was aware of my presence, she gaped with open mouth and raised crest toward the blind, as though she expected trouble. Her ever raising crest (Plate 4.) was always an index of her anxiety. The male bird and young raised in captivity exhibited this rather human quality of showing their distress during disturbance. When the male bird attended, he flew to a perch beside the nest, and with much whistling and fluttering, he held a whining session with his mate before feeding her. After this feeding, it was interesting to watch the female snap her beak and lick the edges of her bill, and undergo swallowing motions, as though she enjoyed the food very much.

The eggs were usually laid before eight o'clock in the morning, though on some occasions, when I missed a morning check, they could have been laid later in the day. My observations lead me to believe that egg laying took place between eight o'clock at night and eight o'clock in the morning. During the incubation period, which was twelve days for two nests and eleven days for one nest, a set of eggs from Nest 10. lost 10.6% of its weight.

THE NESTLING STAGE

YOUNG BIRDS IN THE NEST

The growth of the young is represented on charts 2,3, and 4, and should be referred to for better comprehension of this study.

Upon hatching, the young waxwing is slightly longer than an unhatched egg (Plate 5.). The young bird comes out of the egg head first, with the posterior part of the body the last to leave the shell. The flesh colored infant is very weak, being able to hold its head up for only a few seconds. The leg and foot movements are likewise very feeble, and the young bird is unable to make a sound. The inner organs are visible through the membranous skin, and the feather tracts may be found under the skin only upon very close scrutiny.

The close eyes of the nestling are very large and bluish; the beak is flesh colored and edged with white; and the mouth is orange-red with purple marginal stripes. As the young bird grows older, the skin becomes darker, and the subdermal feathers along the dorsal tracts become evident as tiny blue pins. A slight movement of Nest 10 brought the one day old nestlings to attention for food. They wobbled all over each other, and could only with great effort hold up their heads for a few moments to gesture for food.

As Plate 6. shows, the nestling of two days is still entirely naked, and the spinal feather tracts are barely evident on the kidney region of the back. The bird is able to move its toes, but it cannot make a definite grasp at anything placed near

its foot. It is with difficulty that the bird holds up its head, even though the body weight is nearly double that of the first day. The nestlings show their photo sensitivity at this stage by reaching for food when the nest is shaded from the sun. I believe, however, that the act of feeding is stimulated more by the jarring of the nest when the adults alight, than by the shading of the nest at their approach.

By the third day the feather tracts show up very clearly on the dorsal side, but the ventral tracts are not very evident. The flight feathers on the wing have broken through the skin to a length of 0.4mm, but the nestling moves the wing only in feeble, indirect motions. When placed upon his back upon a board, Bird A (Nest 2.) was unable to right himself, though in the nest he used his ability for directive grasping on the side of the nest to turn himself over. The birds on this day again showed reactions to shade, when they were stimulated to a feeding pose by the observer's hand over the nest.

On the fourth day Bird D's (Nest 2.) primaries are 2mm long, and with the exception of the posterior ventral tract, the body feathers are beginning to fuzz out. The bird is noticeably stronger, but still uses its feet almost entirely to move about on the blind floor. D cannot turn himself right side up on a flat surface. The eye-slit, though still closed, may be observed on the nestlings at this time.

At five days D has primary feathers 3.5mm long, and his feather tracts continue to fuzz out. Great strides are made by D, for on the sixth day he is able to right himself from an inverted position on a flat board. The eyes on this day are

nearly fully opened. The nestling is quite active, and constantly claws and grasps about with his big feet, as though attempting to hold onto something. D showed his strength by holding a small slip of paper in the clasp of his foot. The bird's primaries are now 7mm long; a large group of pins gives evidence of tail growth, and the pin feathers of the ventral tract are starting to fuzz out. Bird C (Nest 2.) was able to turn rightside up on the slippery metal weighing pan on the scales.

The feathers on the back of D. (Plate 7) on the seventh day almost cover the bird, and begin to show a brown gray color. The neck region is becoming well feathered out. Bare skin is still visible on the belly, but the ventral tract is fuzzing out as light yellow feathers, and is progressively restricting the ventral apertures. Bird D was strong enough to pick up a decimeter celluloid ruler and hold it in one foot; however, it is still unable to support itself on a perch. The primaries are now 1.5cm long.

The activity of the birds is increased by the eighth day, when they used their wings to advantage in navigating about the floor of the blind. The 2.6cm primaries of D are beginning to fuzz out at the tips. The rectrices on this day are 6mm long, mostly yellow, with a few of them black. The occipital region is particularly well feathered out; the belly is now the only bare spot, since the crural feathers are beginning to erupt from their sheaths.

The ninth day is very important, because Bird A uttered the first peep which I heard a nestling make. It was perhaps a note of displeasure, since it was made while I was measuring the

the wingspread. The bird is able to perch on my finger, a great stride in the display of strength. As Plate 8. illustrates, the 3.1cm primaries are erupting at the tips. The very slowly improving tail is now 9mm long.

The peace and quiet of the waxwing nest is now gone, with the restless young jabbering and whining for food, and receiving assuring replies from their parents. The young waxwings stretch their wide mouths upward as though engaging in a mock feeding exercise, and flap their wings eagerly, appearing ready for a take-off. Preening and stretching, the nestlings occasionally work their bills by chewing the edge of the nest. The latter activity is perhaps a sign of hunger. All of the young of Nest 2 peep actively and run about the blind like mad during the weighing process. The belly and mid thorax are still bare of feathers. Plate 9 shows the great improvement in D's primary eruption.

