# Theory of Soaring Flight

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PART 9

## SUMMARY AND OUTLOOK

IT HAS BEEN shown that the sources of energy which are available to soaring birds are so ample and the methods by which they can be utilized are so variegated that the observed performances can be scientifically explained and need not be looked upon as mysterious. Most soaring flights are undoubtedly and primarily accomplished by utilizing ascending air currents, whether the origin of the rising current be obvious in any particular instance or not. Systematic wind vector measurements and soundings will do much to extend our knowledge of the texture of the atmosphere. As to dynamic soaring, it must be recognized that at least some birds, such as the sea gulls, albatross, and swallows, do practice it occasionally. The smaller birds are somewhat better off in this respect than the larger ones for which the power margin is more critical. It is interesting to speculate on the possibility of much more powerful meteorological energy sources having prevailed in the prehistoric ages when, according to our knowledge of fossils, much larger birds with high wing loading must have been roaming the atmosphere.

Human soaring flight and the emulation of the feats of the birds is not only theoretically demonstrable but has become a fact during this last generation. Motorless flight has found adherents all over the globe. It is being pursued for three purposes: (1) as a thrilling sport; (2) as a means to study the behavior and improve the design of aircraft in general; (3) as a means to train students in the art of flying.

Static soaring flight started out as slope soaring above the windward slopes of hills, mountain ranges, and coasts. It developed from there into thermal soaring which opened up a vast realm of cross-country soaring and cast off the shackles of the topography.

Dynamic soaring maneuvers have been deliberately tried by expert pilots but here the results accomplished are insignificant and uncertain. Our "feel" is admittedly undeveloped and it is difficult to learn to decide when a positive lift surge is caused by a vertical or a head-on gust, which should be distinguished and differently parried. At low flight speed it is occasionally possible to observe airborne material such as insects, plant seeds, etc., floating in the air and giving away the presence of vertical flumes in the atmosphere. Instruments for detecting atmospheric energy which utilize optical, acoustical, radio and thermic gust and thermal gradiometers for detecting this energy have been proposed and tried.

Even if the sailplane could be equipped with the most elaborate instrumentation, completely describing the aerodynamic and dynamic flight parameters, the information conveyed by it would not enable the pilot to determine and execute the maneuver which would wrest the maximum of energy from whatever gustiness he encounters.

While the problem of automatic stabilization of aircraft in essentially straight or steadily turning flight has been solved to a reasonable degree of accuracy the same is by no means true for soaring flight involving dynamic maneuvers. In fact this constitutes a much more formidable problem. In order to determine the status of acceleration of a surrounding mass of air it is necessary for a complete solution of dynamic soaring automatization to resort to instruments responsive to terrestrial "fields" independent of those detected by air speed meters, wind vanes, yawmeters, altimeters, gyroscopes, accelerometers, and the like. Magnetic, optical and radio devices have been considered, but no scientifically complete system has yet been demonstrated.

As to the application of soaring flight techniques, both static and dynamic, to powered aircraft, it has been established that under favorable circumstances performances can be improved and hazards overcome by clever tactics and it is in this respect that experience gained in soaring flight will stand a power aircraft pilot in good stead.