A Study of Bird Flight

Edith E. Wyman

1940

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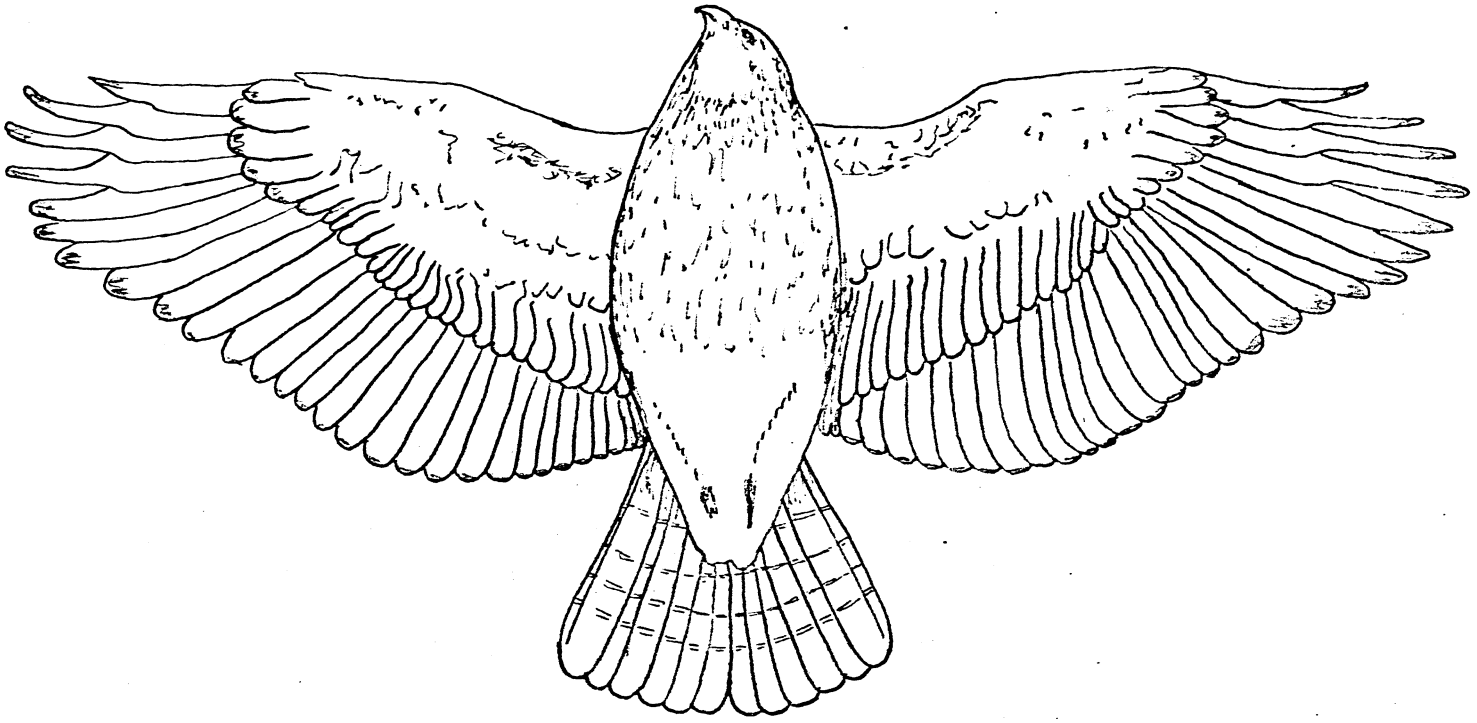


Fig. I
The Red-shouldered Hawk

When a group of smaller birds darts out to attack this bird it begins to spiral upward. After it has reached the proper upward amount of air it spirals with no apparent effort or motion other than a slight lowering of its wing, now and then, to aid in guiding its circular flight. This circular course is made easier because the whole bird is tipped toward the center.

Introduction

The sleek little Cedar Waxwing is entirely responsible for the gathering of the information which follows. It was he who attracted my attention by his busy flight over the lake, in search of flying insects. Hour after hour I watched him, fascinated by his interesting ways. Then one evening, too late to see distinguishing colors, I discovered that I had a new visitor on the lake; and more surprising still was the fact that I made the discovery because the visitor had a different flight. This opened up new possibilities for bird identification in poor light and at unfavorable distances. Instantly I developed a desire to know more about the patterns of bird flight and this interest has continued.

Recognition by size, shape, color and special markings, and song are still the best ways for recognizing birds but all too frequently the light is too poor, the bird is not still long enough, it does not sing, or it is too far away

for ready recognition. Hence a recognition by flight is invaluable.

Gradually I have collected information but it takes much time and repeated checkings to draw any conclusions on bird flight because, not only is it difficult for the eye to see what actually takes place, but also there is difficulty in finding a medium for recording what is seen. Consequently this report is submitted with incomplete evidence, if not even inaccurate evidence. In the future I hope to have a library of moving picture films to verify my findings.

The kindly interest and useful suggestions of Aretas A. Saunders, of Allegany School of Natural History, Quaker Bridge, New York, have been of help and encouragement in gathering information.

The pictures, diagrams, and moving pictures of Doctor Olin Sewall Pettingill, University of Michigan Biological Station, Cheboygan, Michigan are of special value because they showed more specifically the actual wing movements

Of Birds.

Useful references were :-

Allen, A.A. The Book of Bird Life
Allen, A.M. Birds and their Attributes
Aymar, G.C. Bird Flight
Chapman, F.M. Handbook of Birds of E.N.A.
Hankin, E.H. Animal Flight
Newton, A. A Dictionary of Birds
Poole, Bird Flight
Peterson, R.T. A Field Guide to Birds
Thompson, J.A. The Biology of Birds
Roosevelt Wild Life Bulletin Vol. I, No. 3.

General Discussion

Although birds are similar in that they have bodies modified for flight, their flight is not the same. In general birds have three chief modes of flight:-

1. Most birds have direct flight achieved by active strokes of the wings. While there is much variety in the method of obtaining this flight its main features seem to be similar.

2. Most birds have the ability to glide, supported by outspread wings. This requires velocity attained in some manner — previous wing strokes, descending from a higher level, or commencing flight in a region of sufficient velocity. It is commonly known as gliding.

3. Some birds have the ability to sail on motionless, extended wings. This varies from gliding in that the birds do not lose speed or altitude and may even gain altitude.

There are four general wing modifications for specialized flight:-

1. Short, rounded wings are not very good for extended flight but are fine for rapid escape in short flights. They allow for full speed ahead almost immediatly but not for extended periods. They tend to use up considerable energy. Chickens, Grouse, Quail, & Pheasants have this type of wings.

2. Long narrow wings are adapted for speed and gliding. The wing may be slightly bent at the wrist. Fish Hawks, Albatrosses, Gulls, Terns & Night Hawks can fly rapidly and also glide with ease.

3. Long pointed wings, wide at the base and tapering to a long point are adapted for speed and endurance. Swallows, Swifts, and Terns are some of our fastest birds [illegible] to the wing [illegible] tips.

