

A COMPARATIVE STUDY OF THE
GROWTH RATES OF CEDAR WAXWINGS (Bombycilla
cedrorum) UNDER VARYING CIRCUMSTANCES.

BY

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as an Investigation in Ornithology (Zoology 293), at
the University of Michigan Biological Station.

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INTRODUCTION

The observations for this analysis of the growth rates of the Cedar Waxwing (Bombycilla cedrorum) nestling's were made on forty-two nests in the vicinity of the University of Michigan Biological Station, located on the south shore of Douglas Lake, Cheboygan County, Michigan. All but five of the nests used were located within a half mile radius of the Station Store and the most remote nests were some two and one-half miles away.

Between the twentieth day of June and the twentieth day of August, 1942, the nests were discovered and the fates of one hundred thirty-nine of their eggs recorded.

Day to day weight records were kept of all nestlings accessible from the first day until the sixteenth day of July.

Assistance in planning the project and many helpful suggestions were kindly given by Dr. Olin Sewall Pettingill Jr. I am grateful to Dr. Theodora Nelson for the suggestion's and assistance she has given me in devising practical methods of weighing the nestlings.

I am also indebted to Miss P. Muirhead and Messrs. P. Springer, J. Stanford and L. Batts for directing me to several of the nests referred to in this paper.

STATEMENT OF PROBLEM

The problem was twofold; First, to determine the amount of variation, if any, in growth rate among the nestlings by carefully weighing all available ones from day to day throughout their nestling period, and, second, to discover some of the contributing factors responsible for these probable variations such as the following.

1. The effect of a subnormal number of young birds in the nest on the rate of development.
2. The effect of varying amounts of sunlight on the growth rate.
3. The effect of human activities in vicinity of nest on the amount of feeding and indirectly the growth rate of the young.
4. The effect of removing one parent on the rate of growth of the young.
5. The effect of variations in nest elevation on the rate of development.
6. The effect of season on the rate of development.

FIELD METHODS

The nests were naturally in different stages of incubation and development when discovered, some containing no eggs, some two or three and some all five eggs and some nestlings. For this reason it was necessary to determine the ages of those nestlings found already hatched. Whenever nests of this type were found a careful record of the appearance of the young was made along with their weights. In this way I was able later, *by comparing* this information with information recorded for nestlings

of known age living under similar circumstances, to determine their age quite accurately.

In order to reduce the danger of interfering with nesting activity by my presence in the tree on nest inspections prior to the time of hatching, a mirror was attached to the end of a six foot pole in such a way that the contents of the nests could be inspected from the ground. This also speeded up nest inspections and at the same time reduced the disturbing element to a minimum.

The problem of weighing the young in high nests without the convenience of a bird-tower was partially solved by the use of a set of pocket field-balances which could be easily taken up into the tree and used at the nest side. This speeded up weighing and reduced the danger of injuring the young while carrying them from the nest to the ground and back again.

Faecal sacs alone were found to weigh from one-tenth of a gram to two grams. Sometimes the faecal sac is left in the nest and other times it is retained. This field balance was accurate to one-tenth of a gram. Therefore, because of this variation in the time of disposal of faecal sacs it is quite obvious that weights could be as accurately determined on this balance as they could be on any balance.

A ladder, although inconvenient, was used to get to

Table I

Nest No.	Location of Nest	Position in Tree	On most open side of tree?	Approximate date incubation began	Number of eggs when incubation began	Number of Eggs Hatched	Number of Young to leave nest normally	Date nest activity stopped why?	Dry wt. of nest. Grams	General Composition of the nest	Maximum outside depth of Nest	Maximum outside diameter	Indications of Cowbird	Miscellaneous.
I	100 feet north west of Station Saw mill in white pine tree	30' from ground. 4' from trunk 9' from top.	Yes	June 19	5	2 July 1st	0 2 developed	July 8 young dead nest.					no.	nest so high w/o. of nestlings were made in the tree.
II	South East corner of baseball field in white pine tree	21' up 8' out 28' down	No.	June 17	5	2 June 28	2	July 11 young left nest					no.	Branch lowered 6' so nest could be reached.
III	Between faculty Cabin, No. 36 and beach in Oak tree	10' up 3" out 20' down	Yes	June 19	5	5	0 3 developed	July 7 3 young dead in nest.					no.	One nestling died in nest July 3rd. and another July 4th. leaving 3 for rest of time.
IV	In front of Cabin No. 12 on East State Street in a Maple	9' up 8' out 25' down	Yes	June 24	5	4 July 5	3	July 21 young left nest					no.	Youngest one died July 8th.
V	30 feet west of old flagpole in Oak tree	8' up 12' out 35' down	Yes	June 19	5	July 1st 4	3	July 17 all flew from nest					no.	All left nest July 13 but I put them back where they stayed until 17 when all flew over 200' on first flight.
VI	Between Cabin 12 East State & beach in oak tree	8' up 8' out 20' down.	Yes	June 16	5	4 June 27	3 4 developed	July 14 young left nest					no.	one young disappeared from nest 12 days before others left.
VII	300 feet south of water tank in maple tree	8 1/2' up 1' out 4' down	Yes	June 25	5	5 July 6	0 4 developed	July 15 lost young					no.	3 young disappeared July 14 leaving one to go next day.
VIII	In Orchard along highway 2 1/2 miles east of station in Maple tree	eight feet up three feet out from trunk 20 feet down from top.	No.	June 18	5	5 June 29	2 4 developed	July 14 took only 1 young nestling took one captive 14th.					no.	one left nest 11th. one died in " 11th. one left normally 14th. took one captive 14th.
IX	In front of Cabin No. East State in white pine tree	10' up 2" out 3' down	Yes	June 21	5	5 July 2	5	July 17 last one left nest					no.	1 escaped July 13 3 " July 15 1 stayed till July 17
X	Between first camping spot and beach in trailer area in white pine tree	8' up 4' out 40' down.	Yes	June 22	5	5 July 24	5	July 17 all left nest.					no.	All flew at once when I approached tree and landed in trees as far as they could away.
XI	Sand hills 2 1/2 miles West of Station in an Elm tree	8' up 1' out 10' down	Yes	June 26	5	3 July 7	0 3 developed	July 11 all dead in nest.					no.	Male experimentally removed from nest. Female deserted.
XII	Cross Roads Entrance to Station grounds in a Maple	11' up 3' out 18' down	Yes	July 1	5	5 July 11 & 12	0 5 developed	July 16 all dead in foster nest.					no.	Male experimentally removed. Female deserted. Young placed in another nest where young were present.

Table 2

Nest No	Location of Nest	Position in Tree	On Most Open Side of Tree?	Approximate date incubation began	Number of Eggs in Nest	Number of Eggs Hatched	Number of Young in Nest	Date Nest Activity Stopped. Why?	Dry wt. of nest gms	Maximum Outside Depth	Maximum Outside Diameter	General Condition of Nest	Miscellaneous Notes
XIII	East of High school Deers House in Birch	30' up 10' down	Yes NE	?	?	?	?	?					Nest inaccessible but female incubating July 1st. Too high to reach in woods. Three eggs laid on July 3rd & 4th in same place in proximity. Eggs still at there Aug 10
XIV	Faculty Garage in Red Pine	30' up 3' out	Yes S	6/12	6/23	0	0	7/8 deserted					Two cowbird eggs were placed in the nest July 1st. It was worms deserted generally one left nest July 5
XV	Just West First Pine Oak on East Base Line Rd. in a White Elm	4' up 2' down	Yes NE	6/9	6/20	0	0	7/1 deserted					Student set up blind close to nest & female didn't return.
XVI	In front of Hospital in White Pine	12' up 2' down	Yes NW	6/10	?	3	3	7/7 Young left					
XVII	Upper Pine across road in Maple	4' up 1' out	No. N	6/27	?	0	0	7/1 deserted					On July 1st female was on nest with one cowbird egg in it. She was seen with full set of eggs deserted in no apparent reason
XVIII	one half mile west of station in Oak tree	14' up 13' down	Yes NE	didn't	7/1	0	0	7/2 deserted					
XIX	Garage side of Cabin East Side in Maple	11' up 17' up	Yes S	6/22	5	0	0	7/10 deserted					Young nearly full grown out both days in nest & greatly quit Oct 1
XX	Faculty Garage in Oak In corner, just west of road 7/2 mile East of Station in Maple	9' up from ground, 9' out from trunk	No. NE	6/27	5/1	7/10	0	7/11 Empty of Eggs of E. stricklandi					Some predators cleared nest out without injuring nest
XXI	In Orchard East Side of Road 2 1/2 mile East of Station in Maple	10' up from ground, 1' out from trunk	No. E	7/1	1	0	0	7/20 deserted					Nest deserted from July 2nd until July 6 the single egg incubated for 4 days
XXII	Back of Station Gas House Back Side in Maple	3' up 5' out	Yes W	?	?	?	?	?					Nest inaccessible as too high to climb to.
XXIII	Garage Cabin Aft in Maple in Maple tree	1' up 2' down	Yes S	6/28	5	0	0	7/3 deserted					Probably deserted because of the queen inspection by <i>Manulius</i> accompanied King carrying nest was removed by service given before hatched
XXIV	Front of Garage in Oak	9' up 15' down	Yes E	6/29	3	0	0	7/2 deserted					Nest inaccessible as too high & too far out on limb. Nest coming to it was just from the tree
XXV	In front of Jurisdiction Lab in Red Pine tree	45' up 10' down	No. E	?	?	?	?	?					Nest was deserted July 2nd in 1st day on any no eggs. Subsequently returned to nest started incubating. No sign of it was ever seen. Found just no young were leaving.
XXVI	Parking Lot of Upper Elm Highway 5 mile West in a Maple	1' up 1' down	No. NW	7/10	5	0	0	7/24 deserted					
XXVII	One eighth mile West of one quarter mile East of Station in Maple	11' up 3' out	Yes E	?	?	?	?	7/10 vacated					
XXVIII	One fourth mile West of Station in Oak tree	8' up 25' down	Yes NW	?	5	0	0	7/24 deserted					It was 3 days from the time the eggs were laid to 5th. All eggs were deserted with a hole in the end
XXIX	Garage in front of Cabin S in Maple tree	10' up 6' out	Yes S	?	?	?	?	?					Nest inaccessible.
XXX	Front porch front entrance near the Electric power near the Electric power by water pump in front of club house in Oak	6' up 9' down	Yes S	7/12	5	0	0	7/14 deserted					Eggs were up in cage of nest July 24 indicating tree had been tampered with
XXXI	Same nest as No. 22 but on the other side of road in Maple	11' up 20' down	Yes NW	7/18	?	?	4	7/19 full grown Aug 11					Swarm being constructed beginning in July 18 & continuing to July 8 next August
XXXII	Near Camp Road at Station entrance in Red Pine	37' up 21' out	Yes W	7/20	3	0	0	7/23 NOT incubated					Full young from nest in July 23 as believed it was a nest but was not. This nest started same day nest 22 was deserted across the road.
XXXIII	Across Road from boat dock in Birch tree	25' up 10' down	Yes N	7/8	?	4	4	?					Nest out of reach and nearly see 4 young clear cage of nest
XXXIV	Top of tower in a Spruce tree	6' up 2' out	Yes W	7/12	5	4	4	Aug 12 probably					Nest photographed by Edward Boren with young being fed.
XXXV	Front porch front entrance near the Electric power near the Electric power by water pump in front of club house in Oak	13' up 12' down	Yes NW	?	5	0	0	Aug 11 deserted					
XXXVI	Manville near Cabin in Maple	13' up 21' down	Yes S	?	2	0	0	Aug 8 deserted					Another case of renesting but not completed (nest old nest occupied again by M)
XXXVII	Forestry Building in Maple	20' up 21' down	Yes N	?	9	4	0	Aug 3 all dead just					
XXXVIII	Upper Pine in Maple	3' up 23' down	Yes E	?	?	?	?	July 2					
XXXIX	Side Tower yard in Maple	15' up 2' out	Yes SW	?	?	?	?	Young left					
XL	1/2 mile West of Station in Maple on South Side of Camp in Birch	33' up 11' out	Yes NE	?	?	4	4	Aug 16 probably					

