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WINTER STARLING ROOSTS OF WASHINGTON

BY E. R. KALMBACH

The winter Starlings of Washington are in no wise different from other Starlings. They are as typically Starlings as the cosmopolitan citizenry of the National Capital is American. They have all the individual vices, much of the proletarian spirit and doubtless also some of the less frequently mentioned virtues of Starlings living elsewhere. Yet, withal, they have distinction. The mere choice of the National Capital as their winter domicile assures them that.

Here their nocturnal squeals and chatterings reach the ears of the mighty and here also at times the voices of the mighty rise in protest. Here the shopper and the shop owner; the pedestrian and autoist; the bird hater and even bird lover periodically join the chorus of damnation. Even the staid ranks of profound ornithologists have echoed the song of lament.

It is in such an unsympathetic setting that the appended notes on Starling behavior have their origin. They are devoted in general to the subject of roosting activities and in origin are more or less of a by-product of a few experiments in control. In point of time they deal largely with the happenings of the past five years.

Winter Starlings made their first appearance in Washington in the fall of 1914, when a few score used trees near the Bureau of Fisheries as a rendezvous. At that time they were objects merely of ornithological interest and made no impression on the lay mind except as attention was called to their presence. On the advent of colder weather these birds either left the city for points south or passed the nights in more protected and less conspicuous places, as the interiors of church towers or building ventilators. It was not until about 1922 or 1923 that noticeable numbers began to frequent the eaves and window ledges of buildings on down-town streets and formed a nucleus of what in following years developed into a roost of many thousands.

By January, 1926, the gathering had reached such proportions that local merchants complained of its presence, and, in a limited way,

experiments were started to alleviate the condition. These early experiments, involving frightening measures, were followed by attempts to trap the birds, then to poison, and finally experimental work was done with toxic gas on small mixed roosts of Starlings and English Sparrows. The rather high degree of failure, tempered with indifferent success in a few of the experiments, carried with it the conviction that there still was much to learn of Starling behavior that might have a bearing on the general problem of Starling control where needed. Of primary importance was the need of a better understanding of Starling migration or seasonal drift in order that the effect of a winter reduction of numbers at any one point might better be appraised. This led to banding operations.

The first of these attempts to band winter Starlings in Washington was directed at a group roosting in two ventilators on top of the Post Office Department Building on Pennsylvania Avenue. There were four of these ventilators, essentially the same in construction. Starlings, however, occupied only two, these being the ones from which a steady flow of warm air emerged throughout the night, and where the birds, protected from rain and snow by the broad, overlapping shutters, enjoyed the advantages of almost human comforts. Fully a thousand birds resorted to each of these ventilators during the height of their occupancy in the winter of 1927-28. On December 21, 1927, a party of four, consisting of C. C. Sperry, F. M. Uhler, F. C. Lincoln, and the writer visited these ventilators and succeeded in capturing a single Starling. There was no method of reaching the birds from the inside and the diffused light of the city made our approach from without so evident that most of the flock took wing at the start of operations. This single experience was sufficient and the scene of operations was promptly changed to the tower of the First Presbyterian Church on John Marshall Place where, during this same winter, as many as 2600 Starlings repaired nightly. This tower had been used by Starlings for several years and by pigeons for many more. The former were contributing rapidly to the supply of guano which on some landings was eight to ten inches deep. About a quart of this material yielded the remains of no less than 105 specifically different food items of the Starlings. More than half of these were animal in origin and the varied assortment gave indication of the wide daily rangings of this flock up and down the Potomac and throughout neighboring Maryland and Virginia.

Banding was begun at this location on the night of January 4, 1928, when 317 were banded. An even thousand were tagged on Janu-

ary 14 and another thousand on February 21. The peak of operations was reached on the night of March 2 with the banding of 1,241, and the season closed on March 23 with 559, making a total of 4,118 for the winter. In the following winter (1928-29) 398 additional Starlings were caught and banded in the tower of the Metropolitan Me-