On the eleventh day, with head well feathered and black mask quite evident, the bold cedar nestlings sit on the edge of the nest and lisp to their parents. Their great activity makes it difficult to handle them. Bird D now measures 1.4cm at the rectrices and 4cm at the primaries.

When twelve day old nestlings were placed out upon the nest limb for photographic purposes, D flew for the first time. He fluttered to the ground and scampered swiftly through the grass, until I caught him and returned him to the nest. All of the young showed pugnacity toward me as I weighed them, by striking my fingers with their bills and chirping belligerently behind their bold black masks. On the limb they clung tightly, and were able to pull themselves up to a sitting position, when

they were hanging upside down.

The male bird, feeding at ten minute intervals, attempted at first to coax the nestlings back into the nest. The young waxwings, heeding his coaxing, became mixed up in their attempt to descend the branch to the nest; so the despairing parent condescended to feed them out on the limb. When they finally learned the "push and pull" system of limb navigation, the young birds seemed to enjoy standing on the edge of the nest, and then moving out to new territory together. Plates 10, 11, and 12 show the well feathered, fluffy young D with definite black mask, and peculiarly stubby tail tipped with yellow fuzz.

From the fourteenth day until the birds left the nest for good, they were constantly in and out. They showed their fearlessness by jabbing with their bills when handled. The whine of the young birds seemed to be maturing, though they still used the nestling chip most frequently in conversation with their parents. Bird F, transplanted from Nest 3. to Nest 2. at fifteen days because of an accident at the nest, showed extreme fearlessness and pugnacity by jumping into the air and jabbing at my fingers. Bird A pursued my fingers around the blind floor, stabbing at me in opposition to my measuring tactics. This was the most aggressive action taken by the young during their nestling stage, and demonstrates that they are rapidly reaching maturity.

Preening, flapping wings, pecking at each other, and making short flights comprised the activity of the young on the last day of observation before they left the nest and their home life. The young waxwings were fed in the tree and in the nest on the final day, but the banded birds have not been observed in the nest tree since their evacuation. Their activity in

nearby pin cherry trees is proof that they remain in the general region of the nest for at least two weeks after they leave the nest.

Four banded nestlings from Nest 4. were raised in captivity; they tamed down nicely and fed from my hand until one bird escaped. Though he was returned to the cage, the group became restless and unsettled, apparently feeling the "call of the wild."

Until the eighth day of the nestling period, the birds show a progressive increase in weight. For the next six days the energy is used for building feathers and shaping the contour of the body, rather than in increasing weight; so there is a leveling off and slight decline in the weight curves of Chart 2. The wing length and body length curves on Charts 3. and 4. do not show any such rise and leveling off, but point out that the development of the body and wings is a gradual and regular process. We must, therefore, account for the weight curve level off by considering that the activity of the young birds crawling about the nest, exercising wings and voices, and strengthening their muscles, used up the energy as quickly as it was supplied by body metabolism. The slight increase in weight, which occurred shortly before they left the nest, was probably due to the necessity of storing up energy to aid in surviving the strenuous activity which the first days away from the nest bring to the bird.

It is difficult to draw any conclusions concerning temperature and growth, because on the hottest day of the

period there was more weight gained by the nestlings than there was lost; and on the coldest day all of the birds showed regular increases in length and weight.

A mature male bird trapped for banding, weighed 4gms less than the young birds of nest leaving age, even though its wing spread and body length were greater than that of the young. This fact shows either (1) that the nesting duties of the adult are very heavy and cause considerable loss in weight, and, or (2) that the young must leave the nest as heavy, fat birds in order to survive. Bird F, raised in captivity after the sixteenth day, exhibited body measurements closely approaching those of the adult male when it was one month old.

In a paper on the reactions of birds to sound stimuli, Hussey (1916; p.217) states that, "In observations made on the cedar waxwings, these birds were more responsive to sound stimuli before being fed than afterward." This may serve to illustrate the importance of the chirping and lispings, which is done during the feeding activity. The young birds, satisfied by a feeding, are less concerned about the disturbances which occur near the nest.

The nestling stage in undisturbed Nest 5. lasted from fifteen to seventeen days; the average time for the young to remain in the nest was fifteen and eight tenths days. Disturbed nestlings in Nests 2. and 3. remained from sixteen to eighteen days at an average of seventeen and one half days in the nest. In leaving the nest, the waxwing young merely continued their extra-nesting activities -- climbing, fluttering, and short flights -- until in flying about, they no longer felt the need

for the nest, and did not return to it.

PARENTAL CARE OF THE NESTLINGS

It might be well to point out again the division of labor at the nest. The incubation and brooding is done entirely by the female, while the male is loyal enough to feed his mate part of the time. After the young are hatched, the interest, or perhaps better stated, the work of the female decreases, and she pays less attention to the nest. The male bird at this time takes the very active role of supplying the food for the brood.

While the presence of the female is still very important, because she broods, covers the nest at night, and helps feed the nestlings, she brings in only 9.68% of the food, as compared to the 90.32% of the food supplied by the male. These figures, taken from observations on Nest 2., indicate also that the male feeds 73.68% of the food brought in to the young, and passed most of the remaining 26.32% to the female, who aided in the feeding process. The female was observed to bring in food from the field and feed it to the young birds on only a few occasions.