the nests whenever possible instead of climbing the trees thus reducing the disturbances around the nest as much as possible.

Weights of individual nestling's were taken as nearly the same time of day each day as possible and then the average weight for each nest computed and plotted as shown in Charts 2,3,4 and 5.

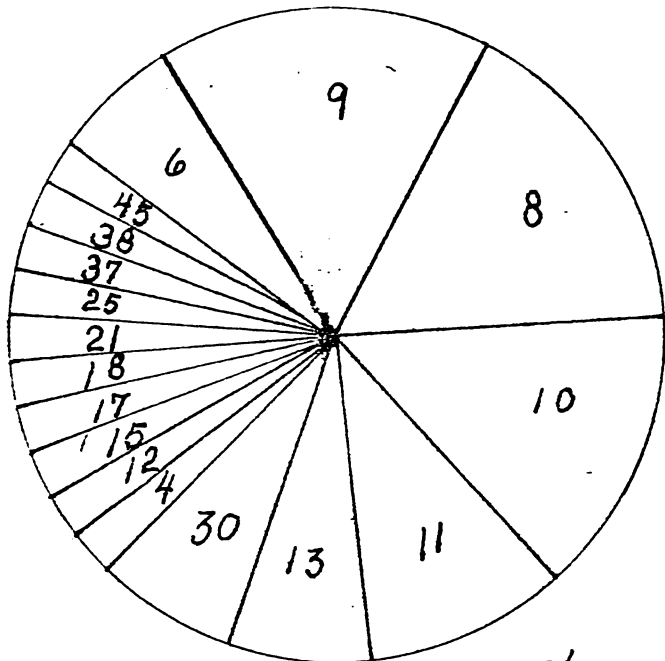
THE NATURAL ENVIRONMENTAL VARIATIONS

Some of the natural variations found in nestling environment seemed quite wide.

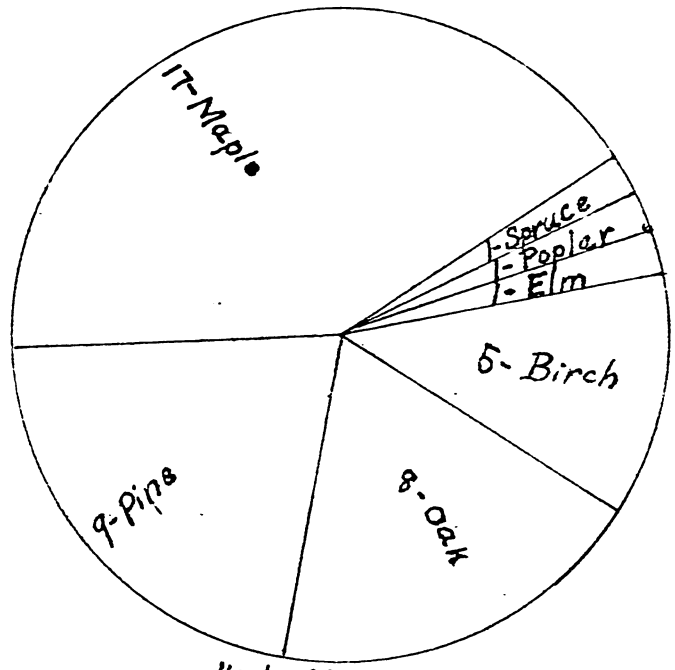
The number of young to develop in each of the 12 nests most closely observed and covered by Table 1 varied as follows: two young developed in two of the nests, three young developed in four of the nests, four young developed in three of the nests and five young developed in three of the nests.

The elevations of the nests varied extremely. One nest was forty-five feet from the ground and another only four feet while most of the nests were from eight to ten feet up as shown by Tables 1 and 2 and Chart 1.

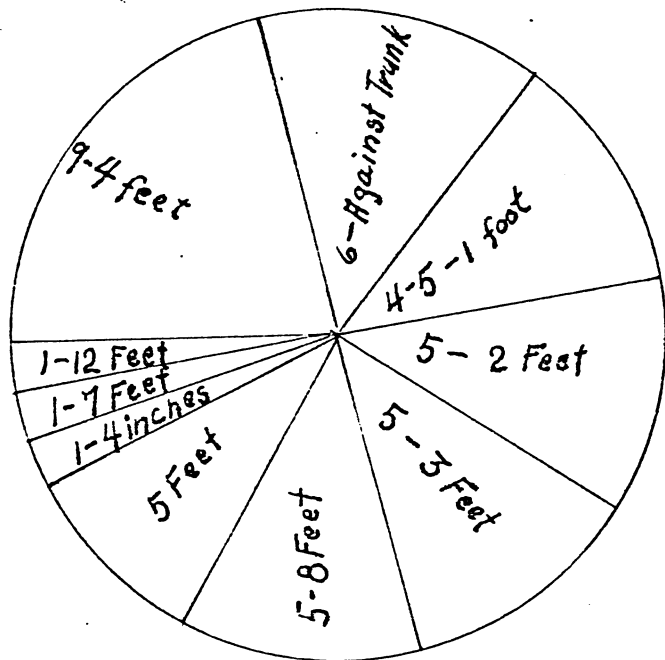
The species of trees where nest were located varied considerably being distributed among eight species of trees. This should effect the amount of light on the nest because of the different shading properties of the different trees. Nests were found in 17 maples (Acer rubrum and saccharum); eight Red Oaks (Quercus rubra), nine pines



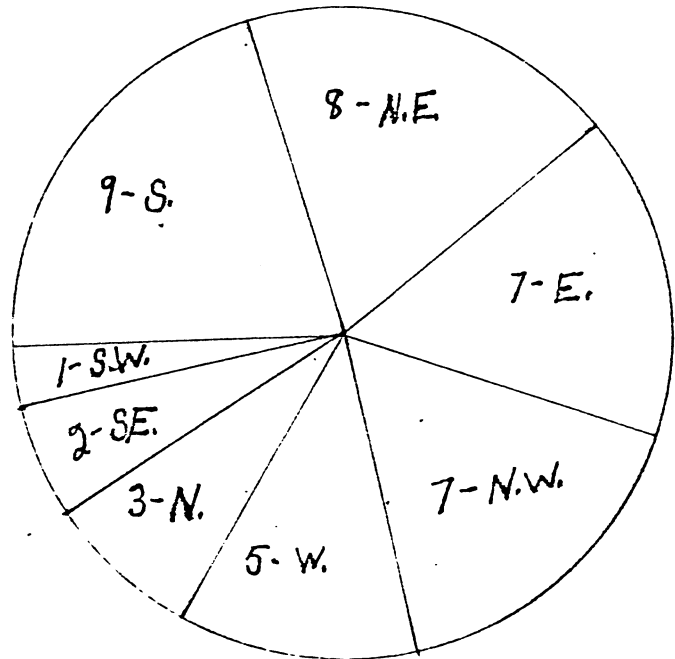
Distance in feet from ground



Kind of tree



Distance out from trunk



Direction from trunk

Variations in Nest Locations
of the 42 Nests Studied

Chart 1

(Pinus resinosa and strobis), five birch (Betula alba) one elm (Ulmus americanus), one American aspen (Populus tremuloides) and one White Spruce (Picea canadensis).

Their distribution among these trees is shown on Chart 1.

The nest appeared in the tree from twelve feet out on a limb to a position against the trunk as shown in Tables 1 and 2 and Chart 1.

The side of the tree on which the nest was located varied as shown in Chart 1. The nest being on one side of the tree about as often as on another.

The distribution of trees containing nest with reference to human activities as shown on Map 1, varied from a nest over the most used water faucet on the station grounds (Number XXXI) to a nest over a mile back in the forest west of the station away from all habitation.

The times of month in which the incubation began in the case of twenty-nine of the nests as shown in Tables 1 and 2 were fairly evenly distributed from the second week in June (June 9) until the fourth week in July (July 20).

