ADVANCED SOARING

BIKLE
BYARS and HOLBROOK
BUTLER
HEROLD
JOHNSON
LINDSAY
MOFFAT
PIGGOTT
SANTILLI
SCHREDER
SEIBELS
SMITH
STAFFORD ALLEN
WILLIAMSON
WOLTERS
WORTHINGTON

a handbook for future diamond pilots

edited by john joss

[illegible] 6.

Ex Libris

From the Gliding Library of

Wally Kahn

ADVANCED SOARING

a handbook for future diamond pilots

edited by john joss

Some notes on this book:

The text was set in Press Roman 11/12 on the IBM MTSC.
The display type is Century. The book was designed and
composed by Graphic Production of Redwood City, California,
and printed by The George Banta Company, Inc., of Menasha, Wisconsin.

The
Soaring Press

P.O. Box 960 Los Altos, California 94022 U.S.A.

First Edition 1974
Library of Congress Catalog Card No. 74-18760
Printed in the United States of America

DEDICATION

To all the authors represented in this volume,
who have taught me almost
all I know about advanced soaring.

CONTENTS

ILLUSTRATIONS

INTRODUCTION

Learning to fly sailplanes competently is a lifelong task for me, closely akin to the craft of writing at which I work daily. Most literate people have the basic mechanical ability to use words grammatically and understandably. Few would consider taking up writing professionally or staking their lives on their literary abilities. Yet many of these same men and women put their lives on the line in a sailplane, often after relatively few hours of training and experience, and with limited education in flying skills. I plead guilty to such incompetence and inexperience in the cockpit, yet like many of my fellow pilots I constantly aspire to higher skills and achievements.

It has always seemed to me that the basic flying mechanisms are relatively simple to train into the average, motivated would-be pilot, and are relatively mundane in their significance. Dick Bach said as much in his superlative "Stranger to the Ground" (1963). As he says, such skills are mere survival. Going beyond the solo and licensed stages to accumulate the 'serious' badges at the Gold and Diamond level, and achieving contest success, is the true test of flying skill, courage and dedication to the sport. Yet there is little formal training available at reasonable cost—or at *any* price in most parts of the world. For most of us, then, our advanced soaring must be self taught by practice, observation and study.

To solve this continuing problem, the world's best soaring magazines, such as SOARING and SAILPLANE & GLIDING, along with the continuing symposia, have been incalculably helpful. So I turned to them and distilled some of the material that has been especially useful to me over the years in learning to soar better. The authors are all experts, many with names that are household words throughout the world soaring community–Moffat, Smith, Johnson, Byars and Holbrook, Bikle, Piggott, Williamson. Even where they may be less well known to you, the words are still of the highest quality. Putting them all in one place between the covers of a modestly priced book seemed likely to be of most help to fellow pilots and aspirants to competence in this lonely art form. We can, in effect, stand on the shoulders of these great men–pilots who have taken the time and trouble to impart their wisdom to us. Our skills can ascend with them at a cost approximating that of a 2000-foot aero tow. The organization of the book is self-explanatory, so I won't dwell on it. You can read straight through, or you may prefer to dip into the specific subjects that are of primary interest or that give you the most trouble.

Along the way, stop off and take a breather from the serious stuff by reading Moffat's marvelously self-effacing piece on getting his Silver 'C' in France. Until this chapter appeared originally in his book "WINNING On The Wind", it was commonly believed that he was born with at least a Silver 'C' in his mouth. Or you can take in the diversions of those two great soaring writers Dick Wolters and Gren Seibels at their manic best. Folded between their seemingly simple sentences are some of the most telling truths of soaring, no less instructive because they are lighthearted.

Technique often seems dull, whether it is acquired from a book or from an instructor beside or behind one. My hours of watching the yaw string are not among the most inspiring of my flying. But the fact is that technique is the basic discipline that will carry us through when we are exhausted or afraid, when our ships or our weather seem to have betrayed us. I don't know about you, the reader, but I find myself referring back constantly to the great basic texts on virtually every aspect of soaring, cited in the book references of the Appendix. They help me improve the solidarity of my central core of knowledge and ability in the easiest possibly way. I hope these chapters are of help to you, and are not tedious. Each pilot is a strong individualist–problems that afflict one may be duck soup to another, so bear with me.