While the young were one to three days old, the brooding female showed much concern by shifting frequently over the brood, and by taking note of activity in the blind and nearby road. During this very early stage, the male brought food to the nest, regurgitated the indistinguishable masses of fruit and insect material, and gave a share of it to the female, who swallowed it. Both birds then proceeded to regurgitate and force the food down the gaping mouths of the nestlings. The food at first was all

pre-masticated, but later on whole berries were regurgitated and fed to the young. Even during the early nestling stage the bill clicking and mandible licking conclusion was made on the feeding activity ^{of} the adult birds.

The sanitation of the nest was carried on by both adult birds, as defecation usually occurred after each feeding interval. The attendant bird at Nest 2. almost invariably took the fecal sack directly from the young and swallowed it. Since the male's duties increased as the nestlings grew, he became the chief sanitary agent of the nest unit. His strong instinct to keep things clean was noted, when he insisted upon taking the fecal sacks from the young, even though they were perched upon a limb two feet from the nest.

It is noteworthy that the feeding frequency of the waxwing is greatest, not when the young bird is gaining weight (first eight days), but after the eleventh day when the activity of the bird is rapidly increasing. Chart 6. demonstrates the feeding frequency of the birds during their nestling stage, while the attendance of the adult birds at Nest 2. is shown in Chart 7. In discussing the feeding frequency of birds, it is important to consider the rate at which young birds can take care of the food supplied to them. Stevenson (1933; p. 161) says that juvenal cedar waxwings, starved for two or more hours, and then fed on raspberries, will digest the food in one hour and forty minutes. It is difficult to determine the degree of hunger which the nestlings exhibit; because tame captive birds, with an over supply of desirable food, chirped at my approach as much as the less well fed nestlings did.

THE FOOD

The food for the young at first was presented after regurgitation in small masses. Occasionally insect antennae could be perceived projecting from the soft food mass, indicating the presence of animal food. The diet of the cedar waxwing is believed by McAtee (1926; p. 68) to consist of one sixth animal food. Mr. Eugene Castle observed a pair of waxwings tearing down a maple-moth caterpillar tent on the Station grounds, and eating part of the contents.

Small red elderberries were eaten whole by four day old nestlings. The material was forced down the throats of the young, until they were able to eat no more. On one occasion when the young were six days old, the female cedarbird attempted to "drive" whole Juneberries into the mouths of her brood to no avail; so she ate them herself. Crushed berries were successfully eaten by the young, and on the tenth day they were able to eat a small amelanchier berry whole. Six of these berries at one time was the largest load I observed the male bring to the nest.

The birds under observation in captivity showed a preference for amelanchier berries over all other fruit available, but considered the pin cherries as a fine food after the first of August. They were reluctant about eating blue berries, though they were eager to obtain the grasshoppers fed to them. The waxwing is truly a "cherry bird" and fruiteater; McAtee (1936; leaflet BS - 44) lists nearly all of the wild fruits as favorable for waxwing food.

After the young left the nest, the parents were never seen feeding them, probably because I was unable to follow up the young birds, which were seen feeding themselves in pin cherry trees in the territory of Nest 2.

AVIFAUNAL RELATIONS

THE COWBIRD

The cowbird caused the waxwings the most trouble; yet of the twelve nests under observation, only two were parasitized. Nest 1. was abandoned for reasons unknown, so the parasitism problem in that nest was never completed. Nest 3. was parasitized with one cowbird egg, but on the following day this egg was gone; so I assume that the waxwing removed it from the nest. When I placed another cowbird egg in this nest, it was brooded but never hatched. The egg was not fertile. A female cowbird was observed to approach and look into Nest 2., but that nest was never parasitized.

OTHER BIRDS

The first contact I observed the waxwings to incur with other birds was during the building of Nest 3. While the pair of adult cedar waxwings were out on the diving board pulling on the mat for nesting material, a least flycatcher sneaked up to their incompleated nest, took some nesting material, and flew towards its territory to the East. The flycatcher made two successful invasions on the waxwing nest, without being seen by the resident birds.

The brooding female paid very little attention to the purple martins and kingbirds, which constantly churtled overhead; on very infrequent occassions she raised her crest in alarm at their activities. The red-eyed vireo and the robin were also compatible neighbors of the nesting cedar waxwings. A goldfinch nested in the same clump of maple saplings, ten feet from a

waxwing nest, and no resentment was shown by either bird.

SURVIVAL OF THE NESTS AND NESTLINGS

Nine nests were charted daily, and records from them show that five nests completed the life cycle. There were thirty five waxwing eggs in these nests, and twenty four of them hatched; neither of the two cowbird eggs laid in the nests were successful. From the twenty four hatched eggs, twenty young birds reached the age of five days, and sixteen became ten days old. Fifteen fledglings left these nests, with the result that 42.8% of the eggs laid were successful.

Reasons for the breaking up of four nests are difficult to find, since three of them were deserted with full compliments of eggs during normal weather conditions. The only factor available for this desertion is the death of the parent birds killed by a predator. Evidence for this belief has been presented by Mr. Castle, who saw a small hawk (believed to be sharp-shinned) swoop on a group of waxwings, while he was making observations on his blue jay nest.

The desertion of the other nest (7) is problematical also, since the four young were six days old, when found dead during a check-up after a gentle rain. The young were cold and had evidently been dead for a day. Since parent birds do not leave nests with young under ordinary circumstances, and because no weather conditions at that time would prompt desertion, we may conclude that the nest was abandoned because of injury to the parent birds.