ARTIFICIAL VARIATIONS

In the case of one nest (Number II) which was located so high in the tree and so far out on the branch that it couldn't be reached, the branch was cut off and lowered some five feet and moved in toward the trunk an equal distance to where it could be reached.

Two nests (Numbers 11 and 12) had the male parents removed from feeding activity when the young were two days old leaving the female to do all of the feeding and brooding. During the first two days of brooding the female stay at the nest almost continuously making it difficult to capture a male at the nest without capturing the female first and exciting her in this way making her desertion more probable. For this reason the males were collected after they left the nest some distance.

✓ THE EFFECT OF THESE VARIATIONS ON GROWTH RATE

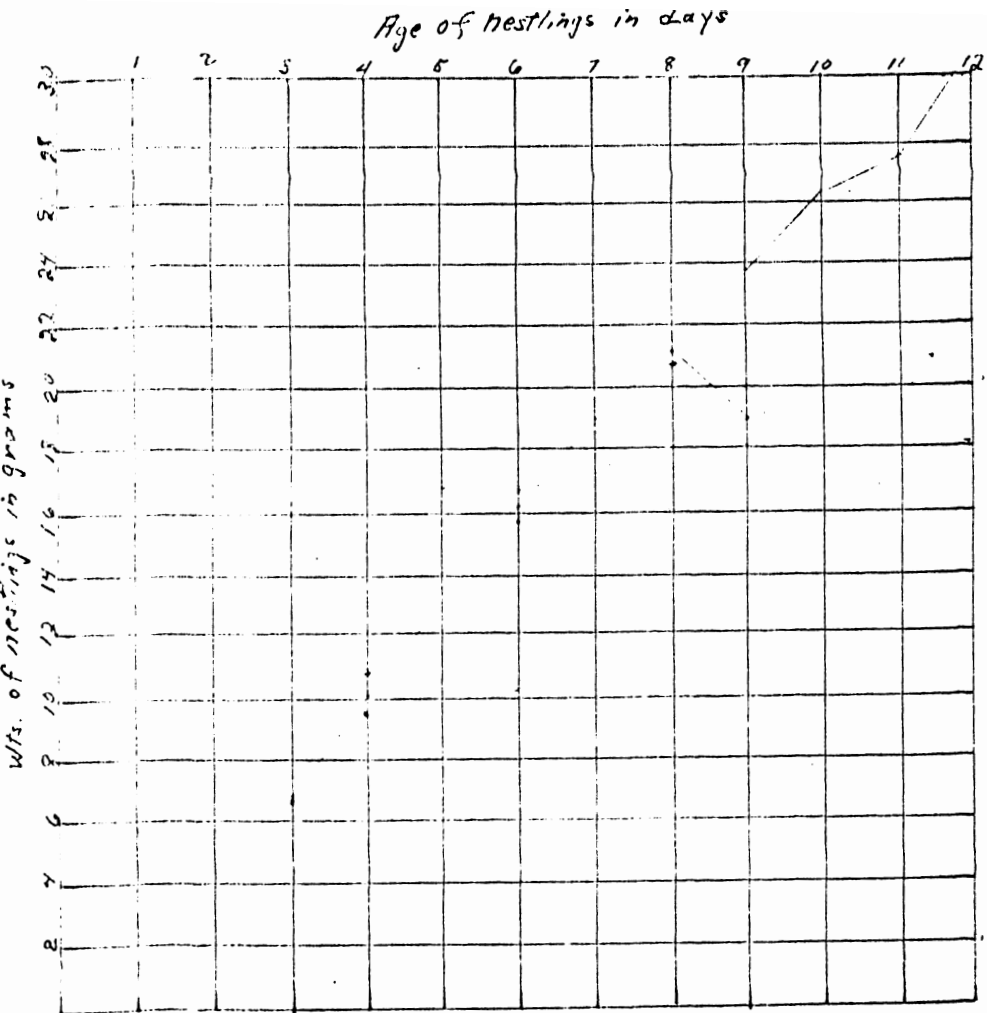
The effects of these greatly varying environmental conditions on the nestling's as shown by Charts 2,3,4, and 5 were almost negligible.

The number of young in the nest as indicated on Chart 6 made no appreciable difference in the growth rate. Whether there were two, three, four or five nestling's raised in the nest the growth rate seemed to be constant i.e. on the third day after hatching the young from the nests with five weighed just as much as did the young from the nests with only three.

The kind of tree, position in tree and varying human activity around the nest likewise seemed to make no difference in the rate of development.

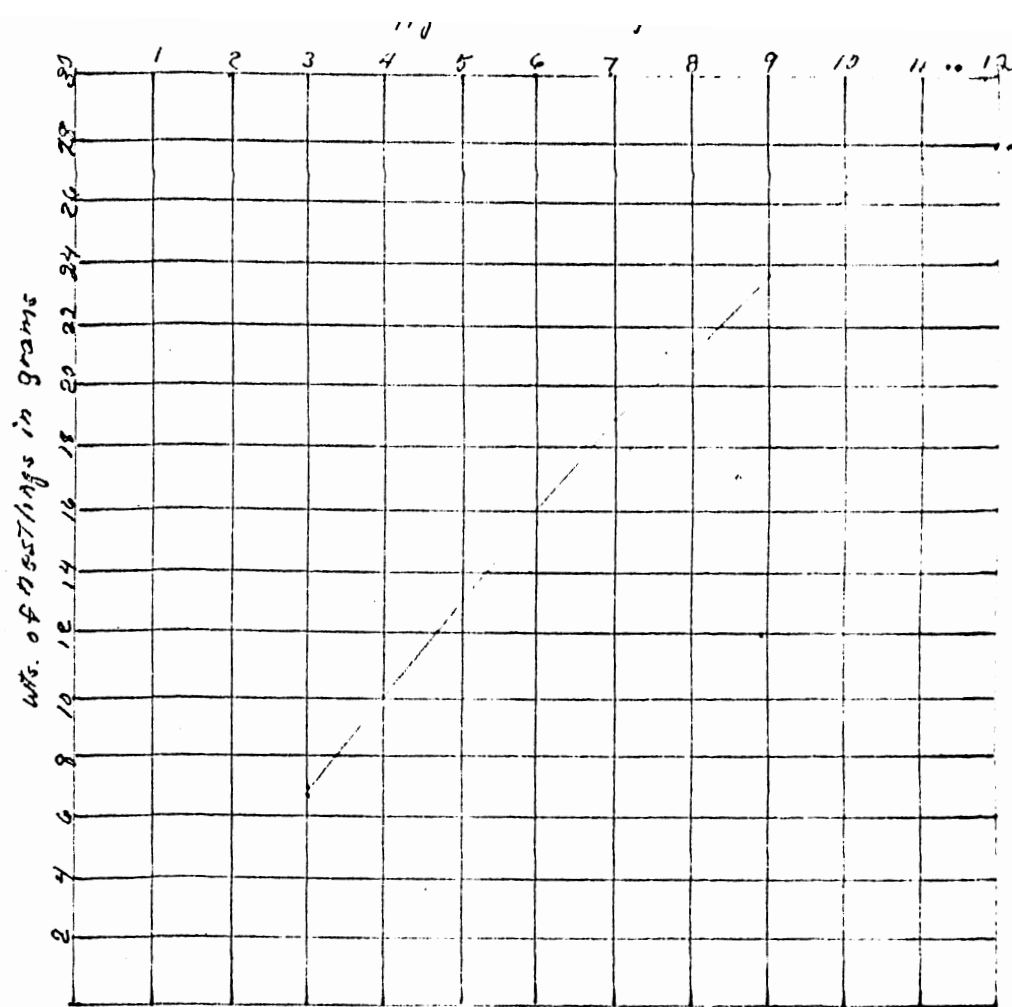
The young in the lowered nest (Nest II) continued to thrive at the normal rate.

The only factor seeming to influence the development noticeably was the removal of the male parents as shown



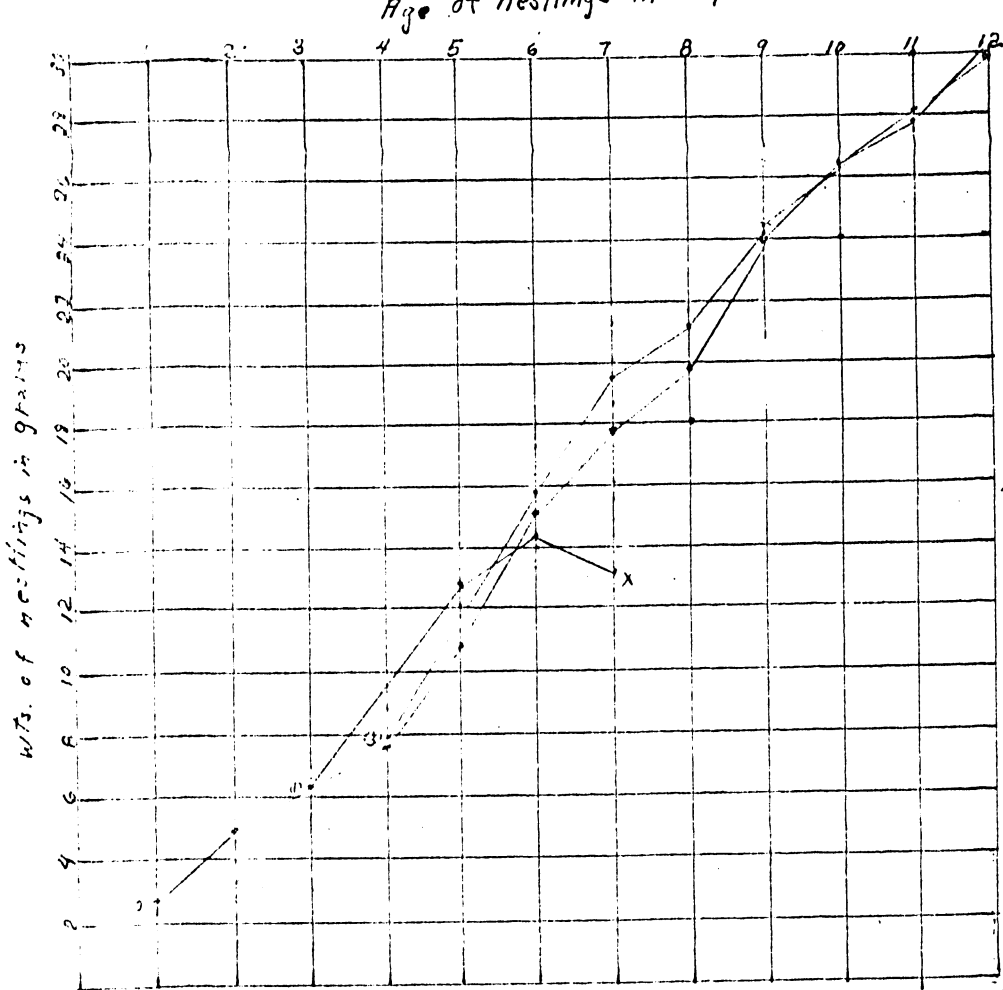
Nests I and II

Growth rate curves for the two nests
 containing only two young per nest.
 The average growth for each nest is
 the figure recorded in every case.