4. Large, broad, rounded wings are adapted for soaring. Eagles, Large Hawks, and Buzzards with such wings take advantage of upward currents of air and soar for extended periods of time. The outer primaries of soaring birds

are narrowed thus allowing air to escape from the under surface.

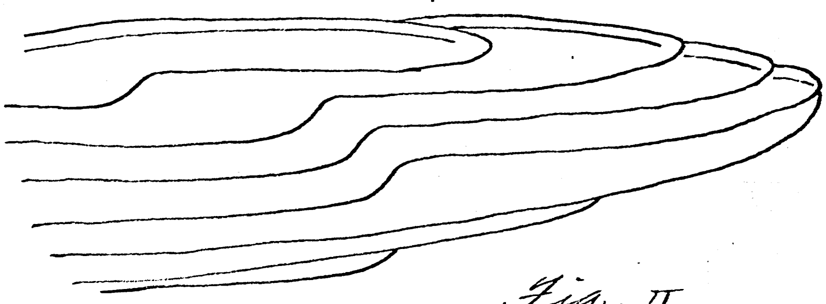


Fig. II

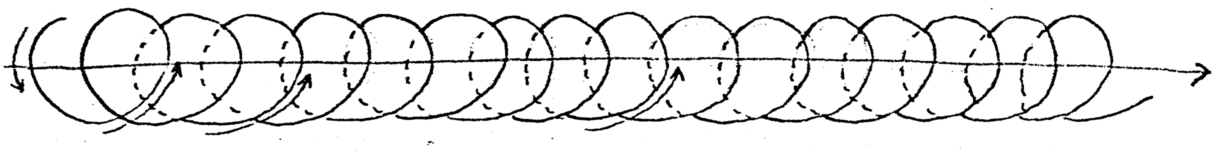
The four notched primaries of a Red-tailed Hawk

See Fig. I and Fig. II.

Direct flight may proceed in nearly a straight line or it may undulate. When flight is in a straight line it is accomplished by regular flapping of the wings — usually rather slowly. When the flight is undulating there are a certain number of rapid wing strokes and then a closing of the wings. Frequently when the wings close, the bird loses elevation and with the next flapping regains it. This flight is not accomplished merely by an up and down flapping of the wings but results also from a powerful forward and downward stroke followed by an

upward and backward stroke. During the former stroke the wing is brought far forward and bent forward and downward at the wrist besides thus driving the air downward and backward forcefully and at the same time driving the bird forward. During the latter stroke the wing is slightly folded thus reducing resistance. These forward and downward and upward and backward strokes are more noticeable when a bird is flapping hard to attain speed. Ordinarily the up and down stroke is more noticeable, however even then, to the observer, it is evident that the tip of the wing seems more than up and down. This can be seen evidently by watching a large bird [illegible] flying at an angle. The up and down stroke is clearly visible at any time but when the bird is flying away from the observer at an angle the wing tips appear to be making

circles in the air. Actually they would not be true circles because of the more powerful forward and downward stroke and the less powerful upward and backward stroke but that is the general impression. See Fig. III



As the movement of the wing tip appears to the eye.

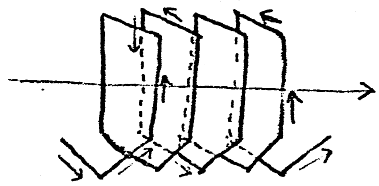


Fig. III

According to pictures and diagrams of Gordon C. Aymar in Bird Flight the actual pattern would be more nearly as the above.

Many [illegible] birds may be observed gliding to their resting place from some higher elevation. This may be accomplished with no apparent motion or with various motions, such as a slight turn of the head, a slight or great spreading of the tail, or, as the bird nears the landing place it may even

resort to a powerful upward and backward wing stroke. More characteristic is the habit of Gulls following ships. The forward motion of the ship creates a lateral up-current of air which the Gulls ride. They flap into this current and glide on it until carried far behind the ship. Then they flap hard to circle forward to repeat the performance. Sometimes they are said to circle with the ship and glide for long times without being carried back but my experience has been with the former kind. I have watched them follow the ship, flapping forward, gliding backward, and repeating for hours, then settling down on the [illegible] [illegible] to be carried [illegible] [illegible].

Still more thrilling to the imagination is the sight of a great bird soaring in the sky with no apparent motion of the wings. See Fig I for a description of the spiral soaring of the Red-shouldered Hawk.

In the mountain regions of the South the Vultures soar endlessly, not remaining at one place yet apparently not flapping. The upward current of air at the mountain sides affords them an excellent opportunity to soar.

Explanation of Graphs

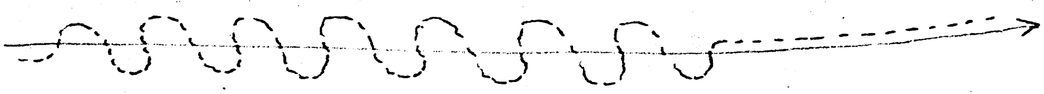
The graphs which follow represent the movement of the body by means of a solid line and the movement of the tips of the wings by a dotted line. When the wings are held stationary, as in gliding, the dotted line runs parallel to the body line of flight; thus there may be a dotted line above, below, or on the solid line, depending on whether the wing tips are held above, below or straight out from the body. When the wings are closed the dotted line meets the solid line and stops until the wings are opened again.

This type of graph is not a truly satisfactory, in that the position and shape of the wing can not be indicated. In an attempt to avoid this difficulty small diagrams were made to represent a supposed cross-section of the bird in flight— usually the representation was made to illustrate wing position in gliding.

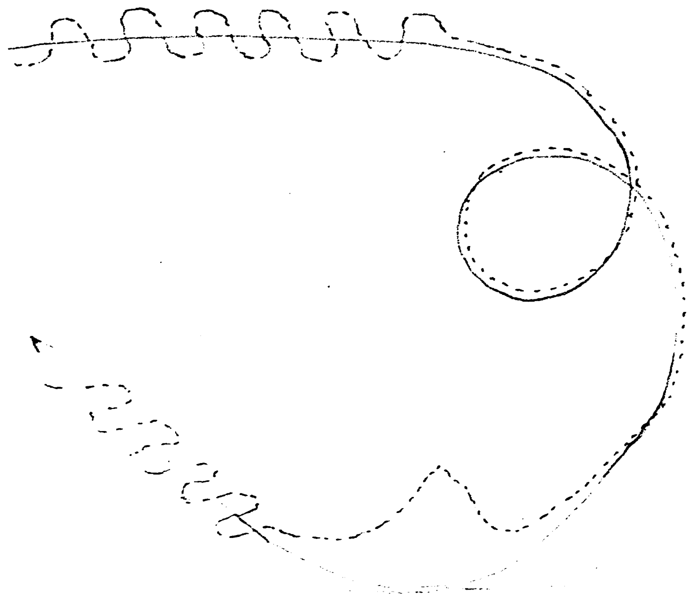
1. Ring-Billed Gull: Larus delawarensis

a. Wing tips observed even with body line of flight, slightly below body line of flight, and above body line of flight when gliding –