SUMMARY AND CONCLUSIONS

1. Twelve nests were found on the Station grounds in an area 600yds. by 200yds. Nine nests were charted.
2. The nests were found in oak, maple, and pine trees 13 feet from the ground and 8 feet 6 inches from the trunk. The nest was a bulky, cup structure.
3. Nest building lasted 5.5 days; the incubation period was 11.7 days. The average clutch of eggs is 4.0
4. The nestling stage lasted 16.6 days; the maximum period was 18 days and the minimum period was 15 days.
5. Both sexes shared the nest building duties about equally.
6. The female does all the brooding; the male brings her food during incubation.
7. As the nestlings grow, the feeding rate increases, the brooding rate decreases, the duties of the male become more important, and the desire of the female to attend the nest decreases.
8. The male brings 90.32% of the food to the nest and feeds 73.68% of this food to the young. The female feeds the remaining 26.32% to the young, of which she brings in 9.68% herself.
9. The fledglings remain in the vicinity of the nest at least until they are a month old.
10. 42.8% of the waxwing eggs which were laid in nine nests developed into successful fledglings.
11. The song of the waxwing may be described as a high pitched lisping sound.

BIBLIOGRAPHY

Barrows, W. B., 1912, Michigan Bird Life, Lansing, Michigan

Chapman, Frank M., Birds of Eastern North America, 1940, New York

Crouch, James E., Nesting Habits of the Cedar Waxwing, Auk, January 1936, Vol. 53, No. 1.

Hussey, Roland F., A Study of the Reactions of Certain Birds to Sound Stimuli, The Journal of Animal Behavior, July-August, 1917, Vol. 7, No. 4.

Lack, David, Courtship Feeding in Birds, Auk, April, 1940, Vol. 57, No. 2.

McAtee, W. L., Fruits Attractive to Birds, Wildlife Research and Management leaflet B.X. 44, April, 1936.

McAtee, W. L., The Relations of Birds to Woodlots in New York State, Roosevelt Wildlife Bulletin, October, 1926, Volume 1, No. 1.

Pitelka, F. A., Breeding Behavior of the Black Throated Green Warbler, The Wilson Bulletin, March, 1940, Vol. 52, No. 1.

Post, Katherine C., The Cedarwaxwing During July and August, 1916, Wilson Bulletin, No. 97, December, 1916.

Saunders, A. A., A Guide to Bird Songs, 1935, New York

Stevenson, James, Experiments on the Digestion of Food by Birds, Wilson Bulletin, December, 1933.