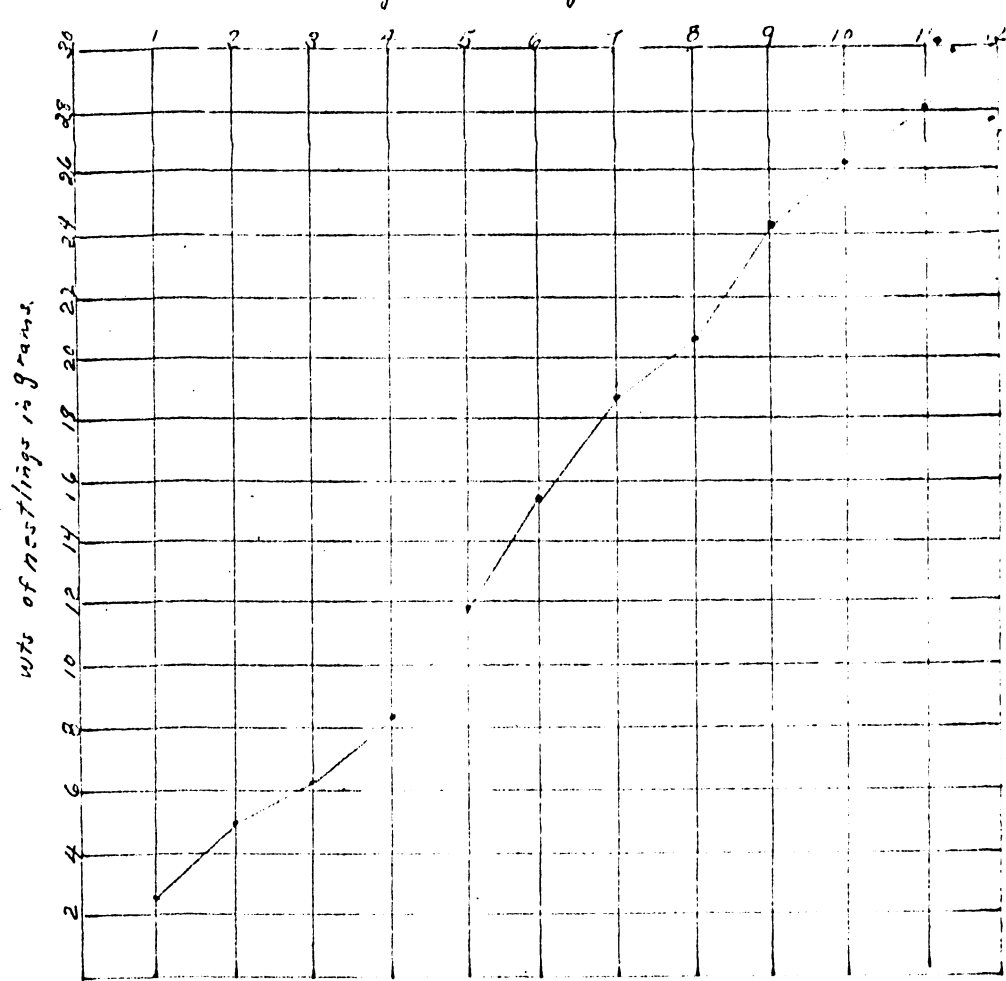
Average growth rate curves for Nests I and II
 with 2 in nest.

Chart 2



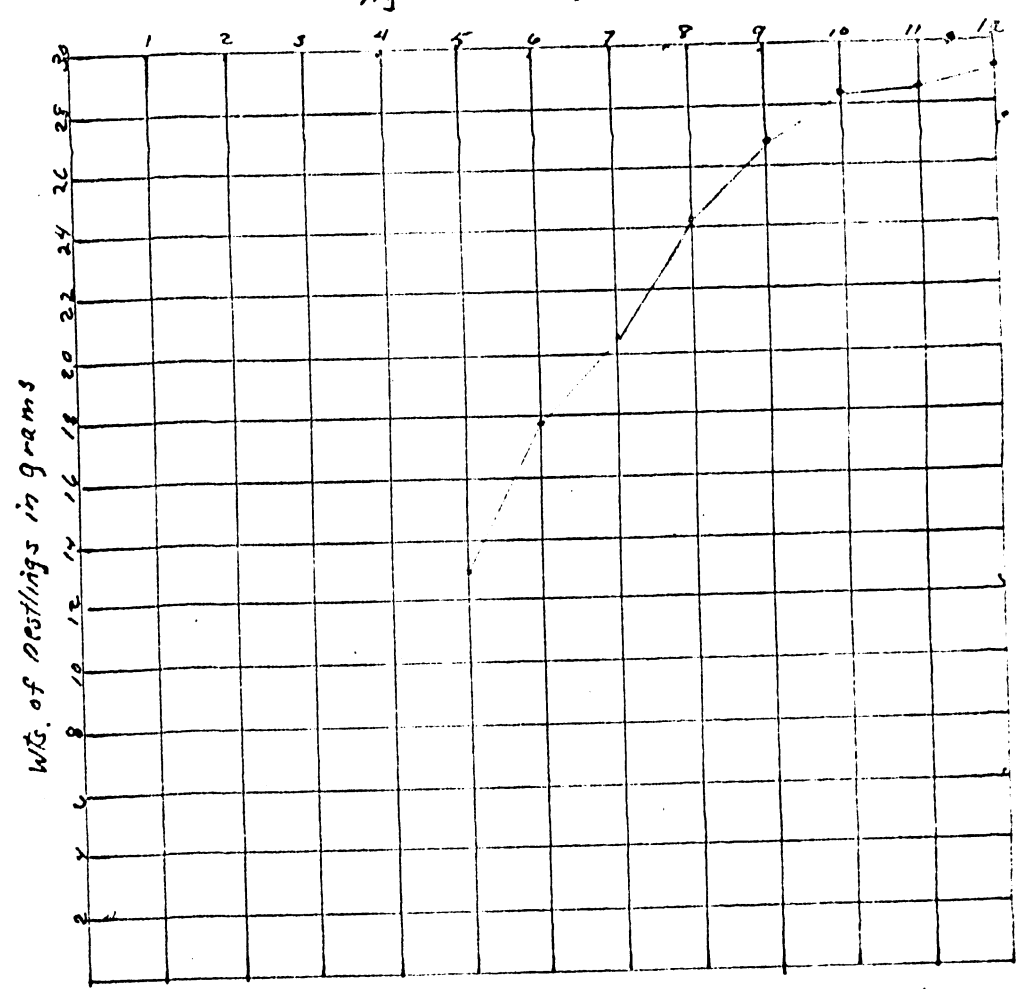
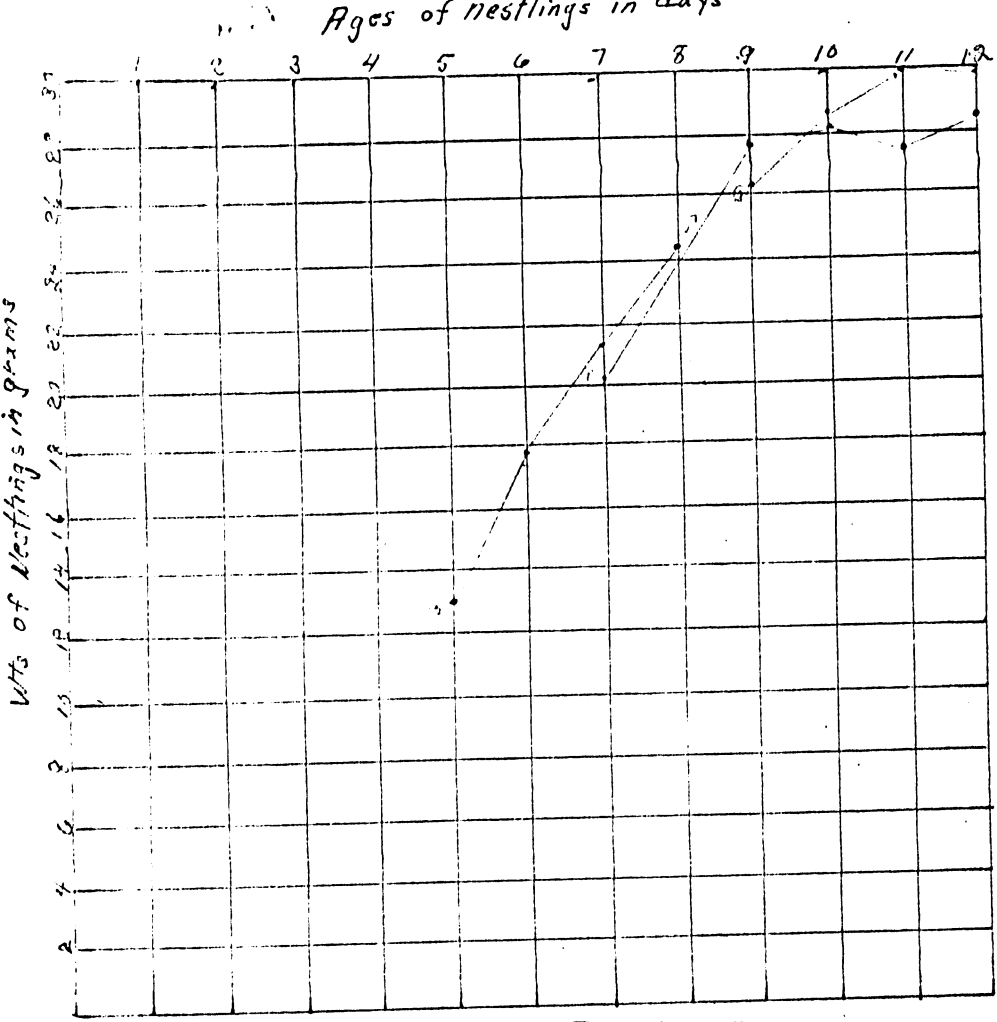
Nests III - IV and V

Growth rate curves for the three nests containing three nestlings per nest. The average weight for each nest each day is the figure recorded.