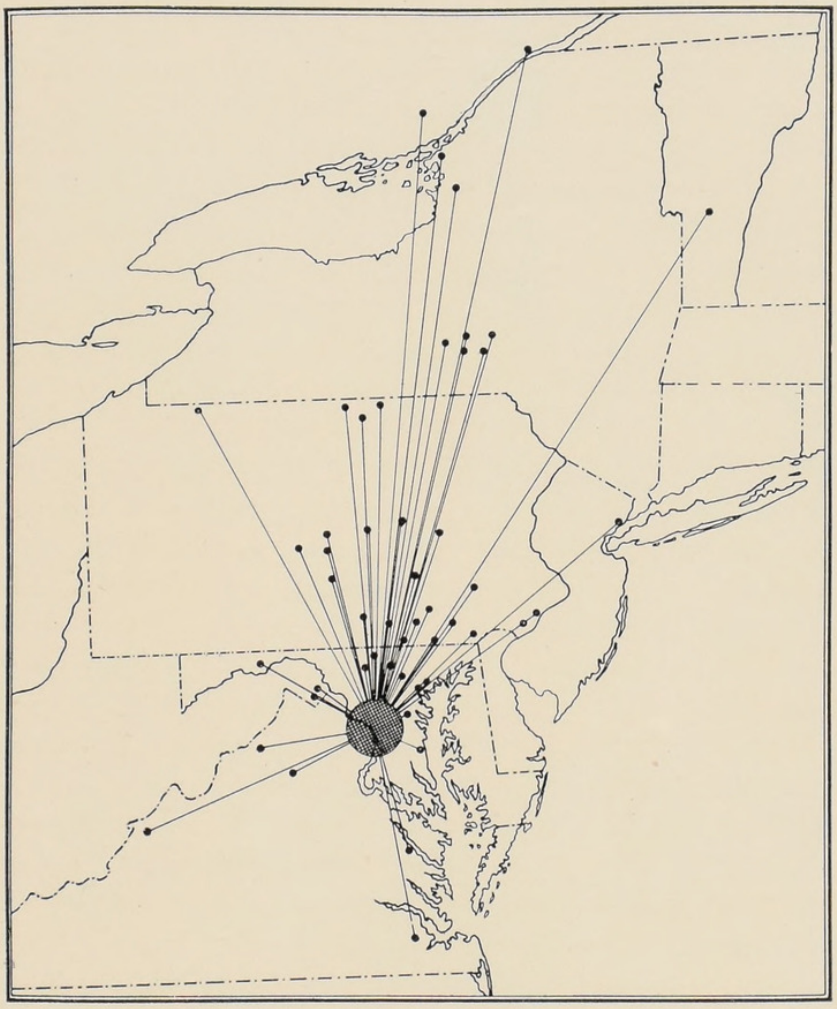

Fig. 14. Map showing the 120 returns from 4,516 Starlings banded in Washington in the winters of 1927-28 and 1928-29. Seventy birds were recovered at points within the shaded circle, having a radius of twenty miles from the point of banding. The most distant return (Cornwall, Ontario) is about 480 miles distant from Washington.

morial M. E. Church, situated only a half block from the scene of the earlier banding. In the course of this work a number of Washington ornithologists other than those mentioned, coöperated.

At the time of this writing (March, 1931) 120, or about 2.6 per cent of the total number of Starlings banded in these two winters

(4516) have been recorded as returns. (See Fig. 14). Seventy of these returns have been recorded from points less than twenty miles distant from the point of banding. Of these seventy essentially local returns, twenty-eight were recorded during subsequent breeding seasons and for that reason may be looked upon as resident birds. A portion also of the other forty-two local returns, birds captured or killed during winter months, probably were local breeders. Arguing from these admittedly meager data, it may be contended that something more than 23 per cent of the wintering Starlings of Washington were essentially resident birds. For that reason a reduction in the number of winter Starlings at Washington may be expected to exert a certain influence on the local breeding population but, of the birds eliminated, probably more than half would be northern breeders. Wallingford, Vt., Cape Vincent, N. Y., and Cornwall and Elgin, Ontario, are the most northerly points of return among the birds banded. The few records of return noted in Fig. 14 at points to the south of Washington are of birds captured during subsequent winters and indicate possibly that those individuals had merely gone on past Washington in their southern drift toward warmer climes.