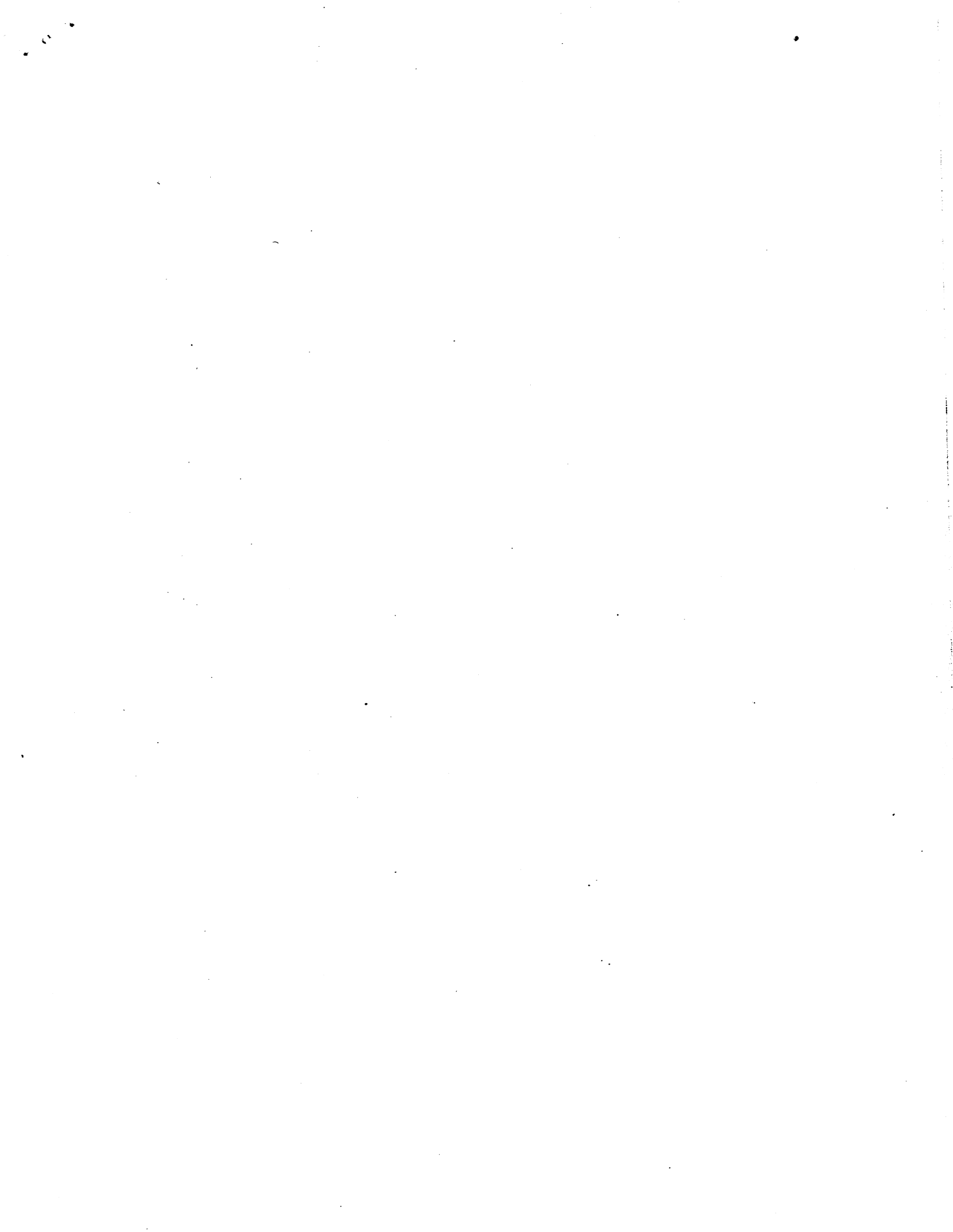
CHART I - STRUCTURE OF NESTS *

Nest	Nest 1.	Nest 2	Nest 3.	Nest 4.	Nest 5.
Location	South of Fire places at Picnic Grounds Maple Tree	West State Street at Parasitology Store House Sugar Maple Tree	West State St. in front of the Garage Red Maple Tree	E. State Street in front of Dean's office Red Oak	North east side of C Street Red Oak
Haight ^{above} ground	(12")	13' 8"	15' 3"	16' 3"	8"
Distance ^{out} from Trunk	(5')	6' 4"	13' 6"	8' 6"	9' 6"
Material					
Lining			White Pine Needles	Grass, rootlets	
Bulk		String, sticks up to $\frac{1}{8}$ " grass, rootlets, leaves, cedar bark, birch bark, Rootlets 18" long were wound about the nest.	Black Spruce Twigs, Diving board mat string, Bark, sticks grass, long weeds up to 30"	Black Spruce, weeds, Bark strips, White Pine needles, string, thread, small rope, rag strips	
Trimming		One feather		Birch Bark	
Measurements					
Inside diameter		3" x 3 $\frac{3}{4}$ "	3 $\frac{1}{4}$ "	3" x 3 $\frac{3}{4}$ "	
Outside diameter		4 $\frac{1}{2}$ " x 5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "	4" x 5 $\frac{1}{2}$ "	
Inside depth		1 $\frac{1}{4}$ "	1 $\frac{3}{4}$ "	1 $\frac{1}{2}$ "	
Outside depth		3 $\frac{3}{4}$ "	3 $\frac{3}{4}$ "	3 $\frac{3}{4}$ "	
Approximate ^{Dry} Weight					