b. Protracted flight –



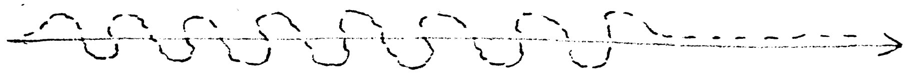
c. Diving to surface of lake –



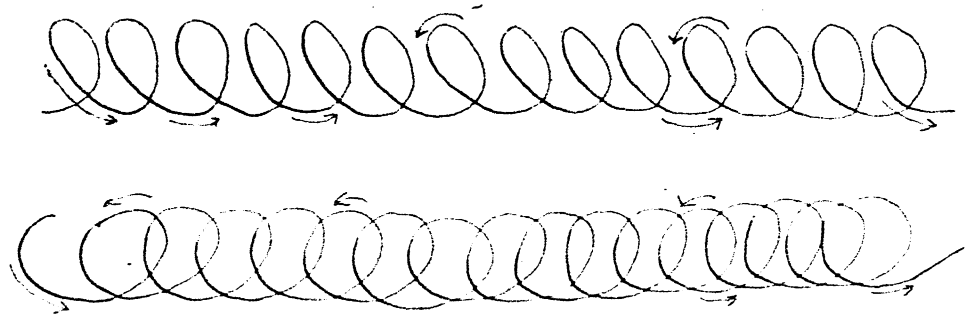
2. Herring Gull. *Larus argentatus*

a. Wing tips slightly above body line of flight when gliding –

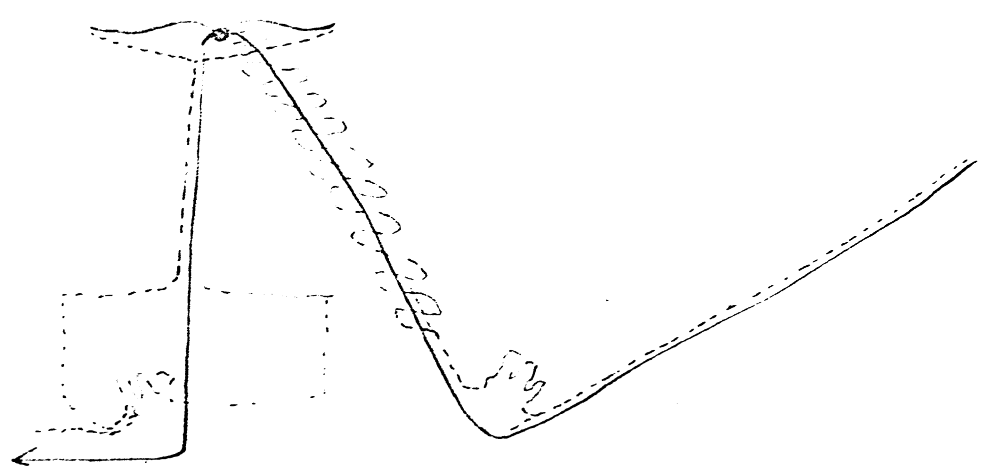
b. Protracted flight –



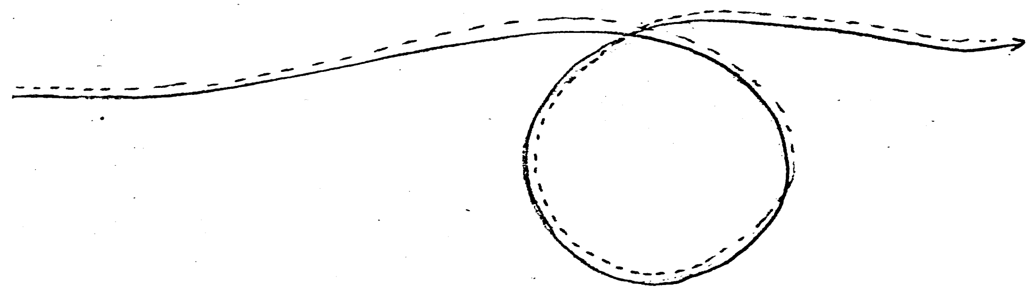
c. Apparent motion of wing tips when viewed at an angle, flying away from observer –



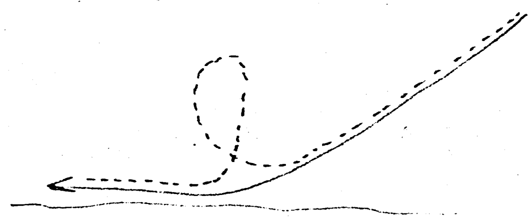
d. [illegible] up [illegible] the [illegible] [illegible] and [illegible] [illegible] plane –



e. Gliding over water –



f. Dipping to surface of water –



3. Caspian Tern. Hydroprogne caspia imperator

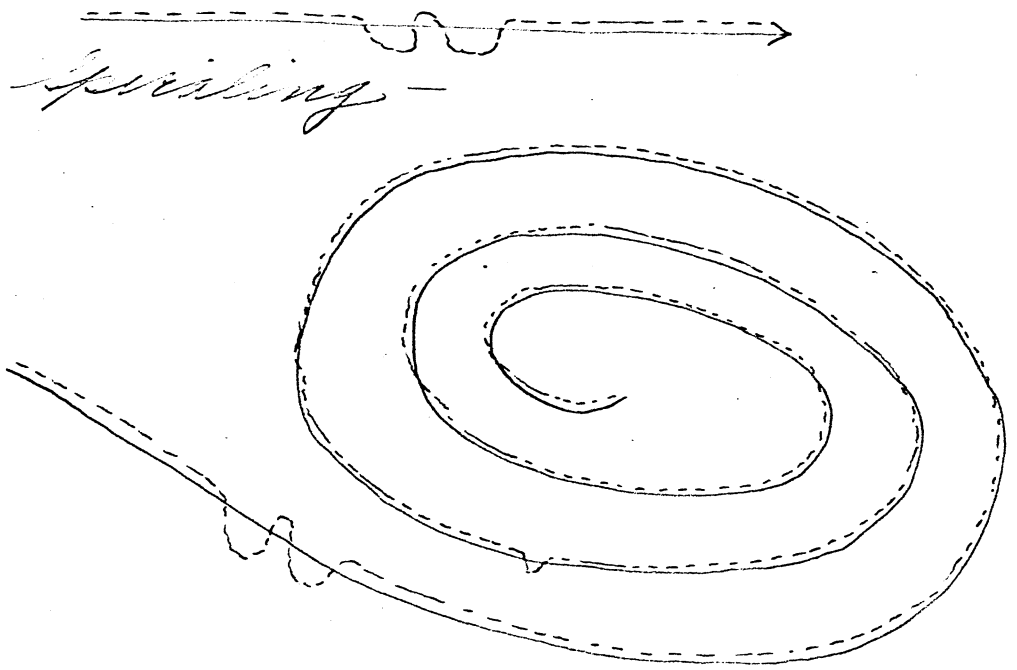
a. Wing tips almost in line with body line of flight in gliding –