The Starlings in the first of the towers visited, which is an old one, occupied various ledges and nooks in the walls as well as the cross braces. At a certain level there was a series of box-like cavities in the wall construction, each about two feet wide, three feet deep, and six inches high. These were filled with Starlings for their entire depth with scarcely room for another, and, despite an outdoor temperature of well below freezing, I am confident a thermometer placed among these birds would have registered a temperature close to that of their own bodies. We ourselves were able to keep perfectly comfortable, even though working bare-handed on cold nights, by frequently delving arms' length into one of these cavities to drag forth a double handful of Starlings. This habit of dense crowding is quite different from that displayed by Starlings when roosting in trees or on the exterior of some buildings where there is ample room. In such locations the birds appear to resent close association and aim to keep between each other a space equal to at least the width of a bird. (Fig. 15). The intrusion of another individual into a line at such a gathering is resisted, but if the newcomer is successful in establishing itself there follows a slight shifting of birds on each side in an attempt to equalize and keep at a maximum the interval between each.

Each successive night of banding at the church tower disclosed a certain number of "repeats" from our earlier bandings. It was also

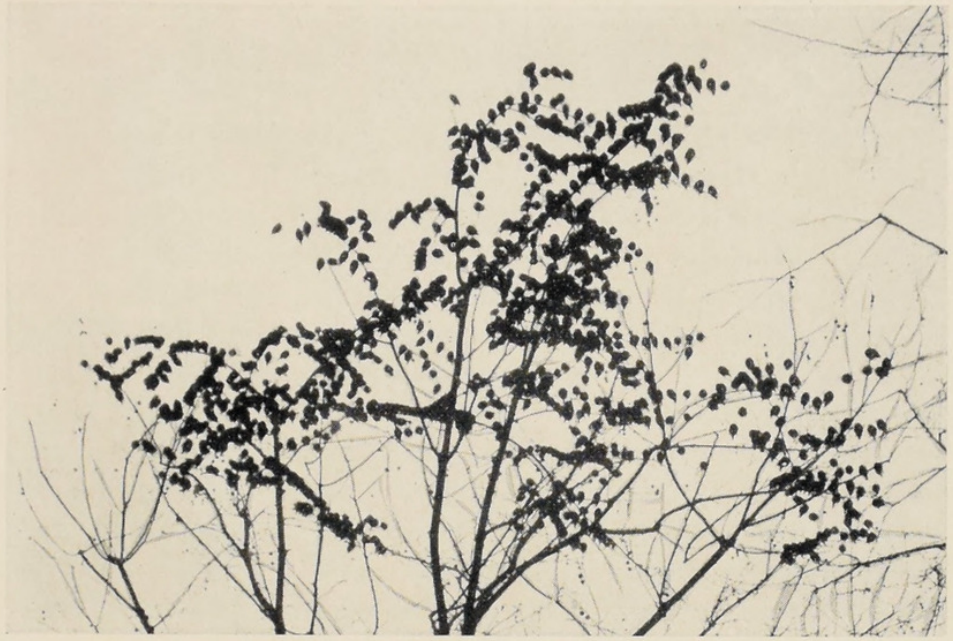

FIG. 15. A count made from the negative of this picture reveals about 1,000 Starlings in the top of this sycamore tree on Pennsylvania Avenue, Washington. The photograph was taken before sunrise.