* Adapted from Pitelka

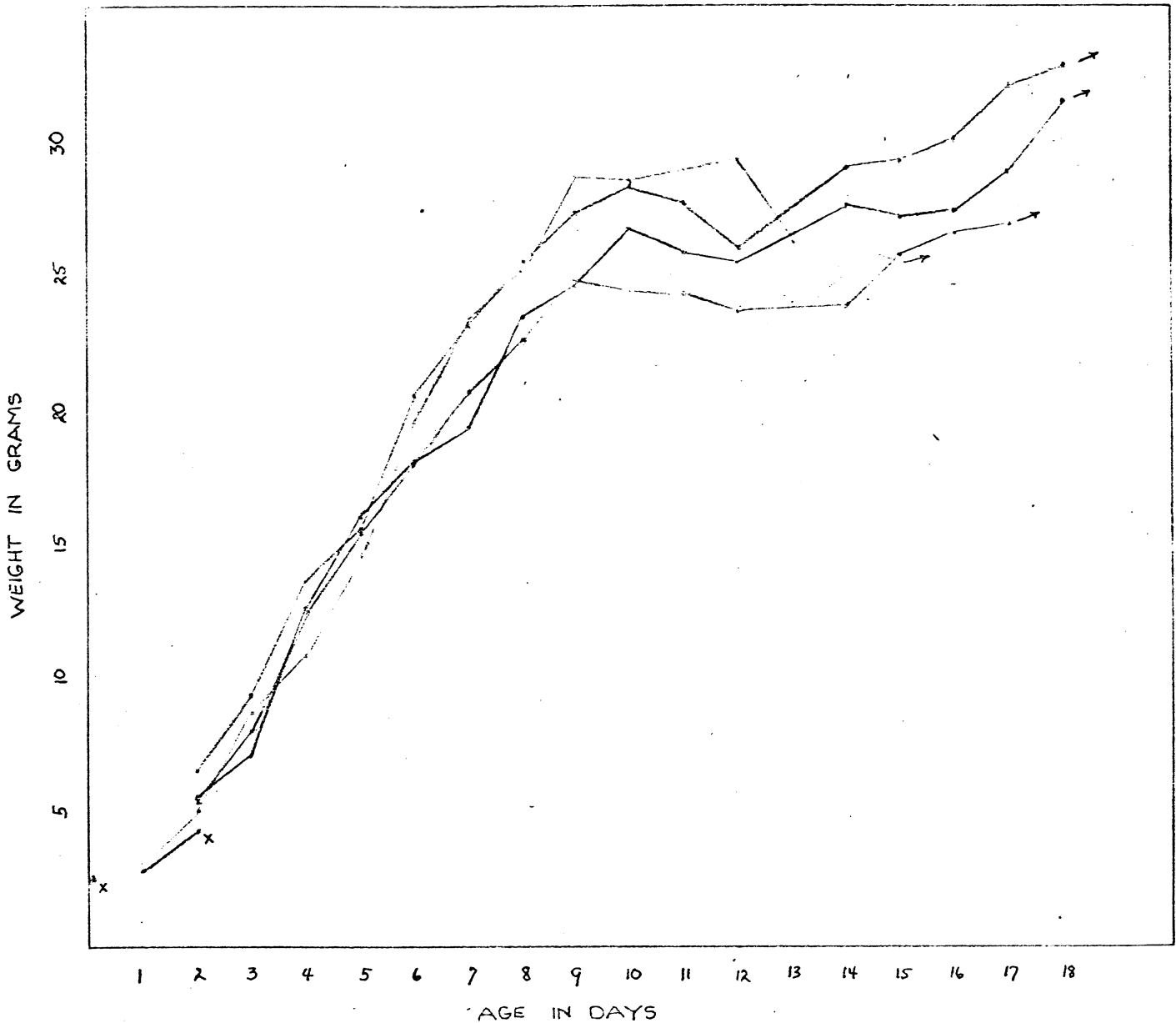
CHART I - STRUCTURE OF NESTS

Nest 6.	Nest 7.	Nest 8.	Nest 9.	Nest 10.	Nest 11.	Nest 13.
46 Faculty Row	N.E. Corner of Riggs House.	Beach - Cabin 15	Aquarium	W. State St. - by Cabin 9.	Aquarium	Pine Point
Red Maple	Red Maple	Red Oak	White Birch	Sugar Maple	White Pine	
10'	10' 9"	9' 8"	(13' 6")	10' 4"	(25')	
0'	0'	9' 2"	(8")	7' 10"	(10')	
Moss + Red Pine Needles		White Pine Needles		Nice grass lining		White pine needles and nice moss.
Sticks, Grass, silky string and thread.		String, sticks, black spruce, bulky white cotton, bark, reeds, grass, weeds.				Grass, leaves, plant down, birch bark, moss, lichen.
2 $\frac{5}{8}$ "		2 $\frac{3}{4}$ "		3"		
4 $\frac{1}{2}$ "		5.5"		5"		
1 $\frac{3}{4}$ "		1 $\frac{3}{4}$ "		2"		
3 $\frac{1}{2}$ "		5"		3"		
	38.5gms.	55.5gms.				



