A Few Hours of Daylight

J. S. Brennan

Articles on the sport of soaring, or motorless flight, are of many kinds, ranging from the highly technical to the highly aesthetic, from low-speed aerodynamics to Jonathan Livingstone Seagull. This article addresses the basic mechanics of soaring, the weather conditions and phenomena which permit soaring flight, but not the technique of flying a sailplane. It attempts to supply sufficient information for the reader to gain a reasonable comprehension not only of the sources of energy which permit soaring, but, by way of fallout, an appreciation of what the sport is all about. Hopefully it will convey to the reader awareness of the fallacy contained in the often-heard question, "Why did you land, did the wind quit?"

Throughout this article the terms "gliding" and "soaring" will be used without precise distinction, although in common usage "gliding" bears a connotation of descending, and "soaring" of ascending. Common usage also distinguishes between a "glider" as being a motorless aircraft of low performance, and a "sailplane" as being one of high performance. We speak more of "performance" later.

Influence of Wind

It is not difficult to accept the fact that a motorless aircraft, be it glider or sailplane, in still air will be constantly descending. So long as it is unaffected by outside influences, the glider will be converting the potential energy of altitude into the kinetic energy of forward motion, through which aerodynamic lift is generated to sustain the glider in flight, while some portion of the energy is dissipated to the surrounding air through aerodynamic drag. Unless energy is added to the system, the glider will eventually expend all of its altitude and must land. In the case of a powered aircraft, energy is continually being fed into the system by the engine. The glider must extract its energy from its natural surroundings. The rate of this energy extraction is a function of the existing meteorological conditions and of the skill of the pilot.

The glider is extremely self-centered. It will fly straight or turn, fly fast or slowly at the behest of the pilot, but it cares only for the flow of air over the surface of its wing. If the flow is fast enough, it will fly, if not, it will stall and descend vertically. What is happening in the air only a few feet away is of no concern, far less what is happening at the earth's surface below. Insofar as the glider is concerned, it is always descending at a constant rate for any given airspeed, and that airspeed is measured only by the rate of flow of the air over its wing.

But what if a wind is blowing? Wind is assumed here to be a horizontal flow of air with respect to the fixed earth. The glider, isolated in its immediately surrounding air, is not concerned with the wind. The fact that the mass of air, through which the glider is flying at its constant airspeed and rate of descent, is moving with respect to the ground has absolutely no effect on the flight conditions of the glider. The pilot may be concerned that his path over the ground is modified by wind-induced drift, or that his speed over the ground is increased or decreased by wind components, but this is a matter of navigation, and has nothing to do with flight performance.

Vertical Flow of Air

Instead of the horizontal motion of the atmosphere which we call wind, let us stipulate the existence of vertical motion. Vertical motion necessarily entails both upward and downward flow, so that the general mass distribution of the atmosphere is maintained. Ignoring for the moment what might be the source of such vertical currents of air, we can accept the fact that a glider, flying in a mass of air which is rising at a speed greater than the natural descending speed of the glider, will gain altitude. These rising currents of air are generically called "lift," while the accompanying downward currents are called "sink."

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Depending on the nature of the meteorological phenomenon which gives rise to the currents, the technique of extracting its energy, that is, the pattern of flight, will differ. The pilot's task is to remain in the lift until he has reached some desired altitude, and then to expend the altitude in straight flight along his intended path.

The vertical currents can result from a number of naturally occurring conditions. The principal sources of such lift are known as "ridge lift," "mountain wave," and "thermals." In addition, there are coldfronts, shear lines, orographic thermals, anabatic winds, thermal wave, and all varieties of combinations of some of these effects. Almost all soaring in this country uses one or more of the first three named effects, and an understanding of them will suffice for all practical purposes.

Ridge Lift

Ridge lift is the simplest of the three to understand. It is the result of a wind of some velocity, perhaps ten knots or more, blowing against the face of a sharp rise in the terrain, such as a cliff or a mountain ridge. Since the air must rise to get over the obstruction, there is a vertical component to the wind flow, and it is this vertical component that provides the lift. The flow is shown diagrammatically in Fig. 1. The location of the maximum lift will vary somewhat with the shape of the rise in the ground, with the velocity of the wind, and with altitude. Characteristically it will be located along some line, such as the line x-x′ in the figure, and always on the upwind side of the slope. Corresponding to the lift on the upwind side of a ridge, there is nearly always sink on the downwind side at low altitudes. Ridge lift is usually associated with a terrain feature of some length, although it might be found near an isolated hill.