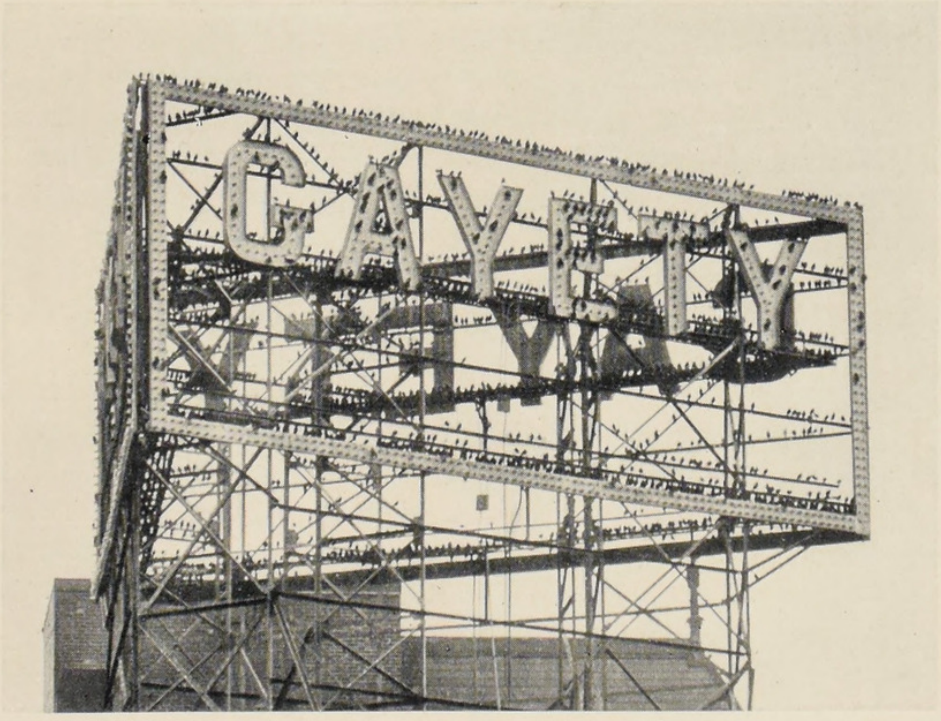

FIG. 16. "Gayety" is the keynote of this assemblage of approximately 3,000 Starlings on the top of a burlesque theatre in Washington.

Photographs by E. R. Kalmbach.

apparent that these operations were causing a decrease in the total population of the tower as we had to go to higher and higher levels to obtain the birds. It was not until the last banding of the first year (March 23, 1928) that we were able to capture practically every bird in the tower. On that evening it was necessary to climb to the very top of the cupola to obtain the last two hundred birds. Among these last birds *there was not a single "repeat"* although for that entire evening "repeats" averaged close to a fifth of the birds handled. Even previous to this night it had been noted that there was a tendency for the numbers on the "repeats" to be bunched in a fairly close sequence, much in the order in which they were originally banded. A group of fifty birds removed from one cavity might have six or eight "repeats" and the numbers of these repeats often were in close proximity in the numerical series, indicating, it was thought at that time, that each individual bird had returned to the same spot in the tower that it had occupied at the time it was banded. The absence of "repeats" among the last two hundred birds obtained from the peak of the cupola, which had not been visited before, strengthened this belief.

With the decrease in the number of birds in this tower, came an approximately corresponding increase in the number of Starlings using the ledges beneath the eaves and porticos of the former Land Office and the Patent Office buildings about one-fourth mile to the northwest. A few hundred also repaired to the tall spire of the Metropolitan M. E. Church just a half block to the south. This latter tower was the scene of the banding operations during the following winter (1928-29) when, after two "expeditions" on which 398 were banded, it also became unattractive to the birds. Today, three or four years after these operations, the two towers mentioned remain nearly free of Starlings, despite the fact that they are just as accessible as they ever were and that the local Starling population of Washington still is great.

Although the treatment given the birds when being banded was a bit rough at times, it was not more than the rugged Starling could ordinarily withstand. They were gathered in gunny sacks in lots of forty or fifty, brought down to a lower level, inspected for bands previously placed, banded and then released by tossing them out of a window. This compelled the birds to seek other more peaceful spots of repose for the rest of the night. Inspection of the premises by day on several occasions revealed only one dead Starling that had been handled on the previous night. There certainly was no great mortality. The summary ejection of the birds from the tower with the resultant

necessity on their part of finding new nightly abodes appeared to be the impelling factor that caused the desertion of these roosts. In one of the two towers a carillon of bells, on the framework of which many of the birds roosted, was in no sense a disturbing factor as not a bird was seen to leave the tower while Christmas carols and glad tidings of the new year were being tolled.

After the center of Washington's Starling population had moved to the old Land Office Building late in the winter of 1927-28, observations and certain control experimental work shifted to that scene. Here the birds occupied protected ledges beneath the eaves and on the frames of the upper story windows. The capital of every Corinthian column also had its quota and the regular dispersal of the birds in measured spaces permitted easy estimation of numbers. During the peak of occupancy in the winter of 1929-30, this building harbored nightly about 4,200 Starlings. Here further and more definite evidence of the attachment shown by individual Starlings for the same roosting spot was revealed. It came to light in connection with an experimental demonstration of a scheme to reduce the nuisance of roosting Starlings by eliminating the roosting ledges. The tops of the upper story windows across the entire south side of the old Land Office Building were occupied, each with its ten to fifteen birds. One of these roosting sites was eliminated by placing on the ledge a strip of wood having an end cross section of a right triangle and a length equal to the width of the window. In this manner an inclined surface sloping outward and downward at an angle of 45° from the horizontal displaced the flat ledge about three inches wide. On this incline the birds could not, or at least did not roost. This strip was placed in position on March 14, 1928, where it remained until the night of the 16th, when it was dislodged by the wind. On the night of the 17th every window of the upper story had its regular quota of birds in orderly array except the one on which the strip had formerly rested. This ledge remained absolutely free of Starlings notwithstanding the fact that now it was just as suitable as any other ledge and that there were mad scrambles for lodging space on neighboring windows scarcely eight feet away. On the night of the 18th one bird timidly occupied the extreme end of the vacated ledge and on following nights it was gradually repopulated.

