as the square of a corresponding dimension of similar cross-sections. These considerations suggest that any relation between the weight of a series of birds and the sizes of the tarsi might be examined by comparing the respective cube roots of the weights and some linear dimension of the tarsal cross-sections. For the latter I chose the square root of the product of the two mean diameters as measured. The weight used was the maximum that I could find on record. The figures for about 60 species of passerines were plotted, using weights in grams and tarsal dimensions in millimeters. If we use w as the weight^{-3} and d as the square root of the product of the tarsal diameters, the band covered by the plotted points falls between the following two straight lines:

$$w = 1.35d + 1.07$$
$$w = 1.37d + 0.21$$

It would probably be sufficiently accurate in the present state of our knowledge to use the average slope of 1.36. The relationship appears fairly satisfactory up to a weight of 70 gm. The line halfway between those given above is $w = 1.36d + 0.64$.

Three species of Picidae fall within the same band while two species of Columbidae have relatively stouter tarsi.

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WEIGHTS OF SOME CHIMNEY SWIFTS AT MEMPHIS

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During the past twenty years I have assisted Mr. Coffey in the banding of a large number of Chimney Swifts *(Chaetura pelagica)*, chiefly here in Memphis and Shelby County, Tennessee. Since, in my work as a seed analyst, I constantly use small weights, I was long conscious of appreciable variation in the weights of the swifts in the same flock and between those in the early and the late fall flocks. From 1949 thru 1955, a total of 1893 weights were taken, which varied from 16.1 to 33.5 grams, with a mean of 22.8 grams and a standard deviation

of 2.9 grams. Unless we knew, in fact, that fall weighings predominated, the last two figures would mean little more than did the weight of a single Chimney Swift (17.3) used by Earle L. Poole (1938) and pointed out by L. M. Bartlett (1952) as inadequate sampling. Bartlett weighed 72 of this species, May 28-29, 1950, at Amherst, Mass. and showed a mean of 24.9 and deviation of 4.3; from his graph we figure a deviation of 1.5 while the mean might have been 24.4. Our 31 birds of May 12, 1950, did not differ too much from these but since our results varied as to season, we cannot compare with the other two authorities he quoted: T. S. Roberts (1932) and Paul A. Stewart (1937). A third weighing at this season, one by Ralph Dexter (1957), of 119 at Kent, Ohio, May 20, 1956, gave only slightly higher results.

Chemical balances, weighing correctly to .01 gram, were used at the first ten weighings. On the remaining dates a triple-beam balance, weighing to .1 gram, was used. The birds were placed in a paper cone and the balance adjusted before each weighing. For the graphs, frequency tables were set up for one gram intervals, although the actual extremes, when shown, are to the nearest tenth. Samplings were not always as full as desired, since the weighing had to defer to banding at times, depending on the size of the flocks and the assistants present. If there was a wind, weighing was done inside or in a sheltered place; the birds being kept in a very small cage until weighed and released. The hour of the day was noted at intervals, for the weighings.

Several authorities have discussed variations in weights of birds, one of the latest papers being by Charles H. Blake (1956), who also reviews a number of previous articles on the subject. Daily variation in the Chimney Swift presumably follows a rhythm similar to other species, but retrapping of the same individuals during the day is impractical except for a few samples at nesting sites. Even then, each handling might affect the results unnaturally. We checked the loss in weight of a few individuals confined for a day, in order to estimate the effect on our results of the cumulative delay inherent in weighing, successively, the individuals of a large flock. On Sept. 20, 1953, we weighed 7 adults at 9:35 a.m., again at 1:35 and 4:35 p.m., the mean of the three weighings being 22.2, 21.2, and 20.8 grams respectively. Of interest, however, is that the reductions in individuals varied from .4 to 1.6 grams during the first period (4 hours) and .1 to .9 during the second period (3 hours), but overall only from 1.3 to 1.7. That is, the heavy losers of the first period only lost .1 to .2 grams additional in the next three hours, while the erstwhile light losers lost an additional .5 to .9 grams, approximately evening up the losses.