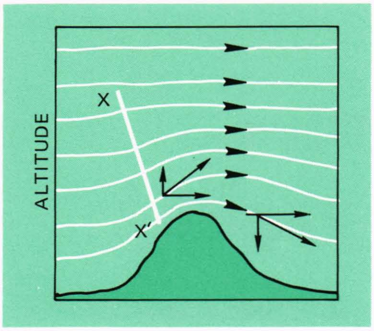

Fig. 1—Air flow against an obstruction resulting in the generation of ridge lift.

Altitude is gained, or maintained, in ridge lift by flying back and forth across the face of the terrain feature which causes it. Generally it is necessary to fly quite close to the face of the slope to find the strongest lift, so that as a safety precaution, all turns are made away from the slope. Rules of the road have been devised to minimize interference when more than one glider is involved.

Lee Wave

Mountain wave, or lee wave as it is frequently called, provides an opportunity of flying to relatively high altitudes. Like ridge lift, it is generated by a wind blowing nearly perpendicularly to a ridge, but it is found on the lee side of the ridge in the form of a standing wave. It can be visualized by analogy to a log lying submerged across a stream. The water rises to cross the obstruction, falls on the downstream side, and then may rise and fall several more times before quiescent flow is again established. In a similar fashion, under the appropriate conditions, a wave is formed in the air downwind from a ridge. While the appropriate conditions are not precisely defined, they consist essentially of the following: (a) wind direction nearly perpendicular to the length of the ridge, and nearly constant with altitude; (b) wind velocity 25 knots or more at the crest of the ridge, and increasing with altitude; and (c) the existence of a stable layer (e.g. a temperature inversion) in the atmosphere separating layers of low stability above and below.

Schematically the flow pattern which accompanies the wave is shown in Fig. 2. While the wave pattern is stationary with respect to the ridge, the air is flowing through it. Typically the horizontal component of the flow at some altitude above the crest of the ridge will be near or above the stalling speed of the glider. By flying into the wind, the pilot can control his position with respect to the wave by changing his airspeed, or if the wind velocity is too low, he can tack back and forth at a small angle to the wind direction.

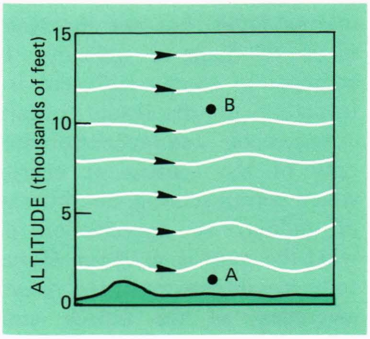

Fig. 2—Air flow over a mountain or ridge resulting in lee wave.

While it is possible under most conditions to climb in any of the upward flowing parts of the wave, the greatest climb rate and peak altitude is usually found in the primary wave, i.e., the wave closest to the ridge. If a glider is introduced into the wave system at some point A in the figure, the vertical component of the air flow will permit the glider to ascend not only along the streamline, but also from one streamline to another until some point B is reached, at which point the lifting component of the wave just equals the natural sinking speed of the glider.

The wave is a fixed pattern in the atmosphere with a stream of air flowing through it. If the stream of air is moist and the amplitude of the wave sufficient, the moisture will be carried above its dew point and will form a cloud of characteristic shape. The cloud appears to remain stationary like the wave, although in fact it is constantly being dissipated on the downwind edge and regenerated on the upwind edge. The flow of air brings the moisture in the air to the level at which the dew point occurs, then the wave starts to descend after its peak and carries cloud particles to a level where the temperature is above the dew point and the water is again evaporated. If the wave is simple in structure, the process will produce long parallel "loaves" of cloud, called lenticulars or lennies from their lens shape in cross-section. A classic formation of this type is shown in Fig. 3, taken from a roof-top in Washington, D. C.

In the local area, wave usually accompanies a post-frontal wind from the northwest or west, blowing across the ridges of the Appalachians. There are a number of these ridges generally parallel to each other, with varying spacings. Depending on wind direction and velocity, the several wave systems may become superimposed and generate an interference pattern of extraordinary complexity. The glider pilot, when such conditions occur, has to abandon the book and exercise his own knowledge, ingenuity, and just plain luck.

Lapse Rate and Thermals

The most ubiquitous source of altitude gain used by the soaring pilot is the thermal. In simplest terms a thermal is a mass of air, buoyant with respect to its surroundings, which rises from ground level to an altitude determined by the existing meterological conditions. There is some disagreement among the pundits as to the exact structure of the rising air mass, with considerable support for the thesis that an isolated thermal is a vortex ring, similar to a smoke ring, but rising vertically as shown in Fig. 4. Since the upward velocity of the airflow is greater at the center of the thermal than the upward velocity of the thermal itself, it is theorized that it is possible to climb through the thermal structure as it rises.