DAILY WEIGHT RECORD OF CEDARWAXWING NESTLINGS

July 15-31, 1940



NEST 2
 Bird A ———→
 Bird B ———x
 Bird C ———→
 Bird D - - - -→
 Bird E • x

NEST 3
 Bird F - - - -→

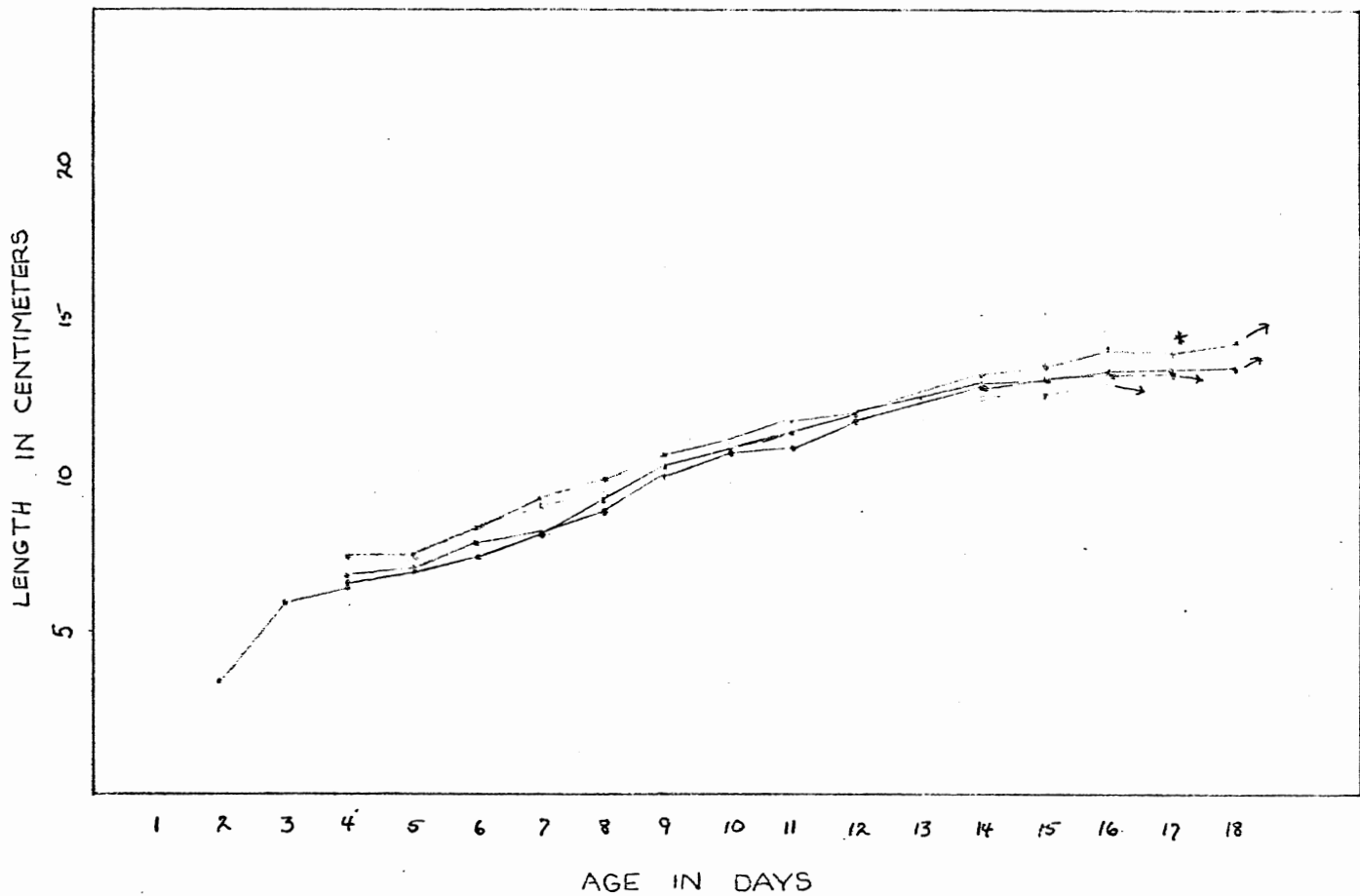
KEY

x - Disappearance
 ↗ - Left Nest

CHART 2.

DAILY BODY LENGTH RECORD OF CEDARWAXWING NESTLINGS

July 17-31, 1940



NEST 2

Bird A ———

Bird C - - - -

Bird D ·····

NEST 3

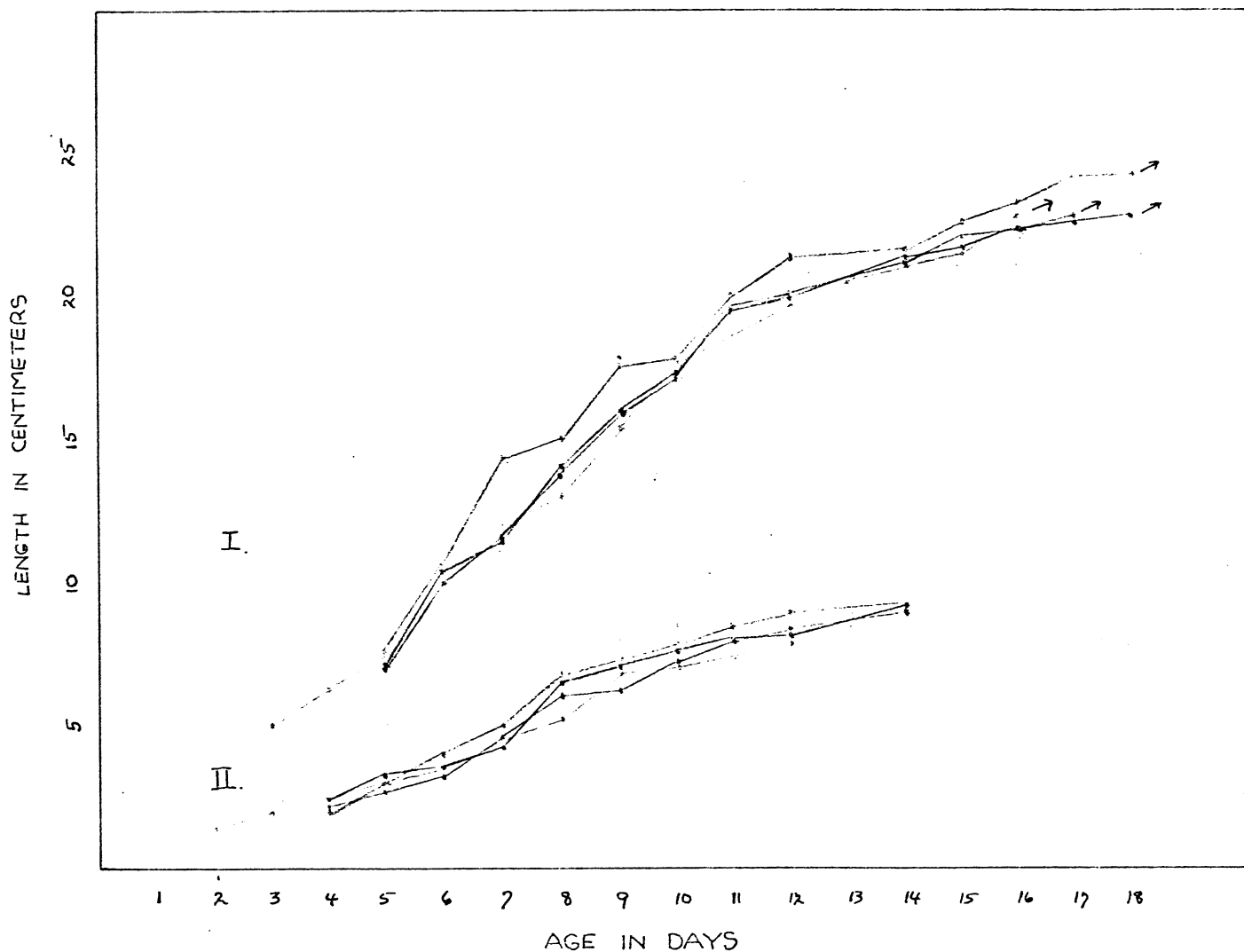
Bird F ———

* - The slight loss in body length is no doubt due to an error in the writer's calculations.

CHART 3.

DAILY WING LENGTH RECORD OF CEDARWAXWING NESTLINGS

July 17-31, 1940



GRAPH I - Wing spread - Tip To Tip

Nest 2
 Bird A ———
 Bird B ———
 Bird C ———

Nest 3
 Bird F ———

GRAPH II - Right Wing Length.
 Top of wing to humeral
 feather tract.