b. Protracted flight –

4. Red-shouldered Hawk. *Buteo lineatus*

a. Wing tips slightly above bodyline of flight in soaring —

b. Soaring —

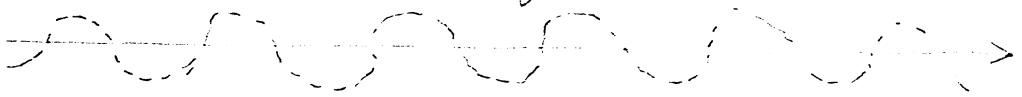


c. Circling —

5. Marsh Hawk. *Circus hudsonius*

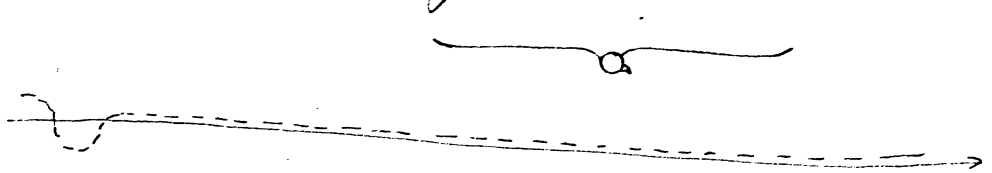
a. Wing tips in gliding —

b. Outstretched wings —



6. Turkey Vulture. *Cathartes aura septentrionalis*

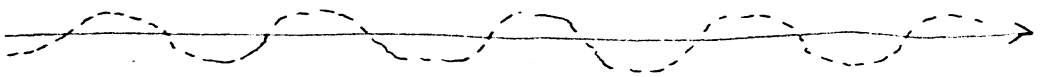
a. Wing tips slightly above body line of flight when soaring —



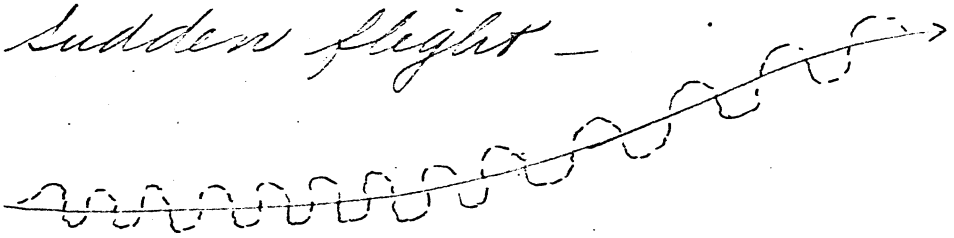
7. American Bittern. Botaurus lentiginosus

a. Wing tips just above bodyline of flight when gliding —

b. Protracted flight —



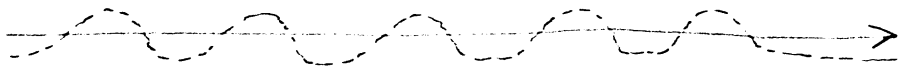
c. Sudden flight —



8. Green Heron, Butorides virescens virescens

a. Wing tips below bodyline of flight when gliding —

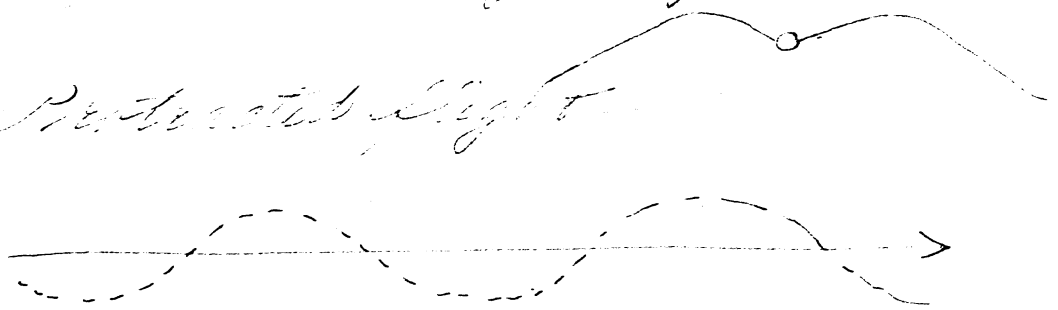
b. Protracted flight —



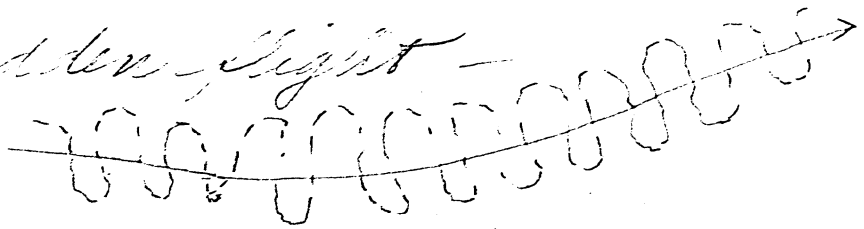
9. Least Blue Heron. Florida caerulea

a. Wing tips below bodyline of flight when gliding —

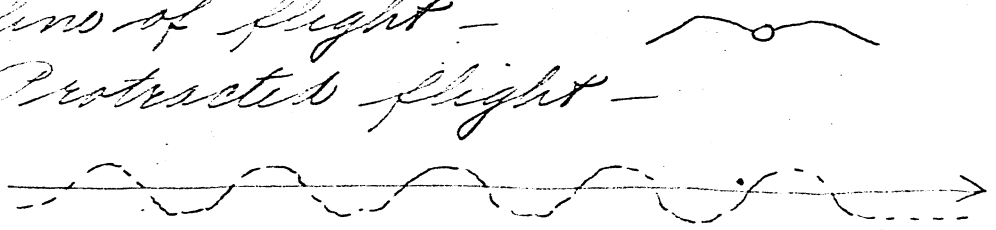
b. Protracted flight —



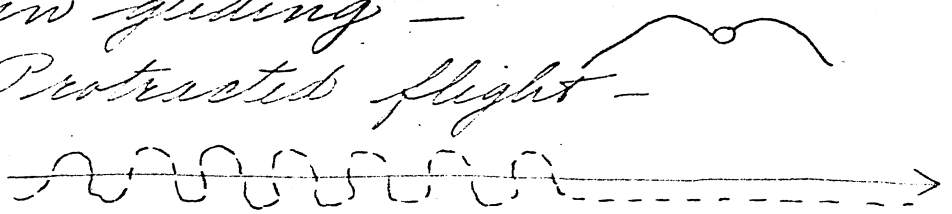
c. Sudden flight —



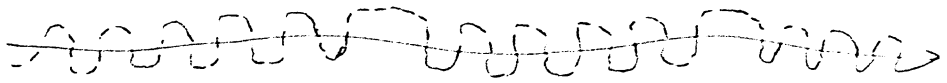
10. Least Bittern. Ixobrychus exilis exilis
a. Wing tips but slightly below body line of flight —
b. Protracted flight —