Average growth rate curve for nests III-IV-V with 3 in nest.

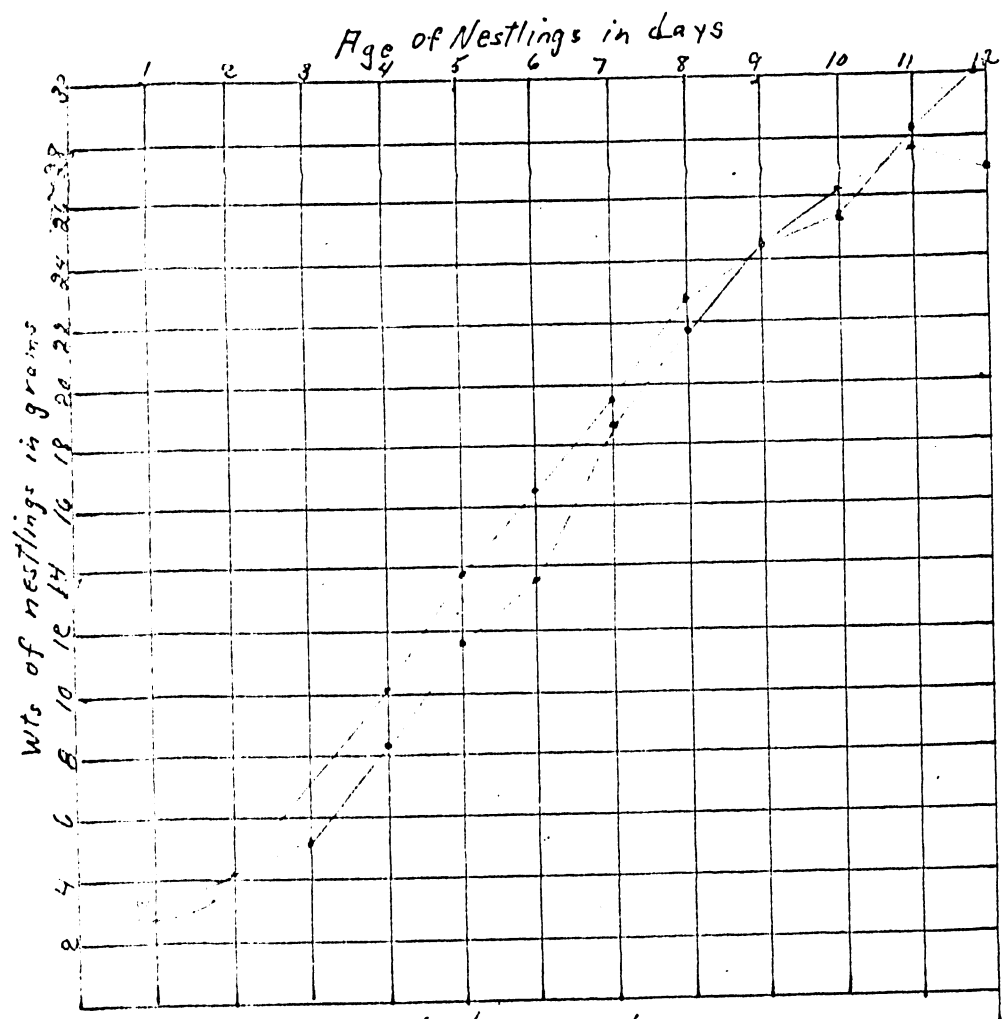
Chart 3



Nests VI - VII and VIII
 Growth rate curves for the three nests
 containing four nestlings per nest.
 The average weight for each nest each
 day is the figure recorded.

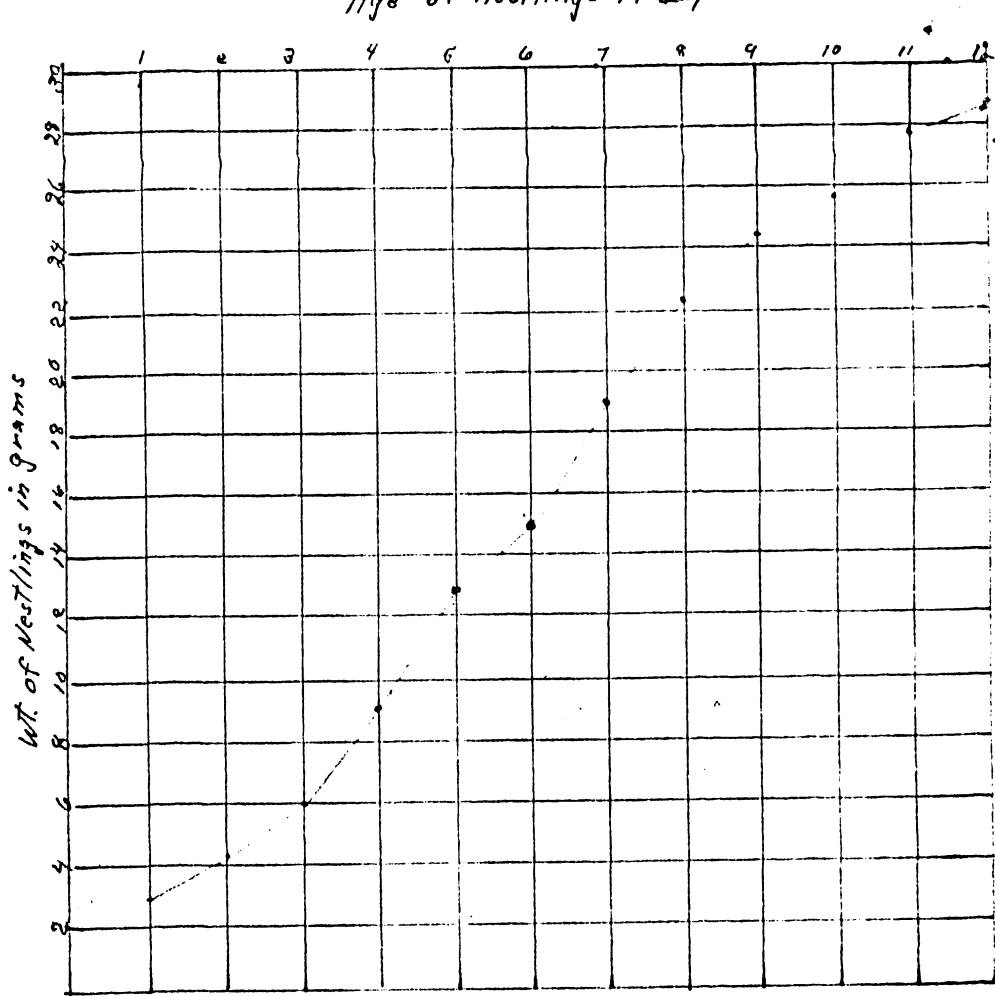
Average growth rate curve for nests
VI VII and VIII with 4 in nest.

Chart 4



Nests IX and X

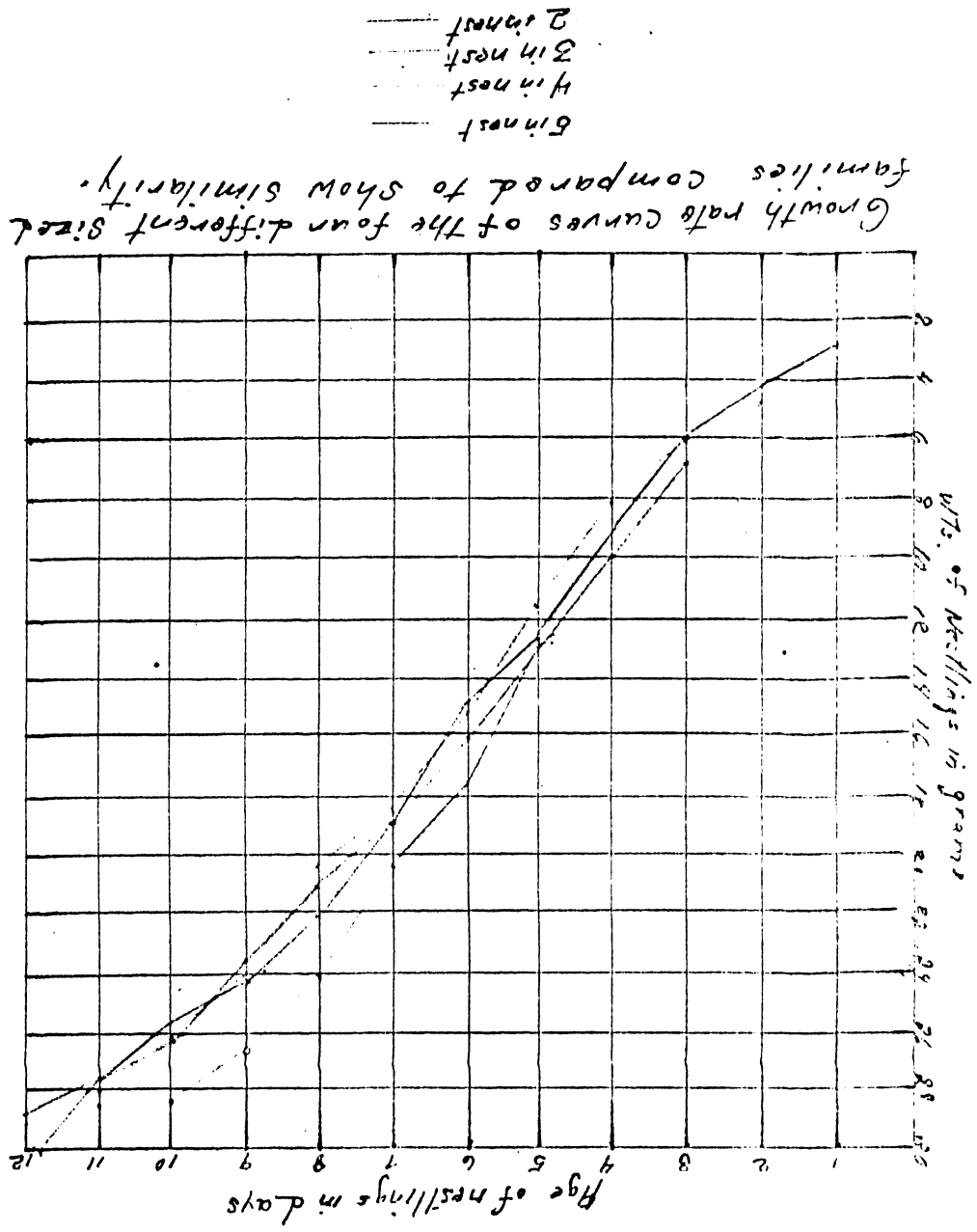
Growth rate curves for the two nests containing five nestlings per nest. The average weight for each nest each day is the figure recorded.