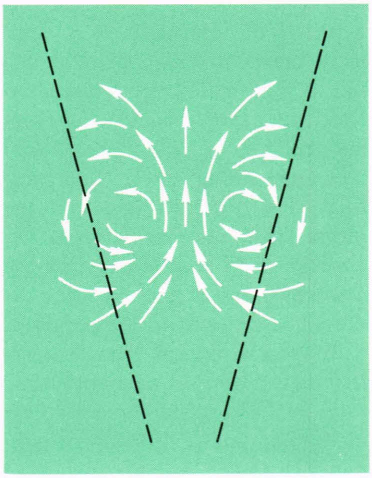

Fig. 4—Schematic representation of flow in a vortex ring believed to be typical of that in isolated thermals.

Official photograph, National Oceanic and Atmospheric Administration.

Fig. 3—Lenticular cloud formations resulting from lee waves over Washington, D.C.

The buoyancy of the thermal with respect to its surroundings is due to either an excess of temperature or an excess of moisture, or perhaps both. A mixture of dry air and water vapor is less dense than dry air alone at the same temperature. Thermals cooler than their surrounding air mass have been observed on many occasions near the seacoast, but almost all inland thermals are warmer than the surrounding air mass.

While the air in our atmosphere is light, its weight is by no means negligible. The column of air over each square foot of the earth's surface weighs about one ton. Since the top parts of the column are supported by the lower, there must exist a pressure gradient with altitude. In the Standard Atmosphere the pressure at 18,000 feet is just half that at sea level. If a parcel of dry air at sea level were in some manner raised adiabatically, without gain or loss of heat, to some higher level, it would expand and cool. The rate of reduction in temperature with altitude is called the lapse rate. In this case the reduction is called the dry adiabatic lapse rate, and it has the value of about 3°C per 1,000 feet. If a parcel of saturated air is similarly raised it will cool at a different rate, called the moist adiabatic lapse rate, which varies from about 1.1°C to 2.8°C per 1,000 feet, depending on its temperature. The lower values for the moist lapse rate result from the absorption of heat released by the condensation of the moisture as the air is reduced in temperature.

When the actual lapse rate is less than the moist adiabatic lapse rate, the air is stable, regardless of the amount of moisture it contains. In Fig. 5 if the actual lapse rate lies to the right of the moist adiabat, then a parcel of air which is lifted to a higher level becomes cooler than its surroundings and falls back to its original level when the lifting force is removed.

If the actual lapse rate is greater than the dry adiabatic lapse rate, lying to the left of the dry adiabat in the illustration, then the air is absolutely unstable, regardless of the amount of moisture it might contain, and any parcel of air lifted from its initial level will continue to rise when the lifting force is removed.

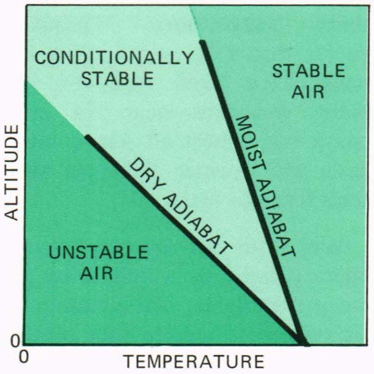

Fig. 5—The degree of stability of the air as a function of the temperature change with altitude.

When the actual lapse rate lies between the dry and the moist adiabats, then the air will be conditionally stable. If the air is saturated, it will be unstable, if unsaturated it will be stable.

The warmth of the air which comprises the thermal, from which it gains its buoyancy, comes initially from the absorption of solar energy by the ground. The heated ground in turn warms the layer of air lying above it. While this air is then buoyant, surface tension effects may hold it in place until additional heating or a gust of wind releases it and it begins to rise. If, as is normal, the air at higher altitudes is cooler than at lower, the warmed air mass which constitutes the thermal will find its surroundings continually cooler as it rises, which preserves its buoyancy.

At some altitude, usually from 3,000 to 7,000 feet in the eastern United States, a temperature inversion frequently occurs. At this point the decreasing trend of temperature ceases or is reversed, and for a few hundreds of feet the air temperature may increase with altitude. When the thermal reaches this altitude the marginal temperature difference between it and its surroundings may disappear and the thermal "tops out," and no further gain in altitude is possible.