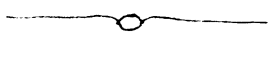
11. Killdeer. Oxyechus vociferus vociferus
a. Wing tips below body line of flight in gliding —
b. Protracted flight —



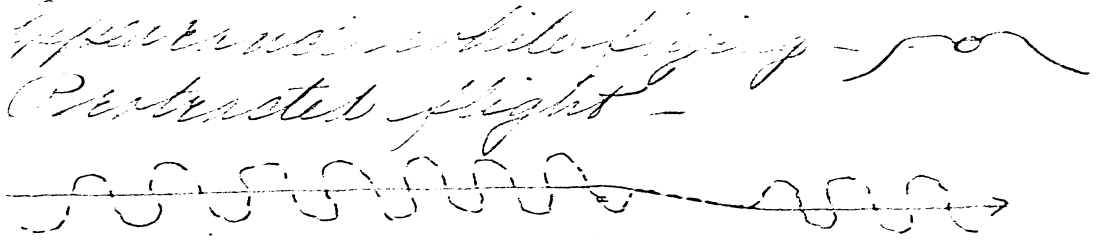
12. Spotted Sandpiper. Actitis macularia
a. Flight over water —



13. Yellowlegs, G.B. Tringa [illegible]
a. Wing tips [illegible] gliding —



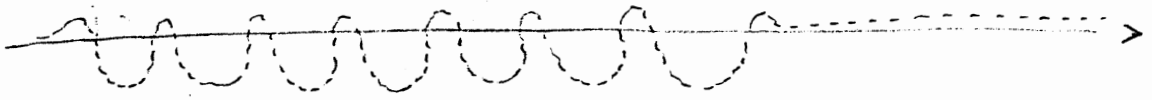
b. [illegible] gliding —
c. Protracted flight —



14. Crow. Grows Starchy Legendre

a. Wing tips extend far below body line of flight. In covering wing tips were observed above and below body line of flight —

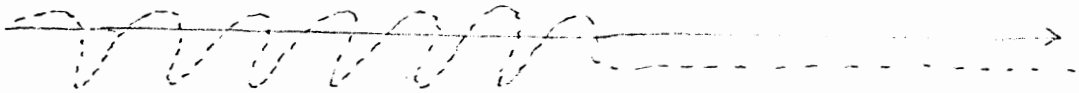
b. Protracted flight —



15. Red-winged Blackbird, E. Agelaius phoeniceus

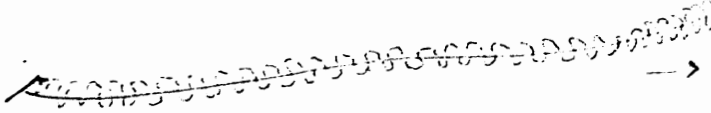
a. Wing tips slightly below body line of flight —

b. Protracted flight —



16. Marsh Hawk, Circus hudsonius

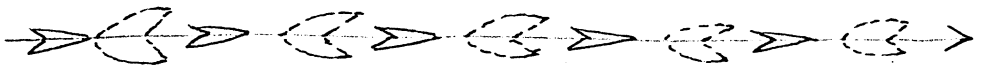
a. Flight steady, wing tips



17. Cedar Waxwing. *Bombycilla cedrorum*

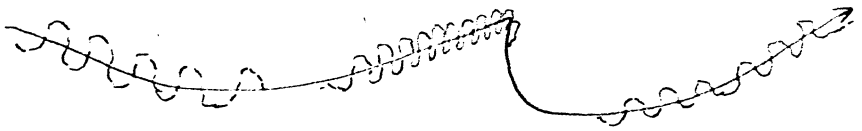
a. Wings straight out when gliding

b. Protracted flight – up high in the sky – apparently an alternating opening and closing of the wings –



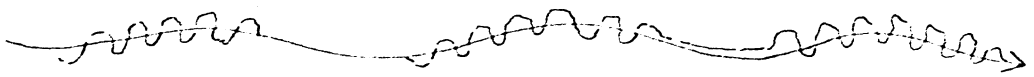
c. Flight across the lake –

d. Flight in catching insects –



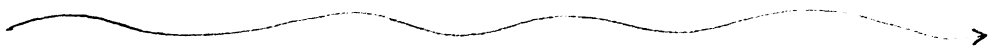
e. Flight when alighting –

f. Undulating flight –

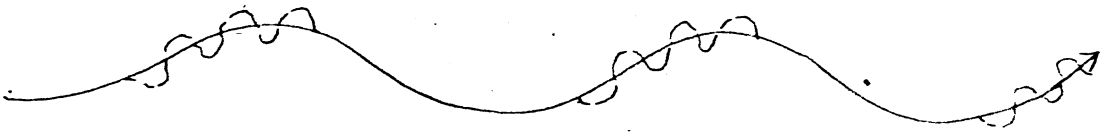


18. Redstart. *Setophaga ruticilla*

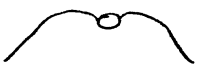
a. Undulations of flight –



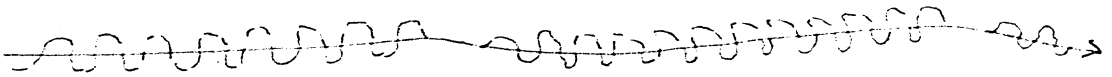
19. Goldfinch, Eastern. Spinus tristis tristis
a. Wings closed when flying downward.
b. Protracted flight.



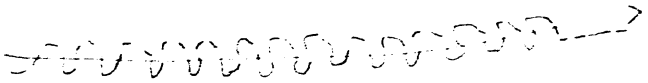
20. Flicker, N. Colaptes auratus
a. Wing tips extended far below body line of flight.
b. Protracted flight.



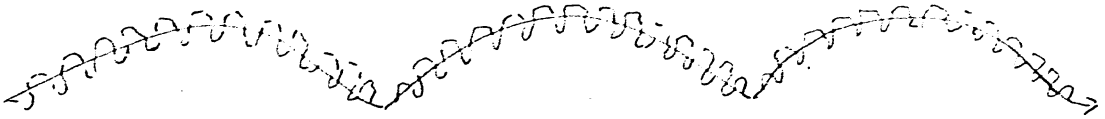
21. Robin, E. Turdus migratorius
a. Protracted flight.



b. Short flight.



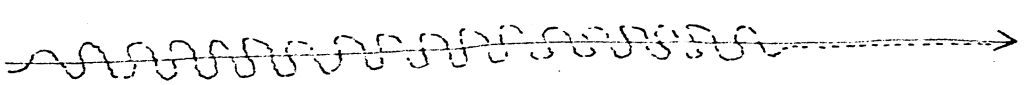
22. Song Sparrow. Melospiza melodia
a. Flight over bushes.