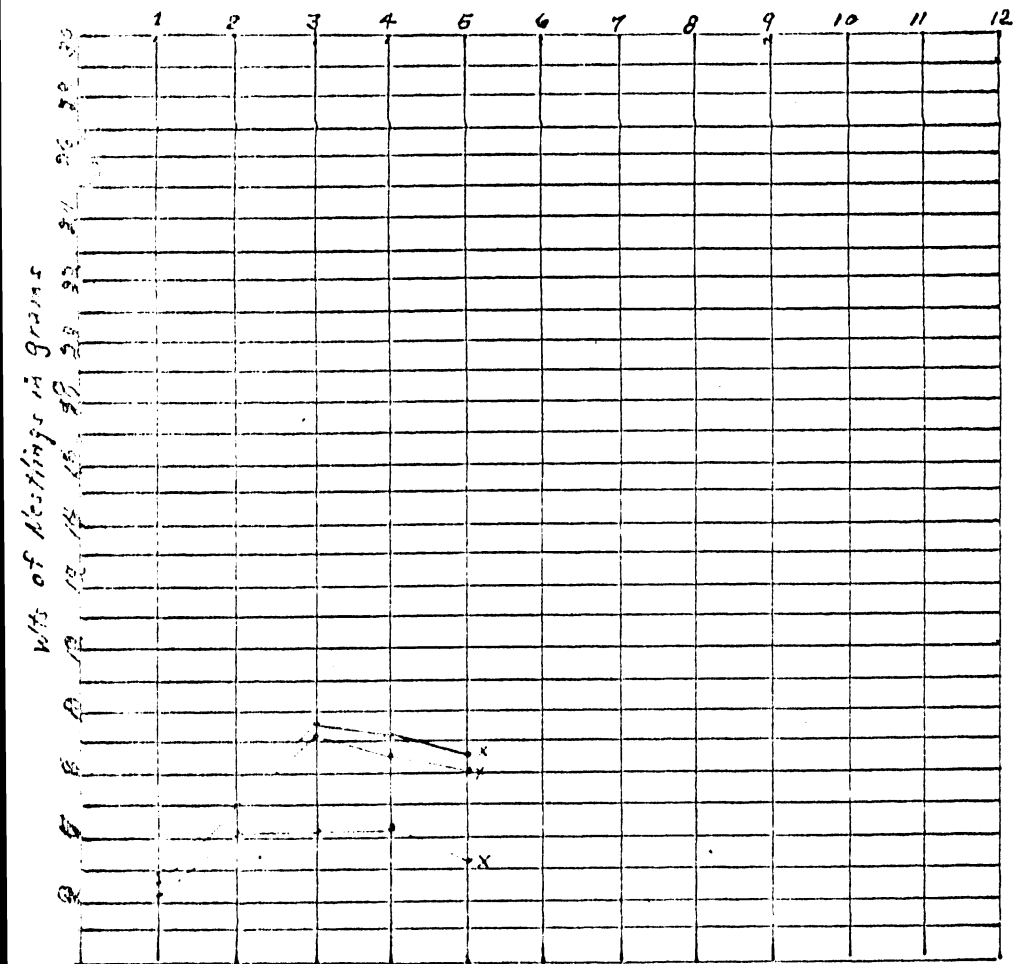
Average growth rate curve for nests IX and X with 5 in nest.