The air at ground level is usually more moist than the air at higher altitudes. As the thermal rises and cools, it frequently reaches the dew point below the level of the inversion and the moisture condenses into cumulus clouds such as those shown in Fig. 6. When the cloud is initially formed it has a clearly-defined and flattened bottom surface and this persists so long as the thermal continues to add more moist air to it. When the thermal ceases, as it will when the supply of heated air near the ground is exhausted, the bottom of the cloud loses its flatness and takes on a more fuzzy appearance. In its later stages there may be suggestions of hanging tendrils of mist, by which time there may be sink instead of lift below the

Official photograph, National Oceanic and Atmospheric Administration.

Fig. 6—Cumulus clouds characteristic of good soaring conditions.

cloud. If the atmosphere is generally dry, the cloud will gradually disappear with a life-cycle time of about half an hour.

Since the lapse rate determines whether thermals of the height and velocity of interest to the soaring pilot will occur, it is an essential ingredient in a soaring forecast. The graph of temperature against altitude is termed a "sounding." While the data are available from the Weather Service from early morning radiosonde transmissions, it is not a difficult do-it-yourself project using a powered airplane.

The typical fair-weather early morning sounding in summer has the appearance of Fig. 7(a). The temperature increases with altitude for the first few hundred feet and then assumes the more familiar decreasing trend until at some altitude the persistent temperature inversion is encountered. The low level inversion results from the nocturnal radiation of heat from the surface of the ground into space.

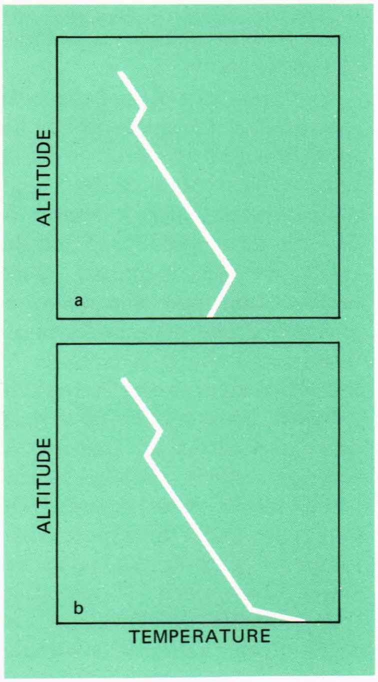

Fig. 7—Schematic representations of soundings. (a) A typical early morning sounding in summer; (b) The sounding modified by several hours of solar heating.

After sunrise the absorption of solar radiation warms the ground and the overlying stratum of air, and some hours after sunrise a sounding would show the situation of Fig. 7(b). The nocturnal inversion has been eliminated by insolation and has been replaced by a superadiabatic layer some tens of feet in depth. The superadiabatic layer is absolutely unstable and hence forms a breeding ground for thermals. Whether the thermals which are born within this layer grow to proportions of interest to the soaring pilot depends on the lapse rate above the layer.

Thermals are the most frequently used source of lift both for local soaring and for cross-country flights. They are sometimes of very limited diameter, and to extract the greatest amount of energy in such cases it is necessary to fly the glider in small steeply banked circles. There is a trade-off situation between the sinking speed of the glider, which increases with bank angle, and the vertical velocity of the air in the thermal, which decreases with distance from the center. To fly in a circle of small radius the bank must be steep, and the small circle is usually needed to fly in the strongest lift. When sufficient altitude has been gained, the pilot flies the glider in a straight line in the direction of his intended flight, deviating, perhaps, in response to a promising cloud formation, circling again to regain height at intervals dictated by his judgment. His path, then, resembles a sawtooth, with vertical climbs of from two to four thousand feet, and intervals between climbs of from three to ten miles, depending on the capabilities of the glider and the strength of the thermals.

Convection as Seen by Radar

While thermals have been described in terms that permit visualization of neat symmetrical columns of upward-flowing air, in real life they, like so many things in nature, are of infinite variety. Radar observations made by APL staff members, under the direction of T. G. Konrad and Isadore Katz, have made it possible to observe both the structure of individual thermals and the structure of fields of convection, and so to investigate their spatial and temporal characteristics. The thermals are made visible to the radar through backscattering from irregular, small-scale fluctuations in the radar refractive index caused by turbulent mixing. The fluctuations are in turn caused by variations in the physical properties of the air, chiefly moisture content, and to a lesser extent, temperature. Since the mixing occurs at the interface between the rising air mass and the ambient surroundings, the backscatter radar signal outlines the outer shell of the thermal, and only seldom gives indication of its internal structuring. Limitations in the resolving power of the radar tend to broaden the delineation of the echoes on the radar screen, so that the rather thin shell of the thermal is presented more in the proportions of a doughnut, as shown in the Plan Position Indicator (PPI) presentation of Fig. 8(a) as well as in the Range Height Indicator (RHI) presentation of Fig. 8(b). These figures show horizontal and vertical sections respectively through the convective field on the landward side of Wallops Station, Virginia, using an S-band radar. It might be mentioned in passing that a glider pilot, seeing the thermal frequency depicted by these samples, might be somewhat incredulous, thinking in terms of his own experience.