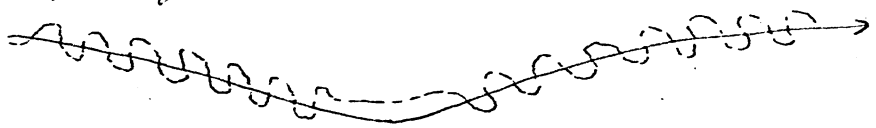
23. Chimney Swift. Flapping flight

a. Wing tips slightly below body line of flight when gliding —

b. Contracted flight —

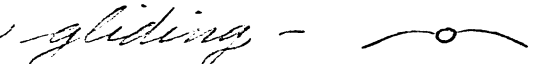


c. Flying to surface of water —

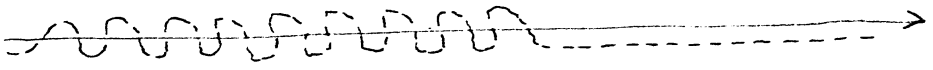


24. Barn Swallow. Flapping & soaring flight

a. Wing tips just below body line of flight when gliding —



b. Contracted flight —

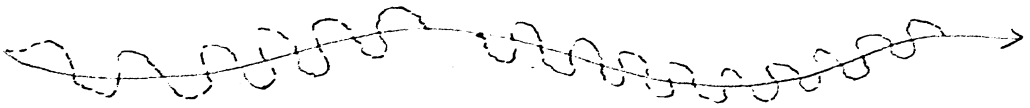


c. Flying to surface of water similar to Chimney Swift.

25. Tree Swallow. Flapping & soaring flight

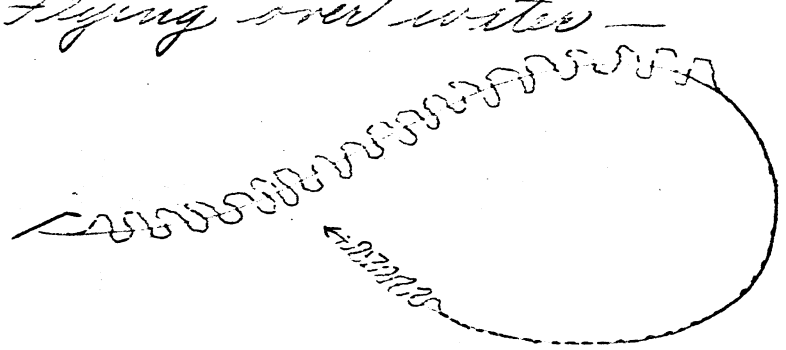
a. Wing tips similar to Barn Swallow

b. Contracted flight —

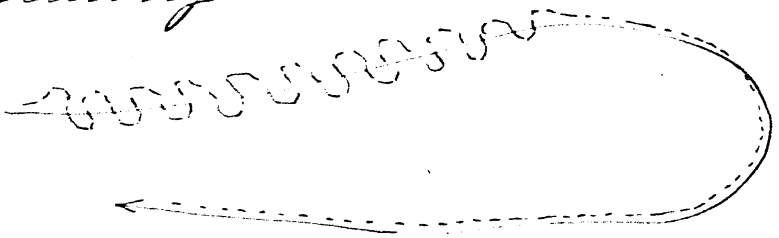


36. Purple Martin. Wing narrow curved

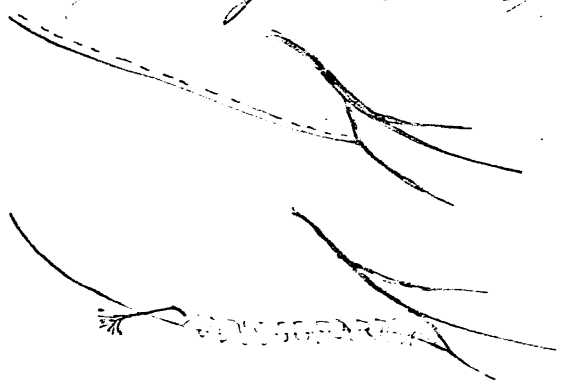
a. Wing tips slightly up or slightly down from body line of flight in gliding —



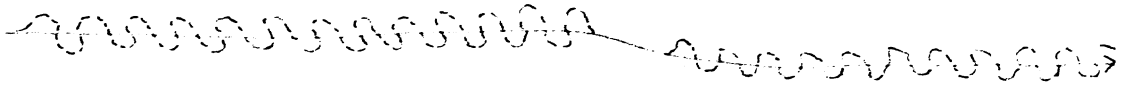
b. Flying over water —



c. Soaring —

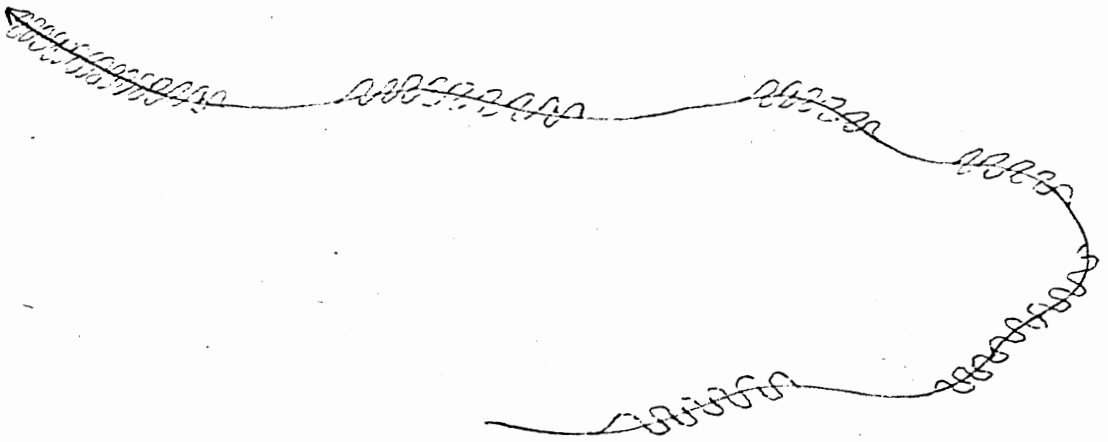


d. Extended or outstretched flight —



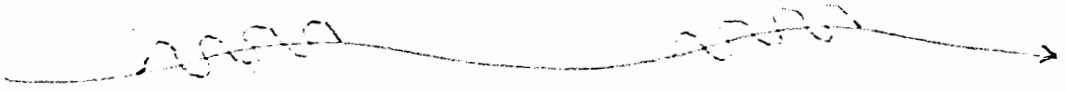
27. White-winged Crossbill. Loxia leucoptera.

a. Wings closed at intervals during sustained flight.