Chart 5

Chart 6

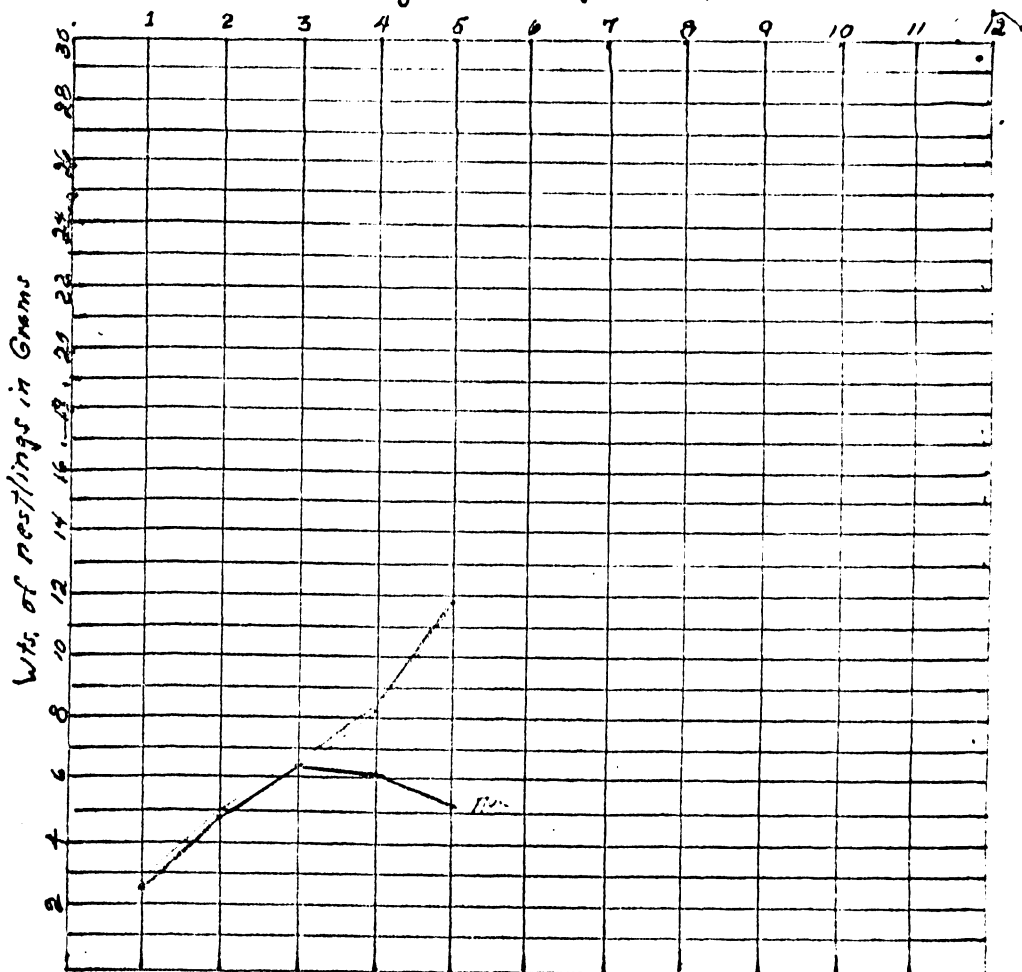


Age of Nestlings in days



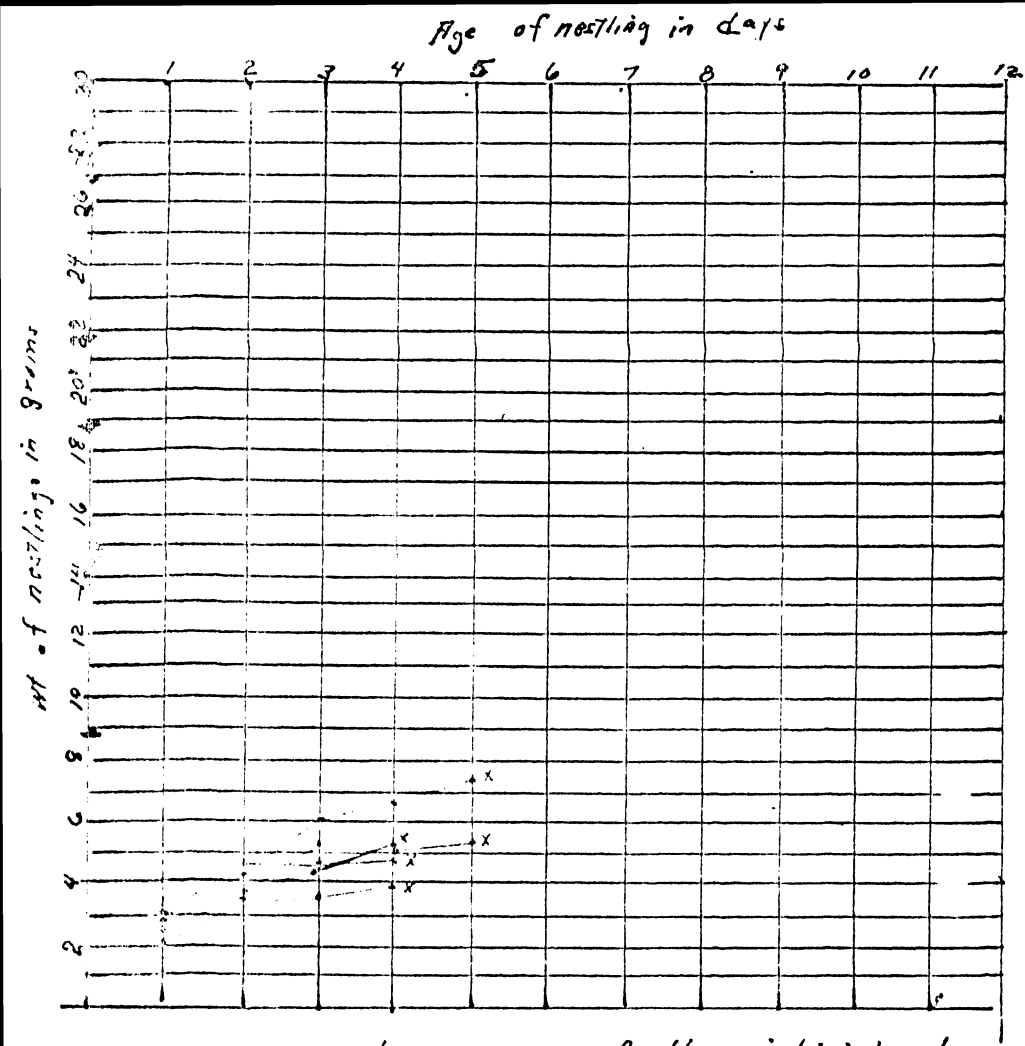
Growth rate curves of the individuals in nest XI showing the effect of removing the male the second day of development

Age of nestlings in days

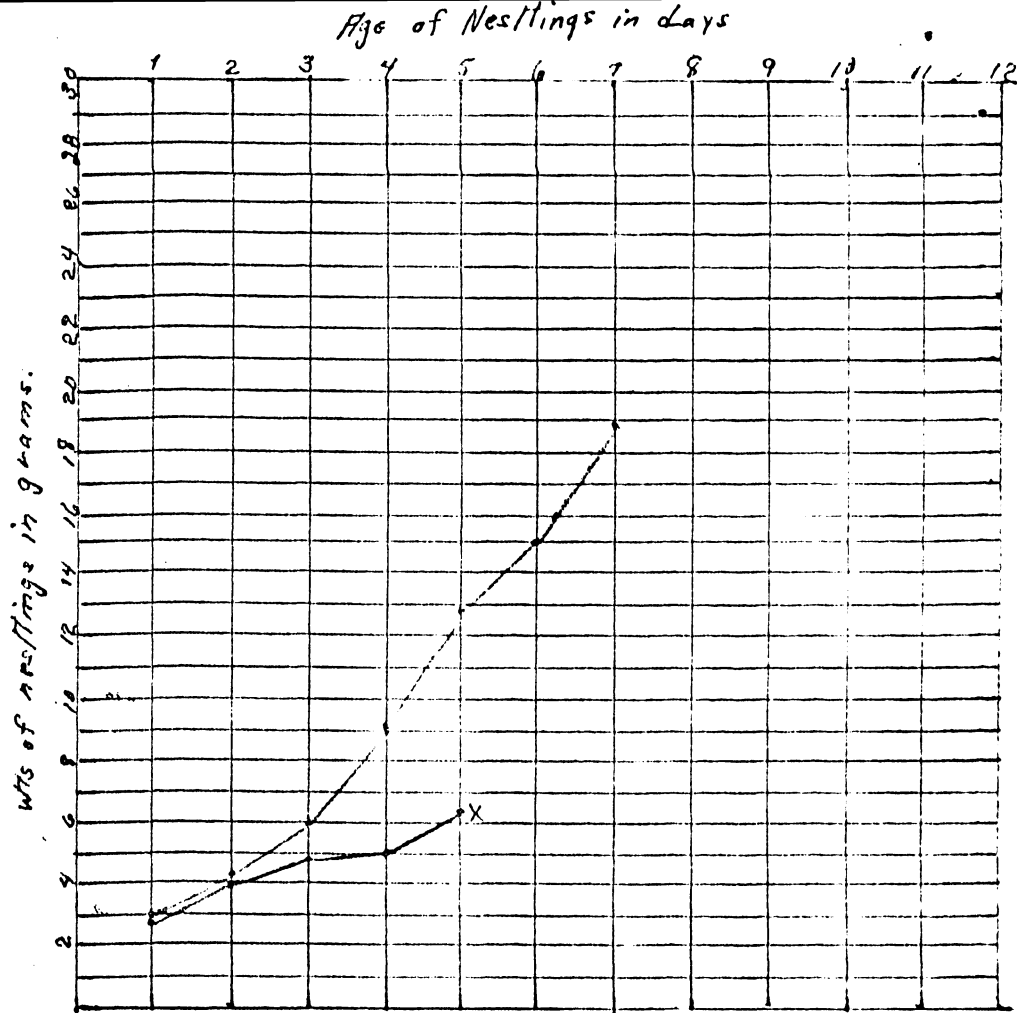


The average growth curve of nest XI compared to a normal nestling nest.
 Experimental —
 Normal —

Chart 7



Growth rate curves of the individuals in nest XIII showing the effect of removing the male the second day of development.



The average growth curve of nest XII compared to a normal 5 nestling nest.

Experimental ———
Normal - - - - -

Chart 8

in Charts 7 and 8. Here, as mentioned earlier the male birds were removed after the second day of brooding and in each case the females deserted two days later. As the charts indicate in each case the growth rate was almost normal the first day. This indicated that the females were capable of supplying the demands of the nest if necessary. The second day the growth decreased rather abruptly and the third day the young, having been deserted, lost some weight before dying.

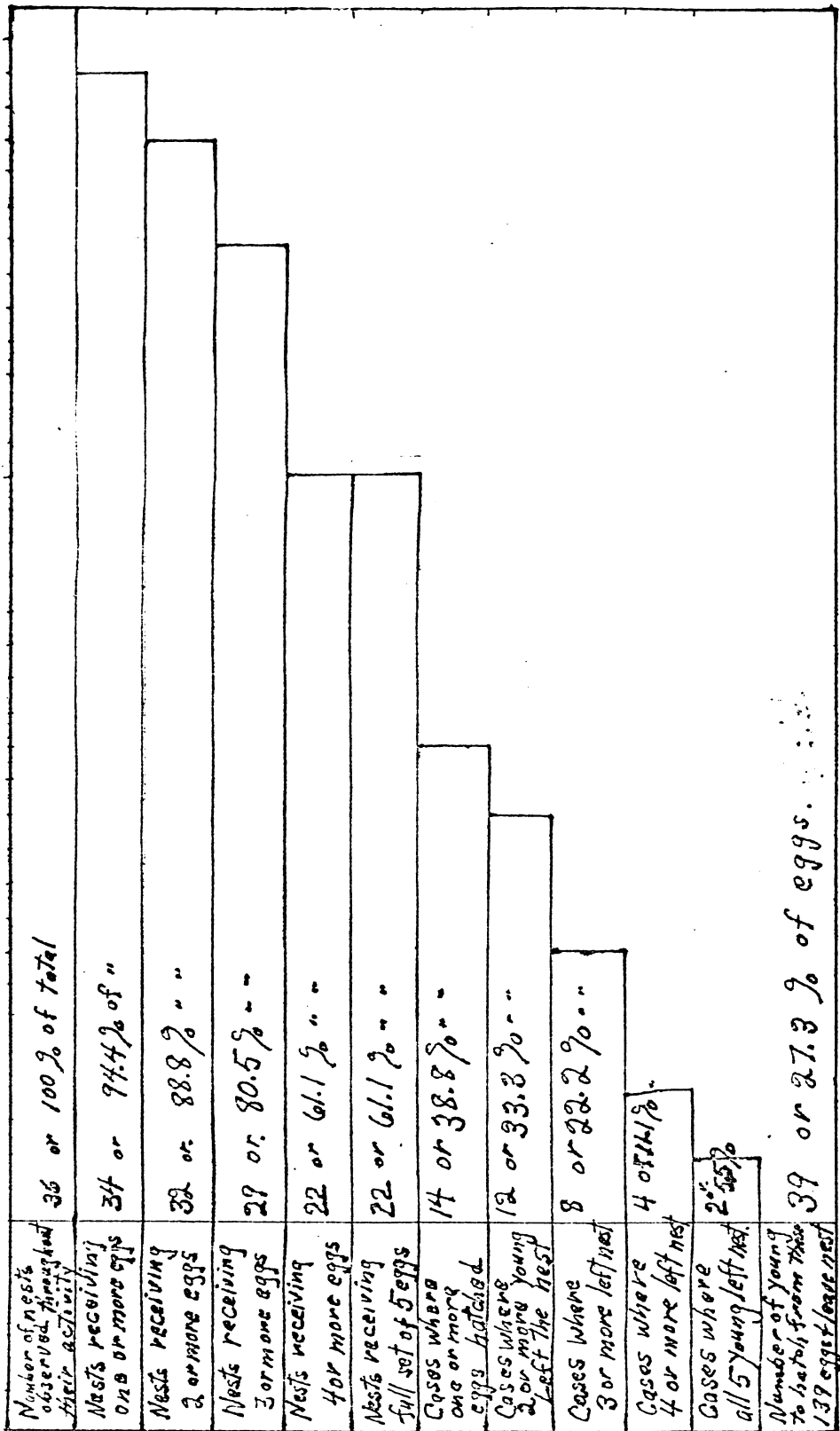
The time of month at which incubation began covered over seven weeks and necessarily involved weather variations. However the growth rates seemed to be independent of these variations.

A careful study of Chart 6 shows the complete independence of the growth rate to all natural and nearly all artificial variations in environment.