Figure 9 shows a variant of thermal development—"thermal streeting." This preferential align-

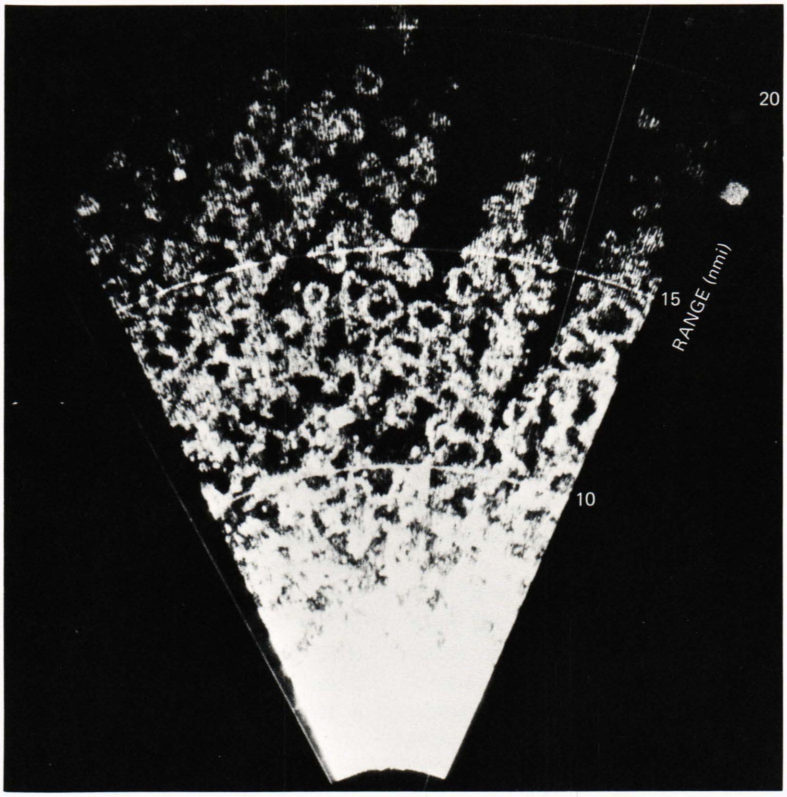

Fig. 8(a)—Thermals as seen on the PPI of an S-band radar.

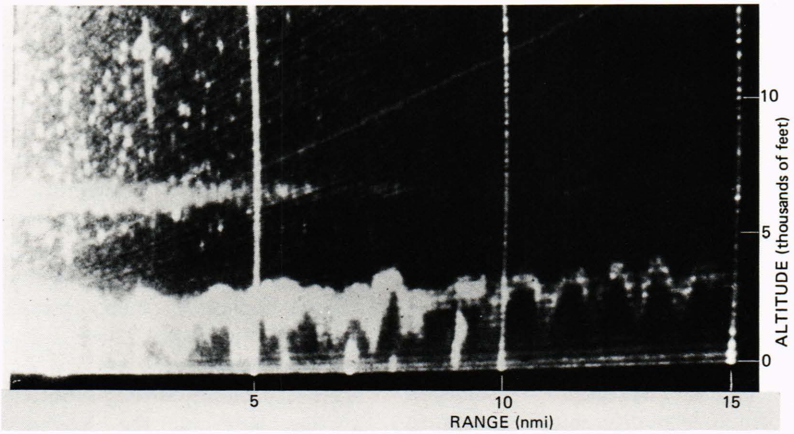

Fig. 8(b)—A convective field as seen on the RHI of an S-band radar.

ment along the wind direction permits soaring at relatively high speeds in the down-wind direction, since the increased frequency of thermal encounter eliminates the need to circle in lift. Airspeed is decreased while in rising air and is increased between thermals, while maintaining a straight course. Heavy sink is usually experienced between the streets, so that the technique includes flying along a street, and then turning at right angles to cross to the next street in the shortest possible time. By this means a course at some angle to the wind direction can be achieved, while gaining the maximum advantage from the ordered arrangement of thermals. Conditions which encourage the formation of streets are the combination of a lapse rate close to the dry adiabat, a significant temperature inversion, and a wind of modest velocity, constant in direction with altitude, and increasing with height to some maximum, then decreasing with height while still within the convective layer. The existence of streeting is usually revealed by a corresponding organization of cumulus clouds.

