Soaring Over the Open Sea

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Editor's Note—With the kind permission of the author and the editors, we are reprinting this treatise from the September, 1942 issue of the *Scientific Monthly*.

Convection Motions Indicated by the Gulls

FROM October until spring the air over the ocean off the east coast of the United States is, on the average, colder than the water.[1] The heating of this air by the water produces ascending convective motions (motions hereafter referred to as thermals) which are columnar in form during light winds, and which change with higher winds to vertical sheets extending indefinitely up and down (parallel with the) wind. Unlike land thermals, these sea thermals maintain or even increase in strength under night-time or cloudy conditions. Also, as one moves southeastward (say from New York City) under average atmospheric conditions one finds thermals of increasing strength until one gets beyond the Gulf Stream—a condition due simply to the increasing difference between the sea temperature and the air temperature.

These convective motions of air over the sea are revealed by the soaring routines of herring gulls living in this air. The first suggestive feature of their movements lies in the fact that they are not seen far (100 miles or more) at sea until the fall, when cold air from the continent flows out over the warmer sea. The probable reason for this correlation is that the birds are unable to maintain a proper balance between their food supply and the energy requirements for flight until the development of the strong thermals of the fall and winter months make moving about over the sea physically easy.

Below a wind velocity of seven meters per second the birds circle about in columnar thermals, drifting along with the wind as they rise. If the rate of ascent in the thermal is great, the birds will have ample potential energy in the form of altitude to glide back to or beyond their starting point. At wind velocities of from seven to thirteen meters per second, birds soar straight to windward in a fast flight in which they gain altitude and over-the-water distance much more rapidly than in the circling flight of lower wind velocities. While moving against a wind of twenty-eight miles per hour, birds have been seen to disappear high to windward in a few minutes time.

Fig. 1 is a graph on which the flight response of the gulls is classified and plotted against the significant physical factors—*i.e.*, the wind velocity and the relative air and water temperatures. Each observation (*i.e.*, each symbol) represents an average period of about six hours during which at any time gulls might have been seen performing

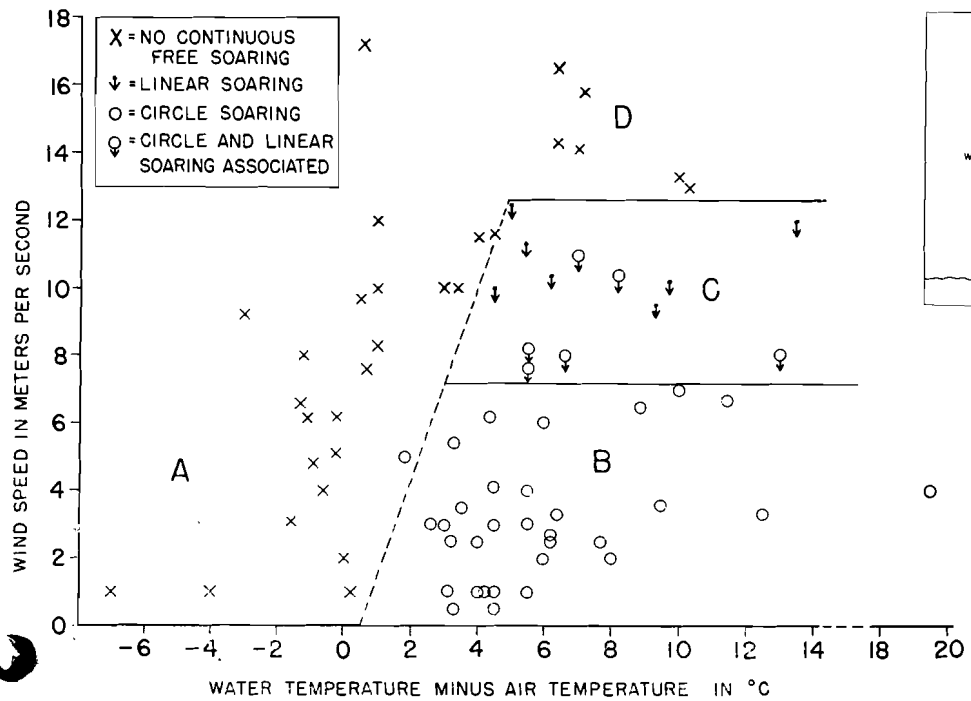

Fig. 1. Flight Response of Herring Gulls At different wind velocities and at various relative air and water temperatures.

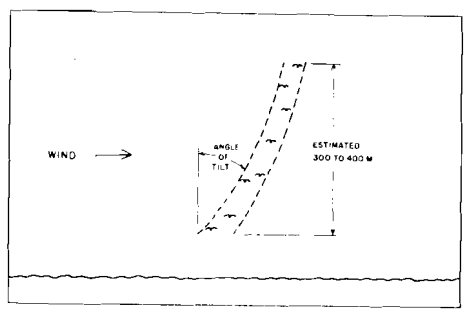

Fig. 2. Diagrammatic Sketch Showing what is meant in the text by "tilt" and "thermal continuity."