

ON SOARING FLIGHT

by E. C. Huffaker

EDITOR'S NOTE: *With the kind permission of the Smithsonian Institution we are reprinting this remarkable paper on soaring flight, first published in the Smithsonian Report for 1897. This is the second installment.*

EXPERIMENTS IN GENERATING ASCENDING CURRENTS.

If the condition of unstable equilibrium is a possible one, and if the normal condition of the air near the earth's surface on a warm day is unstable the fact should be susceptible of verification, and I accordingly made a large number of experiments in the open air, under the conditions known to be favorable to soaring flight. On a warm day in August, with light irregular winds and intervals of calms I tried the effect of producing artificial ascending currents by means of a fan; reasoning that if the air was in a condition of unstable equilibrium I should be able, with little difficulty, to generate a current which, once started, might extend to a considerable height. These experiments were made in the open park surrounding the Smithsonian Institution building. In order to detect the presence of ascending currents I provided strands of white China silk, 1 foot in length, pulled apart so that they were as light almost as spider's webs and yet visible by irradiation in the sunlight at a considerable distance. Holding one of these strands aloft in one hand, I fanned the air upward underneath it; then liberating the strand I continued to toss the air beneath it until it was well under way upward. When once started the silk would be borne up to a height of 20, 30, 50, or 100 feet, and often to much greater heights. In numerous instances the strands were carried upward entirely out of sight, and in the bright sunlight they could be followed to a height of 200 feet, as estimated by comparison with the height of the adjacent towers of the Smithsonian Institution building. I repeated these experiments during the extremely hot days of September, 1897, choosing those localities where the ground was level, and where there were no buildings or trees near-by which might give rise to ascending currents. I succeeded in sending the strands of silk upward almost as often as I made the attempt, and by changing the locality sought to eliminate, as much as possible, the probability that the strands were caught up by currents already in existence. Often a single stroke of the fan sufficed to produce the necessary current, the silk rising steadily and often rapidly. When strands ceased to rise beyond a height of some 25 or 30 feet, I could usually send them on again by tossing the air upward beneath them with the fan, and frequently when falling they were sent upward out of sight. On one occasion a strand had risen to a height of 75 feet, and immediately afterwards a bit of thistle down, which chanced to float horizontally to the spot where I stood, turned upward

without help and followed the path of the silk, continuing upward until lost to view. The current produced thus appears to have had a certain degree of permanence. On cold cloudy days no amount of effort would cause the strands to rise. It seems, therefore, that very slight disturbances, such as the circling and flapping of the bird might produce, are sufficient to produce ascending currents under the conditions which observation shows to be favorable to flight.

THE CONDITIONS RENDERING SOARING FLIGHT POSSIBLE.

We are now in a position to turn to the soaring birds and inquire if in the manner of their soaring or otherwise they furnish any evidence as to the correctness of the hypothesis here set forth. And first we shall consider the conditions of the atmosphere which, as observation shows, render soaring flight possible.

Of recent years writers upon this subject have almost universally agreed that winds are necessary to flight. But notwithstanding this widespread belief among scientific observers I venture to say that while winds may attain a velocity sufficient to furnish through their internal movements all the energy necessary for sustained flight without flapping, the birds may yet soar perfectly when the winds are in themselves too feeble to support them, and that the condition of the atmosphere which gives rise to local winds—that is, an unstable condition of the lower strata—is also the condition which renders soaring flight possible in the absence of strong winds. A light wind on this view is to be regarded not as a cause at all but as an effect, and we may, on this view, at once dismiss the question as to the power which such a wind may furnish, and look instead to the condition of the atmosphere which gives rise to it for the explanation of the flight of the birds, whose ability to soar seems to be so entirely independent of the strength of the winds that they may occasionally be found soaring in what appears to be an absolute calm. I have many times seen the turkey buzzard soaring in sheltered localities when there was no indication of any wind whatever. Early one morning, while following the railroad up the narrow valley of the French Broad River, near the Warm Springs, N. C., I saw a turkey buzzard fly from the western slope of a high ridge and begin soaring in circles above a narrow sunlit meadow upon the banks of the river, alternately beating the air violently with its wings and sailing. This he continued to do for the space of perhaps two minutes, after which he entirely ceased flapping, and rose steadily along a spiral path to a height of 300 feet, before sailing away along a direct descending course. On this occasion there was not the slightest breath of wind to be detected. Not a blade of