The attentive reader will note a considerable emphasis on safety. For those of you who are above this sort of thing, who are confident in their skills, meticulous in their execution of patterns, faithful in their maintenance of airspeed on ridges or on final, calm in the face of new aerodynamics and airframes, I apologize. For the rest of us mere mortals, I think that there are important lessons to be learned. This applies as much on the ground, before or after the flight, as in the air. For me there is rarely a flight in which I have not managed to make a discovery about my sailplane or about myself that is not useful for future reference in getting back safely. In this context, I am especially indebted to George Worthington for his remarkable candor in discussing his problems, fears and mistakes. It is shocking to realize, as has been observed by better and more experienced aviation writers than I, that many pilots would rather die than admit error. A distressing number have done so. How many of us, if we were really honest with ourselves, would not be forced to admit that we have put ourselves in mortal danger while flying sailplanes more often than we care to remember. Read George's truly brave words, and look into your soul with equal humility.

I find accounts of badge, contest and record achievements inspiring and could not leave them out. Do not be deceived by the apparently low-key rendering of such activities. The medium of paper and ink cannot convey the extraordinary realities of these flights. These are the true tests of the human spirit; the emotional, intellectual and physical response made by these men defies satisfactory description. For every moment and feeling that is visible and recorded, there is a massive and invisible 'iceberg' of self-discovery, commitment, desire, skill and often pain that only the individual pilot knows and will never fully reveal. I experienced the same sense of wonder when riding 'back seat' on many flights with the U.S. Navy "Blue Angels" in the Phantom to photograph and write about them. These are the true giants of flying; the fact that their successful flights make history is probably less important to them than the act itself, at the moment of its enactment.

The essential thought to bear in mind, as you work your way through these pages, is that they represent an extraordinary body of knowledge, experience and understanding of soaring that is simply not accessible anywhere else. Here is the chance to sit down at leisure with some of the world's great pilots and find out how they do it. They have some vital words for all of us.

JOHN JOSS
Editor and Publisher
Los Altos, California
December, 1974

BASICS

1. **Advanced Soaring**
   An approach that works
   Ed Byars and Bill Holbrook

2. **Starting at Chavenay, 1959**
   How is your technical French?
   George Moffat

3. **Soaring Tips**
   Some 'never forget' pointers
   Richard E. Schreder

4. **Thermaling**
   The art of going up
   George R. Bromley

5. **Wave Soaring**
   The techniques that really work
   Jack Harrison

6. **Into Waves from Thermals**
   A safer route to altitude
   Alcide Santilli

7. **Cross-Country Weather**
   Air-mass type and season
   favoring long flights
   Charles V. Lindsay

1
ADVANCED SOARING
An approach that works

by BILL HOLBROOK and ED BYARS

To many in the sport, the word 'soaring' is vague and imprecise, covering almost the whole realm of motorless flight from jumping off hills in hang gliders to primary to training, cross country, F.A.I. badge flying to the most sophisticated competition and record flying.

This chapter covers advanced soaring, from the point of view of a post-solo beginner embarking on badge, competition or cross-country flying.

Most sports worth enjoying embody various levels of attainment for participants, each challenging, and soaring qualifies in spades. It is assumed that the reader has already met the challenges inherent in training through the solo and the post-solo practice.

Often the mere challenge of remaining aloft is formidable and taxes the best efforts of the most experienced sailplane pilot. Since soaring deals so intimately with nature and its infinitely variable conditions, a broad variety of situations exists in soaring to challenge participants.

Most pilots, at the level to be interested in this book, feel that attainment is tied closely to achieving F.A.I. badges. The more experienced know that a pilot's real achievement is related to the tasks he sets for himself and how well he accomplishes them. For example, a successful 50-kilometer Silver 'C' cross-country flight may be more challenging and may represent a higher level of attainment than a 500-km,

---

Condensed from CROSS COUNTRY SOARING with permission from *Soaring Symposia*

Diamond-distance flight or a 60-mph, 200-kilometer flight, depending on the conditions.

The sport is so broad that each pilot's attainments may be tied to his success in many diverse areas. To succeed, he must have worked his way up in various areas, including meteorology, low-speed aerodynamics, instrumentation, navigation and structural engineering. His intrinsic spirit of competition will be well honed. It is invariably true that any top pilot in soaring can discuss any of the above areas intelligently, but none thinks that he knows all about even one. The joy of the sport lies in learning to increase one's competence.

Safety

As part of aviation, soaring suffers at the hands of the uninformed lay public with inherent fear of flying. This is not totally unreasonable, since aviation is but one generation old: many who grew up with aviation remember the hectic and turbulent history that brought it to today's advanced stage. They are influenced by media that exaggerate the unsafe, gruesome but possibly newsworthy aspects of aviation. Safety aspects in this book have been designed to cover the realistic, helpful aspects without dwelling on unnecessary phobias.