Glider Performance

On any given day with its thermal strengths and frequencies, the distance or speed achieved by a soaring pilot will depend on the performance of his sailplane. Performance is a somewhat nebulous term, but certainly includes the handling qualities of the ship in flight, which are reflected in pilot fatigue, and the maximum rate of roll, which affects his ability to rapidly center a thermal, but most of all it is flight capabilities shown by its "polar."

The polar is a plot of the sinking speed of the glider in still air as a function of its airspeed. A polar typical of a modern high performance glider is shown in Fig. 10. At the low-speed end the rapid increase in sinking speed results from flow separation at low speeds and high angles of attack, culminating in a stall. At the other extreme the increase in airspeed causes a build-up in drag demonstrated as an increase in sinking speed in addition to that which would result merely from flying the glider in a nose-down attitude to achieve the higher airspeed. The speed of minimum sink is usually the optimum speed to fly when circling in a thermal or when flying in any sort of weak lift, since this permits the maximum gain in altitude, and the tightest circle.

In aerodynamic terms "lift" is

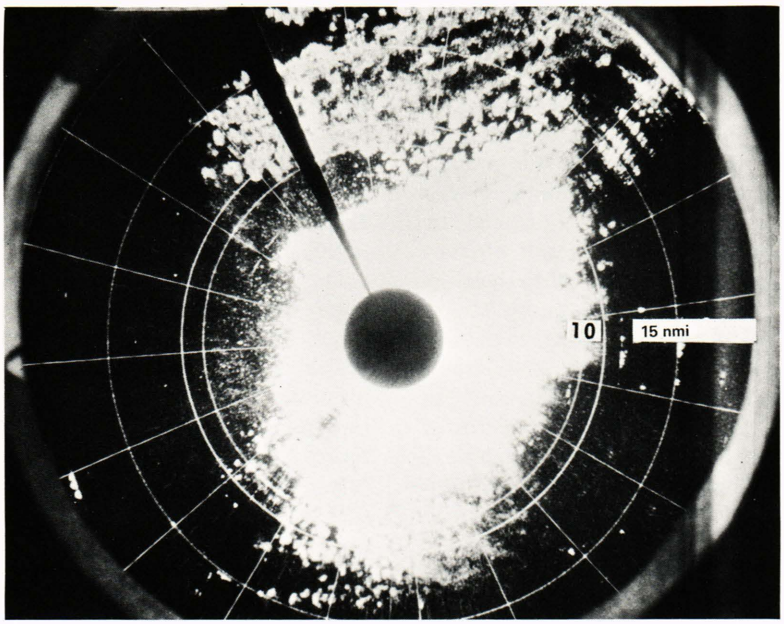

Fig. 9—Alignment of convective cells in the direction of the wind, known as "thermal streeting," as seen on the PPI of an S-band radar.

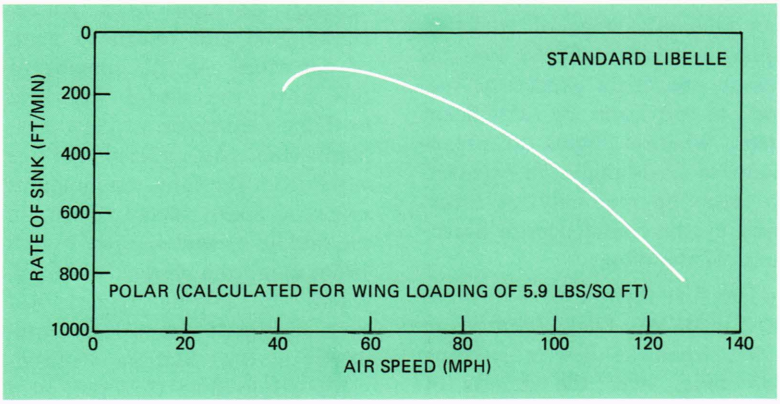

Fig. 10—The polar of a modern standard class glider.

the upward force, generated by the flow of air over the surface of the wing, which sustains the weight of the glider and its pilot. "Drag" is the horizontal force which opposes the forward movement of the glider through the resisting air. The ratio of lift to drag (*L/D*) measures the forward distance the glider can travel for each unit loss in altitude. The airspeed at which the maximum *L/D* will be achieved can be determined by constructing the tangent to the polar from the origin. The airspeed corresponding to the point of tangency will produce the best *L/D* in still air.

However, the best *L/D* is not necessarily the best speed to fly. If the thermals are strong, a higher average speed can be achieved by flying well above the best *L/D* speed, sacrificing some altitude as a result, but gaining time by the ability to climb rapidly in the thermals. A higher speed equates to greater distances since the length of the flyable day is limited. Since the air between thermals is not still, more efficient cruise can be maintained by increasing speed in strong sink and decreasing it where the air is still or the sink is mild.