However, most of our work was completed by noon and we might look at some of the larger weighings for the approximate variations indicated by the means. The mean for the 176 weights on Sept. 25, 1955 was 22.6; for 82 during the first hour and a half (8:55 to 10:25 a.m.) 22.9; for 70 the next hour and a half, 22.4; and for the last 24, weighed between 12 and 1 p.m., 21.6 grams. These were summarized from still smaller periods, not differing greatly within the limits set, although after the initial half-hour, the mean increased roughly from 22.6 to 23.2. Such an increase was noted Oct. 1, 1955 (63 total—mean 22.1, 9:30 to 10:45), 22.0 to 22.6, then dropping to 21.0. The

TABLE A

A. Table of All Weighing by Date (Chimney Swift, *Chaetura pelagica*)

Date	No. Weighed	Mean	Devtn.	Min.	Max.	Remarks
		Grams				Memphis, Tenn., exc. 10-18-53
Sept. 24	35	23.2	1.6	20.3	26.8	Not incl. a 31.1 wt.*
Sept. 24	50	22.7	1.5	20.0	26.1	Two sep. roosts
Sept. 24	(85)	22.9	1.5			Total for the date
Sept. 25	50	22.7	1.5	19.0	25.6	
Sept. 28	19	22.8	1.2	19.8	25.0	Not incl. a 29.0 wt.*
Oct. 8	29	26.9	2.7	21.8	32.5	
Oct. 15	29	30.8	2.0	26.8	33.5	Total, 1949: 212
1950						
Mar. 25	33	23.9	1.2	22.2	27.6	Next highest 25.7
May 12	31	23.0	1.8	19.1	27.3	
July 15	7	20.0	.9	18.5	21.0	Next lowest 19.7
July 30	30	21.4	1.5	19.3	25.5	
Sept. 8	14	19.8	1.1	17.2	21.4	
Sept. 23	21	21.5	1.3	20.0	23.6	Total, 1950: 243
Sept. 30	46	22.4	1.6	19.7	27.2	
Oct. 1	25	23.5	1.3	21.9	26.0	2 flocks, almost alike
Oct. 7	36	24.9	2.3	19.9	29.4	Next lowest 21.5
1951						
Apr. 18	33	22.9	1.8	19.2	26.5	
1952						
July 19	16	19.7	.9	18.3	21.5	
1953						
July 25	123	19.4	1.1	16.1	21.5	
Sept. 20	114	22.3	1.3	19.1	26.0	
Sept. 26	64	21.5	1.2	18.6	24.0	
Sept. 27	38	20.9	1.1	18.5	22.8	Total, 1953: 393
Oct. 18	54	29.3	2.4	22.1	34.1	At Shreveport, La.
1954						
Sept. 17	128	21.1	1.1	18.8	25.0	
Sept. 18	140	21.4	1.4	18.0	25.6	
Sept. 25	147	23.0	1.7	18.9	27.0	
Oct. 3	57	24.8	2.1	20.7	29.8	
Oct. 9	66	27.0	2.5	20.7	31.4	
Oct. 10	51	26.3	2.5	21.3	31.6	Total, 1954: 589
1955						
Sept. 17	73	20.4	1.25	17.8	23.0	
Sept. 18	46	20.7	.8	18.7	22.4	
Sept. 25	176	22.6	1.5	19.3	26.5	
Oct. 1	63	22.1	1.3	19.5	25.0	
Oct. 5	22	24.8	1.9	21.6	29.0	
Oct. 11	27	27.8	1.9	23.5	31.5	Total, 1955: 407
						Grand Total: 1893

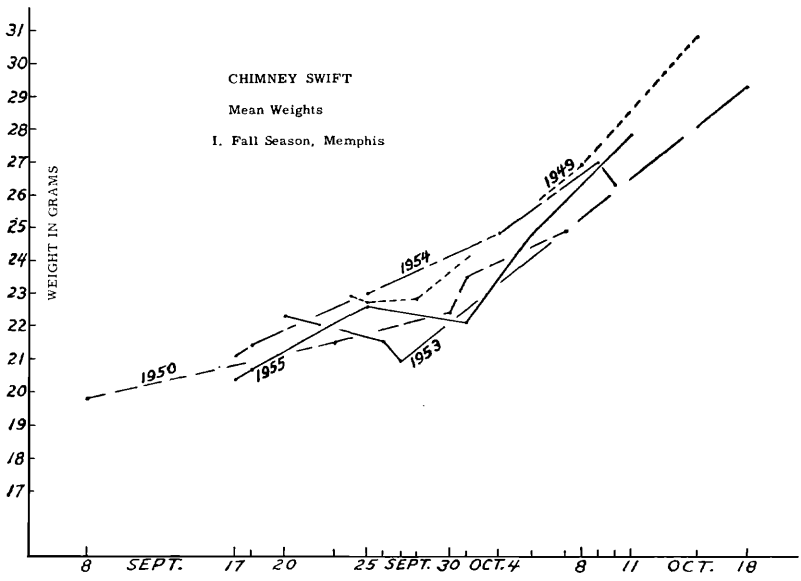
Notes: Actual minimum and maximum weights (to 0.1 gram) shown; however, weights to the nearest 1.0 gram used in setting up frequency tables for calculating the mean and the standard deviation.