THE NESTING SUCCESS OF THE CEDAR WAXWING

The Cedar Waxwing is one of the commonest birds seen in the Douglas Lake region. In 1941 the frequency of occurrence of this bird in the station area was 100% (White 1941 manuscript). These facts would lead one to believe that the bird under consideration was a very successful breeding bird of this area. However in the nests observed during this study there was found to be an unusually high mortality.

As already mentioned there were 36 nests accessible



Record of Nesting Efficiency of 36 nests.

Chart 9

for contents observation. Of the 139 eggs laid in these nests only 39 hatched and matured. This indicates a success of 27.3% or a mortality of 72.7% among the nestlings alone. Only 38.8% of the nests observed succeeded in hatching any eggs and only 5.5% hatched all of their eggs.

The cause of this inefficiency is probably no single thing. The extremely high incidence of desertion on the part of the parents, i.e. 66.6% of the nests were deserted, would seem to indicate a high mortality rate among the parents. In seven of the 36 nests in which close observations were made young birds were left to starve in the nest. In at least three of these cases the young were not quite dead when the nest was inspected showing that the reason for desertion was not because something had killed the young. Chart 9 shows the record of nesting efficiency of these 36 nests.

Mention was made on page seven of the discovery that the females will desert if the male is destroyed. Since the male bird does not incubate or brood (Lea 1941 manuscript) it seems logical that the destruction of either bird would lead to the desertion of the nest by its mate. In other words if desertions were caused by nothing other than the death of one of the parents there should be twice as high a desertion rate as there is parental mortality rate.

MISCELLANEOUS OBSERVATIONS

Cowbird parasitism of the 36 waxwing nests inspected was confined to two nests (Nests XV and XVIII). Nest XV on July first contained two waxwing eggs and two cowbird eggs and was deserted. It had not been inspected since its

discovery as an empty nest June 22. Nest XVIII was found occupied on July first with one cowbird egg in it. On July second the nest was found deserted.

It was noticed while weighing the young birds that in several cases the waxy red feather tips, characteristic of many adult waxwings, appeared on the seventh and eighth secondaries just as they burst from their feather tubes on about the ninth or tenth day after hatching. This may have been more common than was observed as the nesting season was partly over before the almost microscopic tips were noticed for the first time. It was also noticed that ~~an~~ a captive nestling that had developed these waxy tips while in the nest, lost them when put in a small cage where the wings were occasionally abraded by the wire screen.

Two nests were definitely observed to be deserted and reoccupied at a later date. A third nest was believed to be deserted and was found reoccupied later. In the first case, in Nest XXVII, which is the questionable case, the bird was found on a completed nest containing no eggs on July sixth. On July seventh, eighth, and ninth respectively there was no sign of activity about the nest. However on July 10 the bird was found back on the nest with one egg. This could very possibly have been a case of delayed laying. The full set of five eggs was completed and then the nest found deserted again on July 24. It had probably been deserted for some time before this but was merely not checked until the date mentioned.

The second nest (Number XXI) to illustrate this condition was inspected July 10 and found to contain four young, just

hatched, and one egg. On inspection July 11 the nest was deserted and empty. On July 14 the nest was accidentally noticed to be inhabited again and inspection showed it to have one ~~warm~~ egg again. On July 15 the bird was still on the nest but she deserted the following day.

In the third instance (NestXXIV) the nest was discovered June 28, with a full set of five eggs and the female on the nest. On June 29, the nest was apparently deserted as there was no activity about the nest and the eggs felt cold. No farther evidence of occupation was observed so on July second the eggs were removed from the nest as specimens. However on July 11, the nest was reported as occupied again and inspection showed it to contain another set of eggs. On July 12, it was found deserted and uninjured as it remained until its final inspection on August fourth.

Whether these reoccupations were by the original occupants or different ones is not known as none of the birds were banded.

SUMMARY

1. Although the number of eggs in all of the completed sets was found to be five, the number of nestlings to develop from these eggs varied from two to five,
2. The kind of tree chosen as a nesting site varied considerably being somewhat more commonly found in maple, pine, and oak respectively.
3. The position of the nest in the tree with reference to distance from ground, distance out on the limb and the side of the tree, it was located varied extremely.

4. The date on which incubation began varied from June ninth to July 20, a period of six weeks involving considerable weather variations.

5. When the male is removed from feeding activities the female will continue to feed for two days and keep the young alive but will desert after the expiration of the second day.

6. None of the natural environmental variations effect the growth rates of the nestlings noticeably.

7. There is a high mortality rate among the nestlings and probably among the adults as judged by the number of desertions.

8. Cedar Waxwing nests parasitized by Cowbirds are deserted.

9. The waxy red ^{feather} tips frequently appear on the nestling's seventh and eighth secondaries on about the ninth or tenth day after hatching.

10. Nests are sometimes deserted and reoccupied either by the original owners or by some other waxwing.

CONCLUSION

This study seems to indicate that the rate of development of the young does not depend merely upon the ability of the adult to secure food but rather upon some incentive for the securing of food.

The food securing incentive might well be of two kinds, either psychological or physiological. In the first case the parents may get their incentive from the satisfaction they get out of seeing the food consumed, i.e. the more food consumed the greater the desire to supply it.

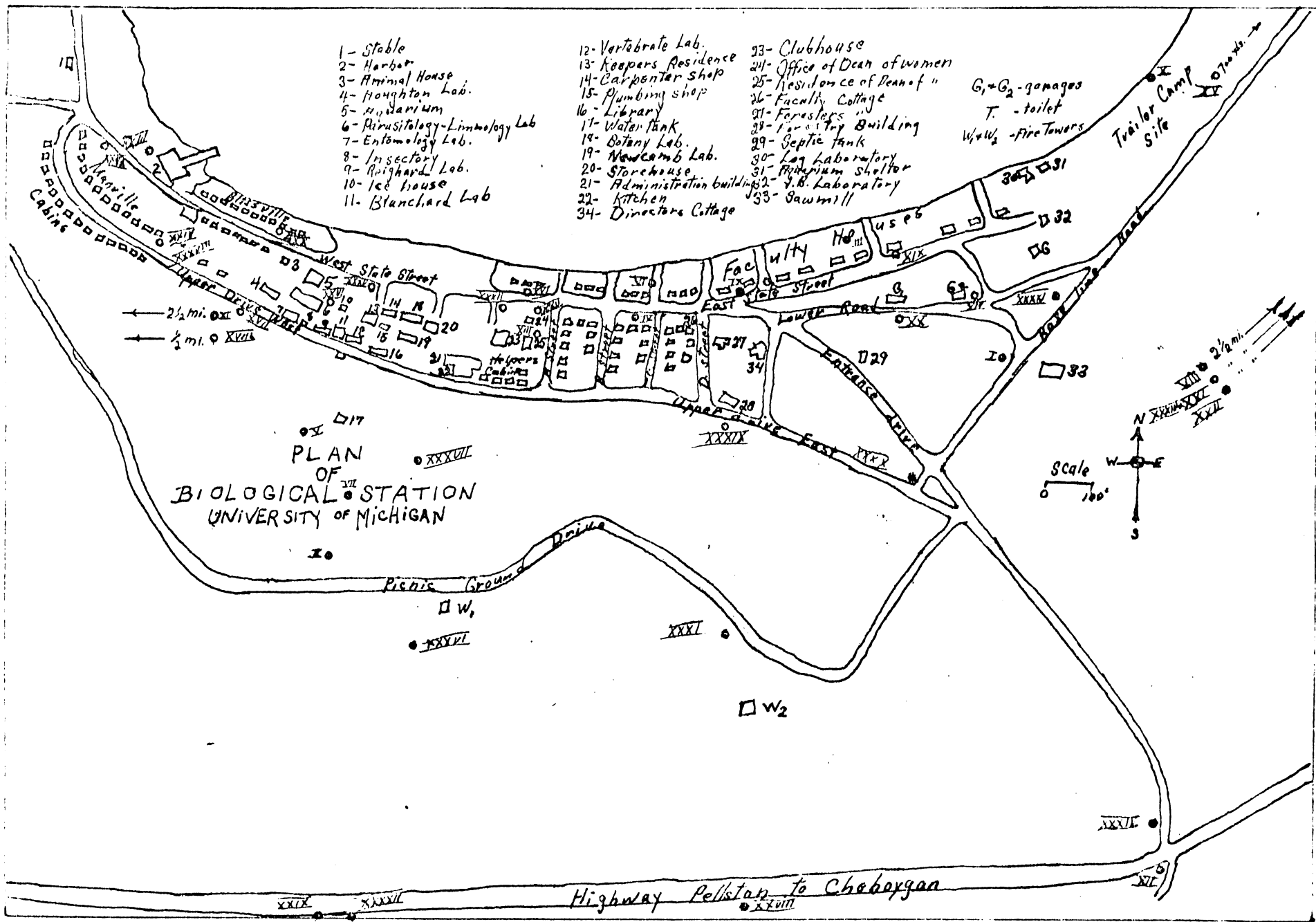
In the second case, there might well be a hormone given off by the nestling in its faecal material which, when consumed by the parent acts as a food getting stimulant. In this way the more young in the nest, would produce more hormone and as a result receive more food.

These two possibilities could well be checked in farther experiments, possibly by testing the faecal material chemically, possibly by artificially either placing faecal sacs from other nests in conspicuous places about an experimental nest or by removing artificially the faecal sacs from the young frequently during the absence of the adults and observe the effects on feeding rate and growth rate as compared to the normal situation.

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Map I



Map of the Main Nesting Area
With Nests Indicated I-XXXVII

- Nests from which comparative wts. were taken
- Nests observed but not usable for weighing.

The Store is a service organization, and we shall try to assist students and faculty in every possible way.

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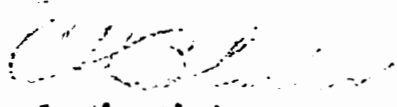
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DAILY	SUNDAY
7:15 to 9:15 A.	9:00 to 11:00 A.M.
10:05 to 11:45 A.	10:05 to 11:45 A.M.
12:35 to 2:00 P.	
3:00 to 4:45 P.	
5:00 to 6:00 P.	

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J. H. Blair