Those who have already been flying know that gliders are inherently safe; their low landing speed means far better rate-of-descent control; they are generally flown only in good weather; they do not have a noisy fire hazard in front. One becomes more concerned about the safety when considering flying cross country, beyond range of 'safe' landing places such as airports. No scientific study has apparently been made on those phases of soaring that contribute most to accidents (see Carl Herold's chapter later), but it is intuitively obvious to those in the sport that soaring accidents in which people are hurt are not connected with cross-country flight but occur usually when training or flying around the airport. This probably reflects the fact that pilots who fly cross country are more experienced and usually exercise better judgement. Structural failure or weather accidents are extremely rare - most soaring accidents represent extremely poor pilot judgement, usually while taking off or landing.

Landing a sailplane in a strange area away from the airport is certainly more risky than on the airport, but it is rare for experienced pilots to be hurt in off-airport landings. All cross-country and competition pilots with whom we discussed this problem never worry about physical harm when flying cross country, because modern sailplanes are extremely tough and offer excellent pilot protection. Occasionally a pilot experiences damage to his sailplane in off-airport landings. Usually it is minor, rarely major; for anyone to even get a bump on the head 'landing away' is unusual. An honest analysis of bodily injury in soaring, compared to most other sports, would show that soaring ranks by no means poorly, especially considering that it is an active participant sport.

Decisions . . . decisions . . .

Hopefully, after reading this book, the reader's important soaring choices will be based less on intuitive hunch than on carefully considering the relevant facts and intelligently assessing the influencing parameters. Soaring is based upon decisions. The important ones must be made on the ground as well as in the air. After reading this chapter, the reader should be able to make these decisions better. Theory and details on such things as aerodynamics of sailplane flight, vortex, theories of thermals, and the theory of best-speed-to-fly rings, have been avoided. The competent cross-country soaring pilot must be familiar with them, but they are adequately covered in other soaring texts.

Pre-flight preparation

The challenge of being far from an airport in a unpowered aircraft is exhilarating and the beauty of the countryside incomparable when seen from altitude with the eyes of a great bird. An uneasy feeling of impending disaster mars the desire of otherwise competent soaring pilots to turning the nose toward the open country, away from the comfortable nest of familiar thermal sources and the home field. A number of reasonable, straightforward preparations on the ground and in the air around these familiar areas will rid the pilot of his anxieties and instill in him a feeling of confidence that will make the call of soaring great distances a beckoning that need not be denied.

Surely the greatest anxiety is that of damaging the sailplane in landing in some farm field, along with the potential liability assumed in landing on someone else's property. This anxiety will remain with a good pilot, and makes him cautious in field selection, exacting in pattern flying and approach speeds and meticulous in planning and procedures. With these precautions taken, off-field landings can be made regularly without damage to the sailplane, to the farmer's property or to the pilot's psyche.

Spot landings

Before attempting cross-country flight, the soaring pilot must be able to land precisely on a selected spot. A good way to practice is to lay out on the home field a 'practice farm field' as shown in Figure 1.

This practice field should be about 600′ long and 100′ wide, oriented in another direction and away from the normal landing area. It should be on sod, to simulate a farm field accurately. The idea is to create on the home airport an unfamiliar, short 'farm field.' The pilot should then have his instructor thoroughly teach him spot landings within this 'field.' Slipping, full spoiler approaches and landings–all short field techniques–should be mastered within the practice field. Air speed control is not just the secret of excellent glider performance, it is a primary matter of safety! Air speed control must *never* be forgotten. Practice coming into this field with enough clearance to avoid the fences and trees that *always* surround farm fields. Practice *right* as well as left patterns. Practice in this field until confident that one can easily land within its confines although the approach may be over obstacles. The fundamentals must be learned in this home practice field before these finer points can be applied.