*Incl. the 31.1 gm weight (Sept. 24, 1st flock) results are 23.4 and 2.0, respectively; using the 29.0 gm sample, results for Sept. 28 are 23.1 and 1.8, respectively.

147 weights of Sept. 25, 1954, 8:45 to 11:40, did not show much variance in the mean of the 3 1-hour periods, but those means figured for 15-20 minute periods varied irregularly.

The weights of Chimney Swifts, as they go to roost at night, will vary not only with individuals and the date, but also on conditions encountered that day and previously. At Memphis, weather conditions the day before weighing were favorable for feeding except for an all-day rain previous to our weighing of Sept. 8, 1950. However, this species can cover more territory, perhaps, than most others, and even when mild weather is present here, some of the swifts may have moved in from an area 100-400 miles distant where feeding was poor. Such a flight itself might affect the weight but those that remained in the roost area were also on the wing throughout the same period of time. Others might have spent most of the day in a chimney elsewhere, because of rain or inclement weather, then moved out late in the day. We are, then, unable to presume or evaluate what these effects are that acted on those we weigh. During the night, loss in weight should not vary too much, and the weight at dawn could be the "target" weight we would want to obtain. The mean of weights at this time would be, I estimate, about .5 of a gram more than obtained and calculated, being an average of near zero loss for the first birds weighed and about 1.0 for the last ones of most flocks. Since this is a small correction and only estimated, we are presenting our results without such revision.

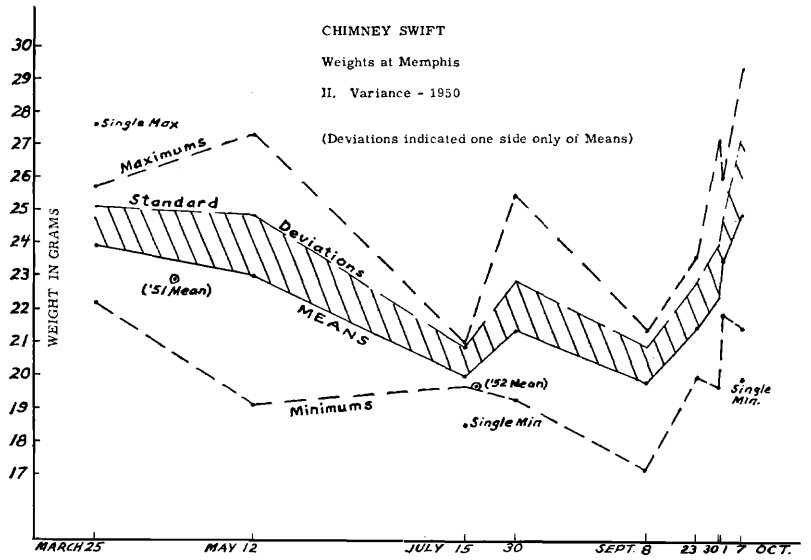
Seasonal variation, while this species is with us, is best shown on the graphs. This variation is perhaps greatest for the six or seven week period of autumnal flocking in our area, because of the apparent



build-up for long migratory flight (possibly 3500 miles). Graph No. I shows the mean of fall weights for five seasons as indicated; the latest plotting shown is, however, for Shreveport, La., rather than for Memphis. In 1955 we thought we detected a drop-off at first, due, perhaps, to less feeding in some areas above us, but the figures did not bear this out. Apparently, any variation from one season to another would not be any more a factor than other variables from undetected or unmeasurable causes.

It is difficult to find spring flocks for trapping; we have about 30 weights each for 3 flocks, including a series on the early date of March 25, 1950. The first noted for the season was a single on March 23; on the 24th this flock went down the chimney of Tech High and a few were seen elsewhere. Of the 63 swifts trapped, 33 were weighed. Unfortunately none were weighed from a trapping, April 22, while on May 12, another group of weighings were made, and again for our last spring banding, April 18, 1951. Two summer weighings, in 1950, enable us to show the variation in 1950, from March 25 to October 7, in Graph No. II. Three points, shown not connected, are single extremes, considered unusual; however, they are considered in the mean shown. Two interposed points, for comparison, show the mean, only, for a third spring flock (Apr. 18, 1951) and a third summer flock (July 19, 1952) the only others for those seasons.

There appeared to be no relative difference between the weights of adults and immatures in the post-breeding flocks. In 1937, Russell S. Davis called our attention to the molt of the adults in the fall and we have used this, in general banding, for age separation. The chance of error appears slight during September, increasing gradually at the month's end and in early October. The error would consist of a small



number passed over as adults and banded as immatures, because any indication of molt has worn off by then, on those individuals only. We check our repeats and returns as an aid in this determination.