Both in the technique of getting the most out of each thermal and in the method of flying between thermals, the differences in soaring skills among pilots of varying ability become apparent. High performance sailplanes, because of the laws of aerodynamics, bear a substantial similarity in appearance to one another. Two classes of sailplanes are recognized internationally—the "open" class, with no restrictions, and the "standard" class, with wingspan limited to 15 meters and camber changing devices limited to fixed-hinge flaps. While separate world records are not maintained for the two classes, they are separately scored in world competition and separate class champions are recognized. In the United States the Standard Class Nationals and the Open Class Nationals are two entirely different events. A standard class sailplane can be flown in open competition, but not vice versa.

The main differences between the two classes lie in the ease of assembly and disassembly, which is strongly weighted in favor of the standard ships, and in the maximum attainable *L/D*, which is limited to about 38 in the standard class, while manufacturers of open class ships, with their wingspans as great as 23 meters, claim glide ratios as high as 54:1. Skill and good fortune can, however, make up for this difference. In the 1972 Open Class Nationals, first place was won by a pilot flying a standard class sailplane.

FAI Badge Program

To encourage achievement in soaring, the Federation Aeronautique Internationale, the Paris-based world body charged with overseeing all forms of sport aviation, including model aircraft records, issues a series of badges, for which the requirements are the same throughout the world. The A, B, and C badges are associated with the early stages of flight training. They are followed by the Silver C, the Gold C, and the Diamond C. The requirements for each of the three highest badges are as follows:

For the Silver C, a flight of 50 kilometers distance, a gain in altitude, after any low point, of 1000 meters, and a flight of 5 hours duration.

For the Gold C, a flight of 300 kilometers distance, and a gain in altitude of 3000 meters.

A diamond is added to the Gold Badge for the achievement of each of the following:

An altitude gain of 5000 meters,

A flight of 300 kilometers over either a triangular course or to a preannounced goal and return to point of origin,

A flight of 500 kilometers distance.

The progress that has occurred over the past decades in the United States can be appreciated from the following statistics:

Silver C, Serial Number 10 was issued in 1937, and Number 100 in 1948.

By August 1968 there were 1453 outstanding, and by June 1973, 2458.

Gold C, Serial Number 10 was issued in 1947, and Number 100 in 1960.

By August 1968 there were 402, and by June 1973, 804.

Diamond Badge (all three diamonds) Number 10 was issued in 1957, and Number 100 in 1968. By June 1973, 253 had been awarded.

World Records

There has been a rather dramatic improvement in equipment and in pilot skills over the recent past throughout the world. This has been reflected in a continual improvement in world records in various categories, with the notable exception of the altitude gain and absolute altitude marks. These figures have remained unchanged since February of 1961 when Paul Bickle, then head of NASA's flight test group at Edwards Air Force Base, in a flight lasting less than 2½ hours achieved an altitude gain of 42,303 feet after a low point of less than 4000 feet, reaching a maximum altitude of 46,267 feet. It is not likely that these marks will be exceeded by the necessary 3 percent unless a pressure suit or pressurized sailplane is used.

The most glamorous record category is that of free distance. In this you are not bound by any preflight declaration of goals, and can take advantage of whatever opportunities are offered. For this reason one might expect the record to advance by significant steps, whereas flights to preannounced goals might be expected to creep up gradually, as measured by the confidence, or brashness, of the pilot.

The first flight over 400 miles was made by Dick Johnson in 1951, when he flew a startling 535 miles over the deserts of Texas. This flight generated extensive discussion in published articles on the subject of how that record could ever be broken. One proposal which was advanced at that time suggested that a flight could be made in thermals over the California deserts reaching Pikes Peak at the end of the day, then utilizing ridge lift at Pikes Peak to remain aloft overnight, resuming the flight to the east when thermals developed the following day.

Johnson's record remained intact for 12 years. Finally in 1963 it was advanced to 544 miles, and in 1964 to 647 miles. By 1970 it was 717 miles, and in 1972 Hans Werner Grosse, a vastly respected German pilot, on an exceptional day flew from Luebeck, West Germany, on the Baltic coast, to Biarritz on the Bay of Biscay near the Spanish-French border, for a new record of 907.7 miles.

On the same day and in the same geographic area, Klaus Tesch flew 652.2 miles to a preannounced goal to set a new mark for that record category. Over a period of nine years this record had been steadily improved from the 1963 mark of 487 miles.

