

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 final installment. The comments we have received have been enthusiastic and reverent and may be summed up in this statement: "Our soaring technique would be tremendously advanced if this treatise by E. C. Huffaker had been brought to the attention of our glider pilots when they first began to stumble upon these truths through the past ten years."*

BIRDS OFTEN BEGIN CIRCLING WHERE NO ASCENDING CURRENT EXISTS.

Upon the hypothesis of ascending currents artificially produced by the bird many such phenomena of flight, not otherwise easily understood, may be readily explained, as for instance the scarcely perceptible ascent in the early stages of spiral flight, with the subsequent rapid rise. If the birds availed themselves of ascending currents already established they should be found rising as soon as they entered the current; but if the current were produced by their own efforts a certain time would elapse before it attained its full force, and we should find as is actually the case, the birds suddenly and rapidly rising, after a more or less prolonged flight at a fixed elevation. The hypothesis explains also why the birds so often flap vigorously at the beginning of their flight, and, what is significant, why their flapping ceases not gradually but suddenly. It has been suggested that as the bird rises it encounters winds of greater velocity and consequently of greater buoyant power. But spiral flight occurs usually when the winds are either light or absent, and the simultaneous cessation of flapping and the steady rise which follows is commonly attained at low altitudes, nor is there any apparent difference in the character of their flight at the heights of 200 feet and 1,000 feet. Besides high winds enable the bird to soar without circling at all and seem rather to be unfavorable to any great ascent by spiral flight. Incidentally it may be stated that the soaring birds seldom if ever rise to great heights by flapping. But aside from these general considerations the birds occasionally furnish evidence of a much more convincing character. Thus on one of the calmest mornings I ever knew I saw two vultures make an attempt to soar in circles at a height of about 100 feet above the earth. In order to maintain and increase their altitude they continued to flap vigorously for about three minutes, after which, having risen to a height of 200 feet, they ceased flapping and continued rising. A third vulture now approached the spot, flapping as it came, and began soaring immediately beneath the other two, over the same spot above which their flight began, but at a lower elevation. But unlike the other two, it did not flap at all, but rose steadily from the first. The elevation in this case evidently had no influence on

the character of the flight, and the fact that the last vulture soared steadily at the exact spot where three minutes before the two others were unable to soar at all offers strong presumptive evidence that the first two had effected some change in the condition of the atmosphere at that spot before the third one entered it. On another occasion, in a moderate wind, three vultures being frightened from a carcass, began soaring in circles near the earth above a meadow. During the early part of their flight they flapped vigorously, but after a time ceased flapping entirely, and rose steadily along a course slanting with the wind. When they had reached a considerable altitude a fourth passed beneath them in direct flight, and continued on until it reached the identical spot at which the three had begun their ascent by flapping. It at once began soaring and rising rapidly, but was not under the necessity of flapping as the others had been. As it ascended it followed directly in the course the others had taken.

On another occasion with light winds prevailing I witnessed the ascent of two flocks of vultures near the Dan River, Virginia. The first flock, which numbered fourteen birds, rose after some preliminary flapping from a wide alluvial plain near the banks of the river. The second flock, numbering fifteen birds, rose from the slope of a hill about 3,000 feet distant. After each flock had continued soaring for some minutes, all the birds above the slope of the hill began flapping and in a very short while began to disperse. And now a singular thing took place. Each bird on leaving the spot sailed directly toward the spot from which the first flock had ascended, and each of the fifteen birds as it reached the spot, at an elevation varying from 75 feet to 200 feet, was seen to rise as if buoyed up by an ascending current, and each at once turning upon a circle began to follow the course taken by the birds of the first flock. Only two out of the fifteen flapped their wings at all and all rose steadily, and soon, with those of the first flock, formed a column of vultures, slanting in the direction the wind was blowing and reaching to a height of perhaps 1,000 feet. Here we may suppose that the vultures upon the hillside began flapping because the supply of heated air which buoyed them up became exhausted, and that being no longer supported at that point, they sought the spot from whence the first flock was to be seen rising; while the fact that each bird was successively buoyed up on reaching the spot indicated the existence of a well-established ascending current which extended to a height of 1,000 feet or more.

Again on a clear day with light winds a flock of forty vultures was frightened from a carcass on a summit of a ridge. They flew directly down a valley in a direct line with much flapping, a distance of a half mile and with