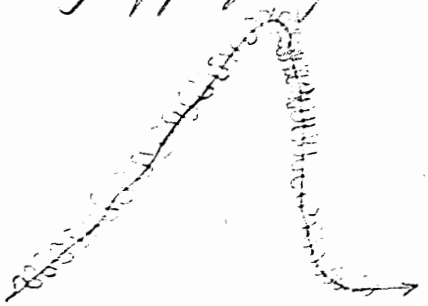


28. Bobolink. Dolichonyx oryzivorus

a. Protracted flight—



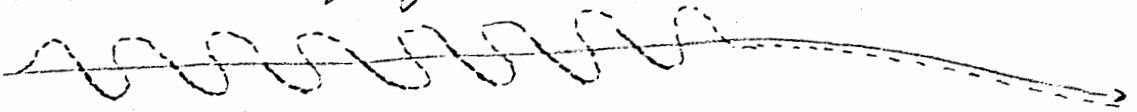
b. Showing-off flight—



29. Lesser Yellow-legs. Totanus flavipes

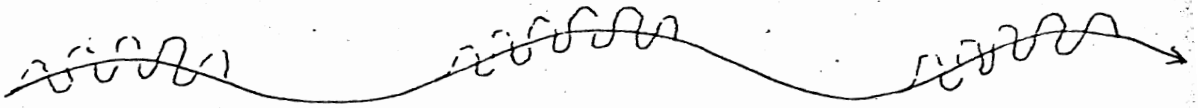
a. Wings slightly bilobed during flight in gliding—

b. Protracted flight—



30. Red Crossbill. *Loxia curvirostra minor*

a. Protracted flight -



31. Common Loon - *Gavia immer*

a. Protracted flight -

1. Ring-billed Gull.

The Ring-billed Gull is somewhat smaller than the Herring Gull and has a more graceful flight. This bird flaps his wings in easy, graceful flaps for some distance then glides in the wind in large circles. When he sees food in the water he dives down apparently making a complete turn by suddenly closing one wing. As he nears the water he holds his wings up high making a few flaps then glides up again and begins to flap again.

2. Herring Gull.

This bird is [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in large circles. [illegible] [illegible] and [illegible] a few flapping around to the [illegible] of the [illegible] and then gliding [illegible] in [illegible] current created by the [illegible]

movement of the ships. When about to wheel about it tips toward the inside of the circle. To alight on water it settles down rather slowly, spreading its tail wide, as a brake, and holding its wings far above the body. After it has landed it folds up the wings, part by part ending up with the hand. When comfortable he rides the waves.

3. Caspian Tern

A most spectacular sight is to see [illegible] diving [illegible] [illegible] [illegible] [illegible] it.

4. Red-Shouldered Hawk

A most glorious sight to behold is a hawk escaping from some smaller bird. He may fly in a straight line, with large, regular flaps of the wings when out darts a bird to attack him. He immediately changes his course to a circular one and begins to spiral upward. At first he does considerable flapping of the wings—apparently until he finds a proper upward current of air. Subsequently he spirals on upward with scarcely an apparent movement of the wings. As he circles, the whole bird is tipped toward the center and occasionally [illegible] [illegible] [illegible] [illegible] [illegible] gradually curving to the [illegible] his ascent. He continues this upward until he is a mere speck in the sky and his tormentor is left far below. Characteristic of this

bird when soaring are the gaps in the outer primaries and the square tail outspread.

5. Marsh Hawk

The Marsh Hawk has longer and narrower wings than the Red-shouldered and consequently it seldom soars. Instead it flaps or glides back and forth over fields looking for food. This hawk is supposed to have a peculiar flight besides the regular gliding and flapping. By Allen in The Book of Bird Life it is described as a "loop the loop" flight, by Saunders in The Summer Birds of the Allegany State Park as, "a curious undulating courtship flight." Other [illegible] may pertain to [illegible] this.

6. Turkey Vulture

The Turkey Vulture is another [illegible] bird which takes advantage of upward movements of air and soars by the hour looking for food. It is very common in the mountainous regions of the South and circles about in the sky end-

body. There seems to be no spot where one may not be found silhouetted against the sky with his broad out-stretched wings. The wings appear rather ragged, partly due to having the outer primaries notched and narrowed toward the tips but also due to ragged feathers.

7. American Bittern

The American Bittern, when startled into sudden flight, rises from the ground with heavy, noisy flaps of the wings. Though he rises with his primaries silent, he makes but little exertion and soon comes to rest in the [illegible] [illegible] with [illegible]. [illegible] [illegible] [illegible] flight, it is [illegible] [illegible] [illegible] [illegible] [illegible] flight. [illegible] rises [illegible] [illegible] wings until he makes the desired setting, then he glides on extended wings.

8. Green Heron, E.

The Green Heron flies in a manner very similar to that of the Bittern. [illegible]

[illegible] it varies in some respects. The head is held up and in. The wings have a decided downward curve in gliding.

9. Great Blue Heron

The flight of the Great Blue Heron is a most majestic sight. This large, careful bird, if suddenly startled from his perch on an old log in a pond, will fly up over any thing in his way with tremendous effort, so much so that he appears awkward in his movements. However, when seen flying along in ease he is a different bird. Then with his out-stretched [illegible] and [illegible] he sails along with [illegible] wings. [illegible] with apparent effort [illegible] appears [illegible]

10. Least Bittern

The Least Bittern differs but little from his larger brother, the American Bittern, in flight.

11. Killdeer

The Killdeer, while calling his loud querulous call, flies ever onward as one approaches him. His flight somewhat resembles that of the Great Blue Heron but he is a much smaller bird, he flaps his wings more quickly, and his wing tips extend farther below the body line of flight.

12. Spotted Sandpiper

The Spotted Sandpiper has an interesting flight. It is a regular one consisting of a few short flaps and a long one. It is illustrated as follows ————————.

The [illegible] then [illegible] is quite evident. When the bird flies [illegible] to the water the wings appear to [illegible]?

[illegible]

13. Kingfisher, E. Belted

The Kingfisher has an interesting flight. He makes several large flaps of the wings then several small ones. Sometimes he spreads his wings and glides. The result is an uneven line of flight as well

as an uneven flapping. Once he was observed flying low over the water from one perch to another. The flight was very interesting. Most of the flapping took place above the body and the body was held at an angle /. The result was that he had to flap harder but did not get his wings wet.

14. Crow

The Crow flies in a straight line with large regular flaps of his powerful wings. In gliding or soaring he always holds his wings above a line with the body line of flight. He is adept at soaring.

15. Red-winged Blackbird, E.

[illegible] ... its ... [illegible] of flight. The wing tips do not [illegible] above the body line of flight [illegible] below it.

16. Marsh Hawk

The Marsh Hawk was observed to fly with the whole body tipped

17 Book Keeping

is not evident to me. In addition this bird can glide on outspread wings; and, for variety, it may combine any or all of its flights.

18. Redstart

The Redstart was observed carefully but he is too small to get the exact wing movement. However the body line of flight was gotten. It is an irregular one. Whether the wings are closed to produce this irregularity is not known but such may be the case. In any case, the flight is an irregular, undulating one.

19. Goldfinch, Eastern

The Goldfinch has a most distinctive flight. The flight is a regular, undulating one which seems to have a rhythm in threes, or multiples of three. It apparently makes three, rapid, upward strokes of the wings while singing, thus giving a "Chittes, Chittes", sound. Then it closes its wings and shoots downward until it flaps its wings and starts upward again.