An unusual flock was that of 220 on Sept. 20, 1953, all being apparently adults, with 59 returns (27%, very high). Of the 114 weighed, 56 were returns. Calculations for the returns and the new adults, separately, gave almost identical results with those for the total weighings, namely, a mean of 22.3 and a standard deviation of 1.3 grams. This mean was higher, while the means of our next two flocks, Sept. 26 and 27, were lower, than our other weighings would lead us to expect. On Sept. 26, 1953, we had

	Weighed	Mean	Stand. Devtn.
Returns	20	21.2	1.0 grams
All Adults	48	21.4	1.2
Immatures	16	21.9	1.3
All Weights	64	21.5	1.5

A breakdown next season, on Sept. 17, 1954, gave these comparative results:

	Weighed	Mean	Stand. Devtn.
Returns	15	21.6	0.9 grams
New Adults	74	21.1	1.1
Immatures	39	20.9	1.2
All Weights	128	21.1	1.1

Comparisons were similar for other mid-September flocks. Generally the mean for the immatures was about 0.5 gram lower than that for adults; uncommonly, the reverse was true. The 1954 and 1955 weighings were predominantly of adults, many being returns.

Since those weighed were often a small percentage of a flock and the probability of recapture was still smaller, only 81 individual birds were weighed on a second date, and only four of these on a third date. A special effort on returns (and repeats) in 1954 and 1955 secured most of these. Very little significance can be gleaned from a hodgepodge of unrelated dates (and release times). Results for those weighed on three dates were:

A	7-19-52, 20.1;	7-25-53, 20.4;	9-17-54, 20.8
B	7-19-52, 19.3;	9-25-54, 22.3;	10-10-54, 26.5
C	9-20-53, 22.2;	9-18-54, 19.9;	10- 3-54, 25.2
D	9-20-53, 24.5;	9-26-53, 22.9;	9-25-54, 24.3

Of three spring birds, one weighed 24.6 grams on March 25, 1950, and 22.1 on April 18, 1951, compared with respective means of 23.9 and 22.9. Another from the first flock, 23.7 grams, weighed 20.5 on Sept. 18, 1954. The third weighed 20.3 on April 18, 1951, and 19.2 on Sept. 18, 1954.

Fall repeat weighings (same season) numbered 20. The few retaken shortly afterwards, in mid-September, showed a drop, probably as a result of the trapping and handling. The means for September 17 and 18, 1954, were 21.1 and 21.4 grams respectively, but the 3 weighed

repeats dropped, from 1.3 to 2.3 grams each; 2 were weighed 4 hours later the second day, one 2 hours later. Of 7 retaken a week after weighing, 2 increased normally, 1 didn't change, and had lost 1.2 to 2.1 grams each (2 reweighed very late). The 10 retaken into October recovered the drop, if any, and increased perceptibly, roughly paralleling the means for the flocks, except no change for 2 and slight increase for 1.

Of those reweighed as returns, only a few varied disproportionately to the means for their flocks. Very extreme variations in individuals were noted for 6 as tabulated below; 3, at least partly, because of the summer-fall variance.

1st Weighing		2nd Weighing		Variation	
Date	Grams	Date	Grams	Grams	% of Max.
9-25-49	25.0	7-15-50	19.7	5.3	21
9-25-49	25.6	7-15-50	18.5	7.1	31.
7-19-52	19.3	10-10-54	26.5	7.2	27
10-9-54	27.4	9-17-55	20.2	7.2	26.
10-9-54	28.5	9-17-55	20.5	8.0	28.
10-9-54	29.5	9-25-55	23.2	6.2	21.

An exception of note was the swift which weighed 19.0 on July 19, 1952, but only 17.8 on Sept. 17, 1955. A group of ten weighed on July 25, 1953, and again on Sept. 17, 1954, had wide variation. On the former date, all but one (at the mean) weighed above the mean; on the latter date, all but two. The swift with the lowest weight, 19.3, on the first date, had the highest, 22.7, on the last date. That with the highest weight increased only 0.1 gram, for the third lowest of the group. Two summer birds, weighed July 19, 1952, were only .3 to .6 grams more on July 25, 1953.

I am indebted to my husband, Ben B. Coffey, Jr., for the calculations and graphs.

SUMMARY

While banding *Chaetura pelagica* at Memphis, Tennessee, 1839 weights were taken, 1949 thru 1955; 54 weights at Shreveport, Louisiana, are added. Variations in weight from various factors were not judged, because of mobility of this swift and difficulty of retrapping an appreciable number of individuals. Variations between adults and immatures in September and October are not significant. Seasonal variations are indicated, with lowest mean weight in the summer and highest just before fall departure, as a result of a rapid build-up after mid-September.

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