The Goal and Return Caper

One of the more exciting examples of one-upmanship in the record-making field has occurred over the past five years in the category of flight to a pre-declared goal and return to point of departure. At the opening of this story, the record was held by Dick Georgeson of New Zealand, who had utilized the lee wave from the long mountainous spine of South Island. Then, in the middle of winter, early March 1968, along the eastern seaboard, where no soaring record had been set for 30 years, Karl Striedieck* of Port Matilda, Pennsylvania (near State College), in a low-performance club glider of steel tube and fabric, launched by a tow from a Jeep driven by his wife from their own field on top of Bald Eagle Mountain, flew to Mountain Grove, Virginia, and back in turbulent ridge lift, for a total distance of 476 miles.

One year later Bobby Clifford raised the mark to 488 miles, flying in thermals in South Africa. A year and a half later Wally Scott, a well-known Texas competitor, pushed the record to 534

*** Karl is the son-in-law of Capt. Louis Stecher, USN, well-known to many on the APL staff.**

miles in the strong thermals of his native state. In November of 1971 Striedieck again took the record over the same mountainous route generally defined by State College, Altoona, Bedford, Cumberland, Monterey, Covington, and Bluefield. His distance was 569 miles. And then the competition began to warm up. Dick Georgeson, on a none-too-good day, flew from Hanmer, New Zealand, to Mossburn and return for a distance of 623 miles, having used up almost all the land distance available to him on his Pacific island. Exactly one month later, on 7 October 1972, Striedieck scored again with a 637 mile flight from his Eagle Field to North Tazewell, Virginia, and back. On 9 October, only two days later, Jim Smiley, an airline pilot living in Clover, Virginia, after telephoning Karl to find out what he had to beat, flew from Bluefield, West Virginia, north to Lock Haven, Pennsylvania, and back for a distance of 657 miles. Eight days later, on 15 October, Striedieck declared a goal of Rosedale, Virginia, and made it for 683 miles. On this flight he flew in company with Bill Holbrook, corporate pilot for Kelly-Springfield in Cumberland, Maryland, who, in many years of soaring, had never earned his Diamond for distance. Under Karl's tutelage he managed to eke out 657 miles, landing in Altoona, while Karl continued on to Eagle Field.

In February 1973 Bill made his own assault on the record, using Lock Haven as his starting point. The attempt ended in ice and snow at Altoona one hour later in what Bill termed "the fastest glider flight ever between two cities before 7 o'clock in the morning." From the experience he learned all kinds of do's and don't's for this type of activity, and sat down to prepare a complete plan for his next attempt, including obtaining official Weather Service support in the person of one of the world's leading soaring forecasters, Chuck Lindsay of Washington.

Promising conditions again occurred on the fifth of May. Bill's flight plan called for take-off at 6:00 a.m. and a flight of 11 hours and 50 minutes at an average speed of 70 miles an hour, for a distance of 816 miles along the slightly curving mountain ridges, and a straight-line distance, which is the record measure, of 783 miles—just 100 miles more than Karl's record of the previous October. The turn-point, the goal, was the intersection of U.S. Route 19 and Alternate U.S. 58 at Hansonville, Virginia.

Take-off was two minutes later than the planned 6:00. The turn-point was reached at 12:07 p.m., four minutes behind the flight plan. Landing back at Lock Haven was at 6:03 p.m., still four minutes behind schedule, and there were still two hours of daylight remaining!

It is hard to predict what accomplishments man will wrest from Nature in the soaring arena in the years to come. While sailplane design appears to have attained the ultimate, it probably has not. While man's knowledge of the atmosphere and ability to extract the most from it seems to have reached the peak of perfection, it probably has not. Conditions such as made Bill Holbrook's flight possible occur about six times a year—and he still had two hours of daylight remaining.

This is what 19th century aronaut Louis Mouillard was talking about when he addressed himself to those pioneers groping toward what was to become Kitty Hawk. "I hold that in the flight of the soaring birds," Mouillard wrote, "ascension is produced by the skillful use of the force of the wind, and the steering, in any direction, is the result of skillful maneuvers, so that by a moderate wind a man can, with an airplane, unprovided with any motor, rise up into the air and direct himself at will, even against the wind itself."

Mouillard would have been dazzled by the modern sport of soaring. For it represents the ultimate distillation of what he had in mind, a sport that combines incredible beauty with the sort of excitement that seizes a man's enthusiasm to the extent he tends to become a bore about it. Soaring is an all-encompassing sport, and one who suffers an addiction to it need take no more than one flight to realize he's become incredibly and helplessly entwined in this romance of the sky.

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Author in cockpit of a typical high-performance standard class ship.