20. Flicker

The Flicker is another of the birds which has an undulating flight. The undulations are deep but not entirely regular. The downward curve again seems to be due to his closing his wings.

21. Robin, E.

The Robin is another of the birds which produces an undulating flight by closing the wings while in rapid flight. The result is similar to that produced by the Cedar Waxwing under similar circumstances, but the Robin may readily be recognized because of his greater size and because his wings flap less gracefully. Besides the flight is very much in a straight line but for the dips caused by the closing of the wings.

22. Song Sparrow

This sparrow, and others, has a peculiar jerky flight. Since the flight is frequently over the tops of grasses and low shrubs this is not surprising. In a cleared space it resembles the

flight of a Goldfinch but is less regular and besides is usually low while that of the Goldfinch is usually quite high up. The Sparrow also closes his wings in flight thus further accounting for the downward curves.

23. Chimney Swift

The Chimney Swift is most unique in his flight. It is one of the fastest fliers among the birds. Its wings are flapped so rapidly as to give the appearance of having ten pairs of them. This effect is heightened by what appears to be an alternate wing stroke. After a long interval of flapping, the bird takes a long, low and easy glide, often sweeping down to the surface of the water. When in flight and the Cedar Waxwings are their flight and the lake it can be recognized readily from them by the somewhat rapid wing strokes, the characteristic, "Chipt, chipt," and by the fact that it is loudly present one instant, gone high over the trees the next, and then

suddenly back again.

24. Barn Swallow

The body line of flight of the Barn swallow is similar to that of the Chimney Swift. However it uses a much longer and slower wing stroke and does not have the appearance of using an alternate wing stroke.

25. Cliff Swallow

In the casual observer the Cliff Swallow has a body line of flight quite similar to that of the Barn Swallow; but this swallow uses a distinctive wing stroke which also changes the body line of flight. The Cliff Swallow, after an interval of rapid flapping, closes his wings for an instant then resumes flapping. This causes the flight to be a light undulating motion - apparently Lackey in the even, flowing rhythm of the preceding bird.

26. Purple Martin

The Purple Martin is so busy that he really needs more than one kind of flight and he does have. He has

first of all a characteristic swallow flight. but he flaps harder and glides more often than any other swallow I have observed. He is given to rapid stroking for a considerable distance then a joyful gliding. He can glide in to a perch with ease or he can fly in with quick hard backward strokes and spread tail. On long high protracted flight he even resorts to closing his wings on occasion thus making his flight undulate to a degree. Since he is larger than the other swallows he can be recognized with ease.

41. White-winged Crossbill

a. A flock of thirty-one birds were observed flying together. They would [illegible] [illegible] a group of trees and fan out in a sort of semicircle and then fly to another perch. The flight was definitely undulating. There was a good many flaps, then the wings were closed and a short glide was taken, then flapping was resumed. The effect was much like seeing a flock

of Goldfinches but the rhythm was not so short as that of the Goldfinch. However the 'chittering' of the birds as they flew along heightened the general effect.

28. Bobolink

The Bobolink in protracted flight has undulating flight. The undulations are shallow. The wings seem to be flapped four or more times then the wings are closed; the repetition is entirely regular. Meanwhile he sings a quick, "whit, bob, o whit, whit bob, o whit," while flying. But more interesting still is the flight in early spring when apparently he is showing off to the female. At that time the Bobolink may be perched at the head of a reed and suddenly fly high into the air with rapid wing beats singing his bubbling song and then drop down rapidly bubbling over with song until he perches on another reed not far away.

29. Lesser Yellow-legs -

The Yellow-legs was disturbed in his feeding and flew up and across

to the next pond. His flight was especially interesting because of the unusually heavy down-turned tube of the wings. The slope of the wing appeared long and unbalanced but the down strike was very pronounced. As he neared the other pond he glided down easily.

30. The Red Crossbill has an undulating flight which resembles that of the goldfinch. There are more wing flaps to each undulation than there are in the goldfinch flight but each undulation is regular and completed in four-four time. I am not sure how many wing strokes there are to each undulation.

31. The Common Loon has a rapid flight with few wing strokes. Its appearance in flight is similar to that of the duck but it holds its short feet out straight behind and frequently it has its mouth open as if it were gasping. The wings appear to be attached at a point about half way between the tip of the tail and the tip of the foot in flight. The loon has to flap very hard to rise up from the water. Frequently he has a sensation of flying & swimming over the surface of the water.

Birds Observed

	Wading	Undulating	Soaring	Unclassified
1.	Ring-billed Gull	Cedar Waxwing	Red-shouldered Hawk	Spotted Sandpiper
2.	Herring Gull	Redstart	Turkey Vulture	Marsh Wren, Sh. B.
3.	Caspian Tern	Eastern Kingbird	Crow	Common Loon
4.	Marsh Hawk	Phoebe, n.	Osprey	
5.	American Bittern	Robin, e.		
6.	Green Heron, e.	Long-Spurred		
7.	Great Blue Heron	Chipping Sparrow		
8.	Least Bittern	Cliff Swallow		
9.	Killdeer	Purple Martin		
10.	Kingfisher, E. Belted	White-winged Crossbill		
11.	Red-winged Blackbird	E. Bluebird		
12.	Cedar Waxwing	Red Crossbill		
13.	Chimney Swift	Y.B. Sapsucker		
14.	White Swallow			
15.	Purple Martin			
16.	Least Yellow-legs			

Conclusion

From this survey it is evident that several points must be considered if one desires to identify birds by their flight. First among these is the general appearance of the bird itself. This includes the size and shape of the bird and the position of the head, legs, and wings. Second is the general body line of flight — whether direct or undulating. Third is the method of using the wings. This includes rapidity, time or rhythm, and the position of the wing tips. Last is special points about the bird. This includes where the wings are held during gliding, whether the wings are closed during flight, and what the wing variations are introduced into the flight.

Although the use of bird flight, to the exclusion of other methods of identification, could not be recommended, too little emphasis has been given to this phase of bird study.

while it is true that color markings and song are excellent for the identification of birds, it is also true that there are times when neither of these can be observed. It is then that a knowledge of bird flight is invaluable. In a poor light it is difficult to see the color markings, but it is actually a good time to see flight. Just before dusk is an excellent time. Besides an individual species has only a few different flights but has many different color markings and they vary with the season. Thus it would seem that flight should be a helpful point in bird identification.

Because the great variety of evolutions one flight of various species would seem to indicate that it is not always constant. No doubt, the difficulty in describing and recording the flight accounts for this. In any case, there seems to be no really satisfactory method for doing these two things as yet;

and certainly it is not as easy for a beginner as using other methods of identification. One merely gradually becomes familiar with the flights. Nevertheless it is a fascinating subject and deserves attention.

Much greater progress is likely to be made in this field by the use of the moving picture camera, especially as faster speeds are introduced in popular priced cameras, for only with slow motion can the bird wing action be recorded so that it can be followed to advantage.