At about the same time a somewhat similar experience was had with Starlings occupying a portico at the opposite end of this building. An automatic acetylene flash gun was fired in this portico for several consecutive nights causing a portion of the birds to seek quieter lodgings. The results were not as successful as hoped for and the

firing was stopped. The birds, however, did not return to the vacated ledges immediately and it was only after a period of several days that the area was slowly reoccupied.

A more recent happening emphasizes further the fact that once a Starling has been driven from a roosting spot and *has located itself at some other point* there is no urge to return to its earlier roost unless driven from its new abode. It occurred at the scene of this same center of Starling population, which had grown to considerable proportions and occupied not only all four sides of the old Land Office Building but also parts of the Patent Office to the north. On the 9th of February, 1931, a crew of eight men, four to each building, started a crusade against the roosting birds. Cat-o-nine tail whips of short poles with several strands of flexible wire attached were used to lash the ledges beneath the eaves. The men operated from the roof of the building. This was repeated on a second night and the work was supplemented by some of the men using "bean shooters", with small stones as projectiles, to dislodge birds that could not be reached with the whips. By the third night the roost was much reduced in size and the whips were abandoned entirely for the sling shots. The crew also was reduced to two men for each building. By the fourth night practically all the birds had left and two men leisurely patrolling from the sidewalk kept the few more persistent birds on the move.

Since then, these two buildings, which together harbored probably in excess of 6,000 birds, have been free of Starlings. It is true a single man goes through the perfunctory procedure of patrol but it is not needed. There is a complete avoidance of the building on the part of the birds. Now and then a small group will fly toward it as if to alight on one of the ledges; they may even perch for a moment or two but it is not for long. As far as these two buildings are concerned the relief from the Starlings has been complete. Yet immediately across the street an electric sign, gaily occupied by the birds, afforded lodging for about 3,000 (Fig. 16), a few of which showed any interest in or inclination to return to their old ledges scarcely 100 feet away. The rest of the evicted tenants found other spots in down-town Washington with a noticeable drift westward along F and G Streets. Even the District Building about a half mile away, from which the Starlings departed about a year previous in response to frightening measures, again had a substantial delegation. Each individual Starling could be expected to return to its own newly found nook or cranny and the old stands at the Patent Office, the old Land Office Building, as well as at the church towers previously mentioned will likely remain

unoccupied as long as the birds are *not further disturbed* at their new locations.

The affinity of Starlings for individual roosting spots seems to account for the sequence of events occurring at roosts in the course of a single winter, or even a series of winters, if we assume there to be a certain homing instinct lasting from one season to another. A group of adult birds, returning to old haunts, might well be expected to decoy the young of the previous breeding season and in that manner a winter roost might be maintained at the same location for a series of years.

The idea of a particular roosting spot for each individual bird is, I find, at variance with the popular conception of large Starling roosts. To the casual observer these congregations convey the impression of a mad scramble to find roosting spots. There is, in fact, a scramble but behind it all there exists, I believe, the impelling desire of each bird to find its own particular location. Admittedly there is confusion, especially when there are new arrivals at the roost or when the roosting birds have been disturbed by man or other causes. But, all in all, these nightly gatherings may be little more of a riot than what one sees at any football game when each of 50,000 or more spectators is attempting to plant himself in his own reserved seat before the start of the game.

There is need for more direct and positive evidence of the trait these observations have indicated largely in a circumstantial way. This could be obtained by observing, night after night, conspicuously marked birds. Just how one would succeed in capturing and marking Starlings at one of the open roosts where they could be watched from day to day, without unduly disturbing the group I cannot say. Starlings are remarkably uniform in appearance but I hope sometime to have the good fortune to locate one or more individuals that are distinguishable so that their movements may be readily detected.