Birds indicated as in
 Graph I.

KEY
 ↗ - Left Nest

CHART 4.

TEMPERATURE AND PRECIPITATION DURING CEDARWAXWING NESTLING PERIOD

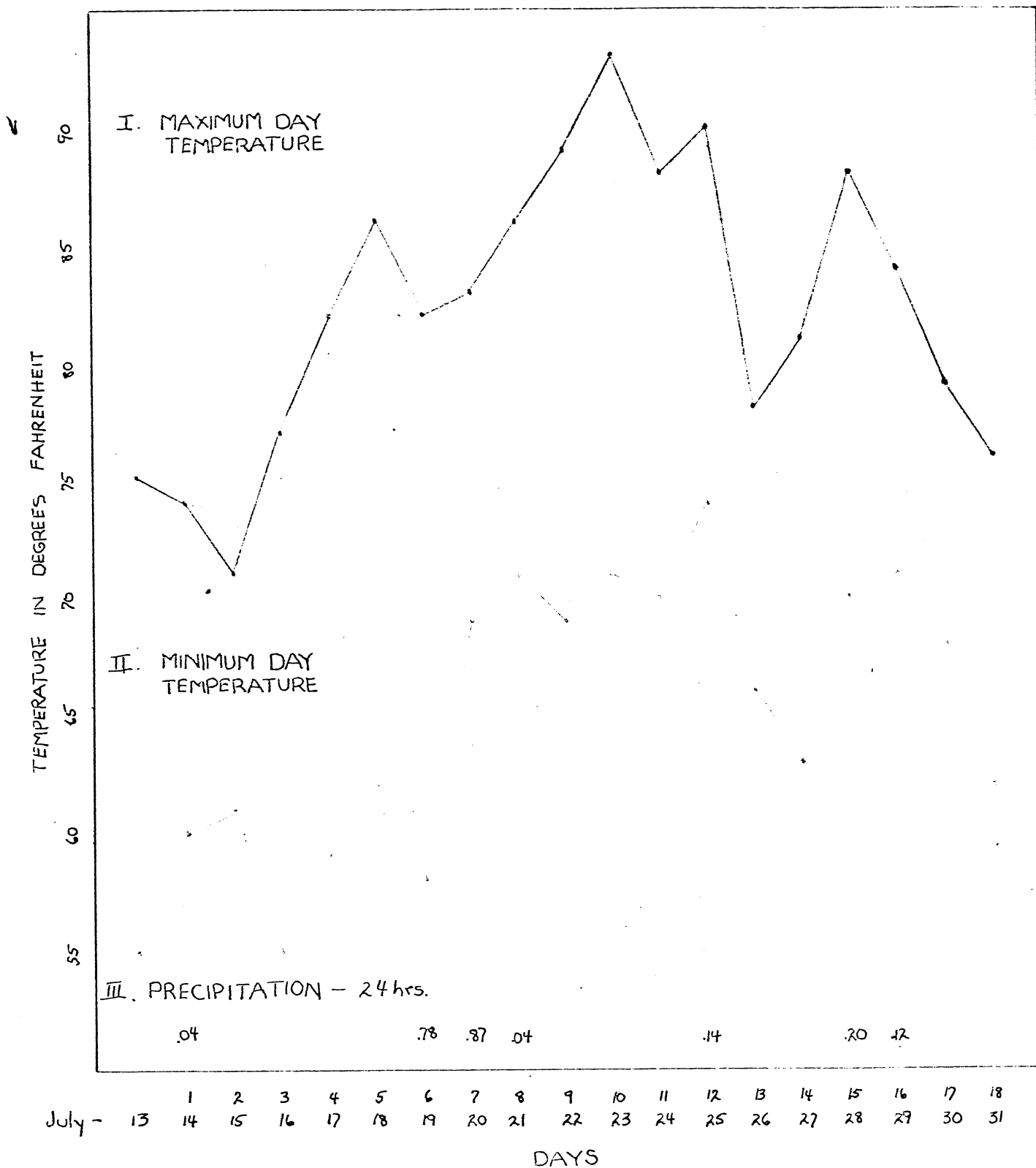


CHART 5.

Chart 6.

FEEDING FREQUENCY OF
ADULT CEDAR WAXWINGS
DURING THE NESTLING STAGE

(Data from Nests 2 and 3)

- 1st. Day - 1/24 - the adults fed the young once every 24 minutes.
- 6th. Day - 1/18 - the adults fed the young once every 18 minutes.
- 11th. Day - 1/9.9 - the adults fed the young once every 9.9 minutes.
- 13th. Day - 1/10 - the adults fed the young once every 10 minutes.
- 15th. Day - 1/15 - the adults fed the young once every 15 minutes.
- 18th. Day - 1/9.4 - the adults fed the young once every 9.4 minutes.

Chart 7.

ATTENDANCE CHART OF
ADULT CEDAR WAXWINGS
OF NEST 2

	3rd. Day of INCUBATION	10th. Day of INCUBATION	1st. Day of NESTLING STAGE	6th. Day of NESTLING STAGE	11th. Day of NESTLING STAGE	18th Day of NESTLING STAGE
♂ In	3 min.	0.5min.	16 min.	8 min.	7.5 min.	5.7 min.
♂ Out	238	104.5	164	57	55.5	41.3
♀ In	203	95	163	30	2	0.5 (?)
♀ Out	38	10	17	35	61	46.5