Despite the constancy with which Starlings return night after night to an established abode, motives bordering either on fickleness or an astute sense of danger at times seem to govern their movements when they decide to vacate. The occupancy of a new roost then may take on the aspect of a deliberate and willful avoidance of their former rendezvous. An incident that well illustrates such a case occurred within recent years in a nearby community in Virginia. A mixed flock of English Sparrows and Starlings roosted, to the great distress of the owner of the property, in the ivy covering the brick walls of a large and stately dwelling. A plea for some relief led to an experiment in the use of calcium cyanide dust as a fumigant. This was

fairly successful and the roost was materially reduced in size but not eliminated. Several dozen birds still remained but, during the days following, these also gradually vacated the premises and sought other roosting places. For the remainder of that season and in subsequent years these ivy covered walls harbored neither English Sparrows nor Starlings, though all essential features that originally attracted the birds still remained.

Compared with the drastic action taken without success against some bird roosts, our activities against the Starlings roosting in the tower of the First Presbyterian Church in Washington were mild and inoffensive. Yet five nights of banding at widely scattered dates so offended Starling sensibilities that they all left and few ever returned. Even more decisive was the manner which the Starlings vacated the ventilators on the Post Office Building. One night's visit of a banding party seemed sufficient to cause a rapid decrease in numbers on following nights until the roost was utterly forsaken.

A similar reaction has been noted with other species. I have known Crows to vacate enormous roosts apparently through the loss of a comparatively few birds through poisoning. Red-winged Blackbirds and Boat-tailed Grackles react similarly in their feeding areas. Stoddard and Handley seldom found individual Chimney Swifts returning to the chimney in which they had been collected, and Dr. A. K. Fisher relates that some years ago a little persecution of English Sparrows at Governor Pinchot's home in Milford, Pa., resulted in the birds abandoning the ivy covered walls throughout ensuing years although the barns a few hundred yards distant still harbored them.

The only thoughts I have to offer on such experiences are the following: There seems to be no dearth of roosting facilities that are acceptable to the birds. Neither are there any inseparable ties or affinities to draw birds back to a roost once it has been definitely vacated and the birds established elsewhere. As I look back, however, over many varied experiences with bird roosts I am unable to explain why, on some occasions the most energetic and persistent efforts at roost eradication fail miserably and on others, little more than a suggestion to move meets with a favorable response. The uncanny ability to detect conditions that spell real danger, especially on the part of Starlings, blackbirds, and Crows, is to me another unexplained trait that often comes to light in problems of economic ornithology. However often it occurs and to whatever extent it may frustrate or alter well laid plans for control, I never fail to marvel at it. After

all it is such non-predictable reactions as these that add so much to the interest of economic ornithology and convince us that however exact our scientific findings may be we can not expect the actions of living birds to conform to formulae.

U. S. Biological Survey,
Washington, D. C.

CURVATURE OF WING AND FLAPPING FLIGHT

BY WILLIAM BREWSTER TABER, JR.

In the last issue of the Wilson Bulletin (XLIV, 1932, pp. 19-22) my paper on "Curvature of Wing and Soaring Flight" gives in detail the explanation of the effect of the curvature of the wing and how the air currents striking the under wing surface are deflected, thus causing an upward lift and a thrust forward, in this way supplying the necessary power for soaring flight. In making this explanation clear it was necessary to resort to a velocity diagram involving technical terms. So as to avoid repetition here I will ask the interested reader to acquaint himself with the technical terms and their meanings as given in this previous paper.

In figure 17, upper diagram, I have represented by the heavy curved line *CD* the cross section of a wing of a bird flying to the left in a horizontal direction as indicated by the arrow above the diagram. We will consider in this case that the bird is flying in motionless air and that the wing is flapping straight downward. By bringing the wing straight downward the same effect is produced upon the wing as if the wing were held motionless and an air current were blowing straight upward against it. (Here let me say that to understand this problem it is essential to keep constantly in mind that the velocity lines represent the directions and velocities of air currents *in relation to the wing*, and not to the body or any other part of the bird or to an observer standing on the ground). The line *BC* represents this upward air current, the arrow on the line showing the direction, and the length of the line representing the velocity of this air current. Since the bird is flying horizontally to the left, the line *AB* has been drawn representing the current of air passing by the wing to the right. The resultant of the two components *AB* and *BC* is *AC*. In other words, the combined effects upon the wing of the two air currents, *AB* due to the motion of the bird to the left, and *BC* due to the motion of the wing downward, is equivalent to a single current blowing upon the wing in the direction *AC* and of a velocity proportional to the