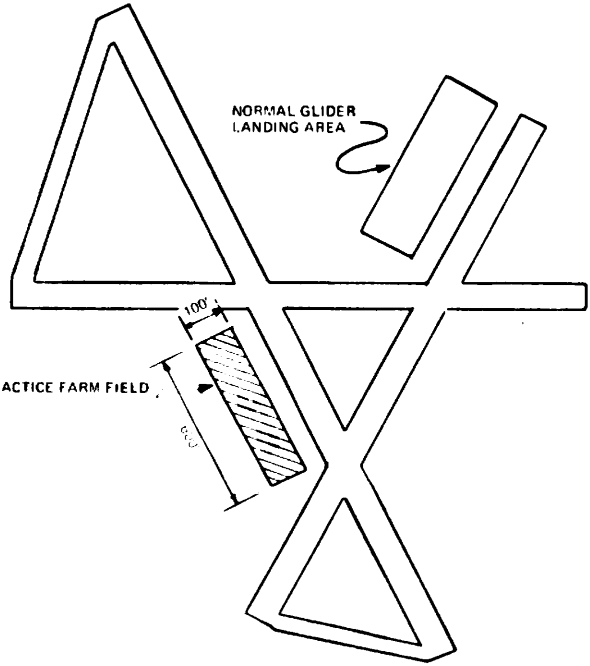
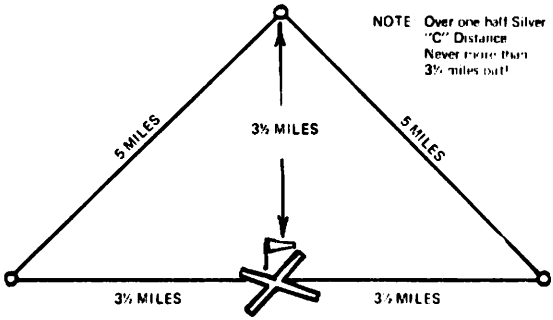


Fig. 1

Are you ready?

Soaring cross country consists basically of working a series of thermals strung out in a line close enough together to be used as stepping stones. But before considering cross-country flight, one should become reasonably adept at recognizing thermals and other lift sources, and climbing in them consistently. To assist in this portion of pre-cross-country training, another learning aid is recommended–the short-distance practice triangle.

Figure 2 shows a seventeen-mile triangle laid out within safe gliding range of the home airport. Over half the Silver 'C' distance can be flown 'cross country' without being more than 3½ miles from the 'nest'. Excellent cross-country experience can be gained by flying this small triangle. Work at flying it will teach proficiency in holding a heading,



PRACTICE 17-MILE TRIANGE

Fig. 2

finding, entering and leaving thermals on course, and proceeding on course to a pre-determined point—all basic factors in soaring cross country. Practice flying on this triangle should enable the pilot to go around easily. Increasing speed around the circuit improves efficiency in basic principles. Limiting maximum climb altitude so as to force the search for more thermals helps improve cross-country techniques and is used by championship pilots. After becoming proficient in spot landings in the practice area, and being able to fly around the practice triangle confidently, one can consider heading out for a cross-country soaring venture.

A passenger ride in a power plane, flown down the selected course at glider altitudes, is the best way to become familiar with the landscape so important to the proposed flight. Let the power pilot fly, so that full attention can be with the landscape so important to the proposed flight and simulating mentally the sailplane flight. The sailplane pilot prepares the map and does the navigating. Practice map reading—pick out the fields in which a glider landing appears feasible and have the pilot fly a glider pattern over some of these sites at an altitude low enough to determine if the selection was safe.

Prepare and use a landing-away check list. Look for broad regions of good fields to head for if a little low—stretches where it would feel safe working a weak thermal at 1,000 feet. Watch for small towns, factory sites and hills that are lift producing features. Identify and study the goal airport. If it is small and blends into the surrounding landscape, pick a prominent adjacent feature to aim for on the final glide, even before the airport can be identified.

Weather

Predicting good soaring weather is an art that even professional meteorologists admit requires skill and luck. But the general weather patterns that produce good soaring in one's local area are worth close study, to develop ability in predicting them. Watch the best local television weather forecaster, particularly on the few days before the anticipated flight for general background information. Then call the nearest aviation weather service, either the Weather Bureau or the F.A.A. Flight Service Station, on the day before the flight, for an up-to-date forecast. This will give thorough familiarity with the general weather situation before making the all important final call early on the day of the flight.

Intimate knowledge and familiarity with the sailplane and equipment cannot be overemphasized. As well as knowing the sailplane's flight characteristics, master all its accessories–the instruments, barograph, trailer, tow car, parachute, all apparatus necessary for take off, course flying, landing, recording the results, disassembly and retrieval. Practice disassembly on the home field before having to do it in a strange, plowed or muddy field, perhaps after dark at the end of a long day. Confidence in the barograph is essential. Learn to prepare it properly and assure that it is working while flying. Practice removing the trace and going through the procedure required to complete it for transmittal to the S.S.A. Swing the compass–know the variometer in the aircraft. Many fine flights have been made by good pilots with slow and inaccurate variometers, but these pilots understood their particular instruments intimately. Practice in all these details builds confidence and allows the pilot to concentrate on flying when the big day arrives for the distance flight.

Map selection and preparation

Sectional charts (1:500,000 scale) are designed for navigation by pilotage in slow-speed aircraft and are the standard charts used in cross-country soaring. Don't use old charts–towns don't move, but new highways spring up and old airports become shopping centers and industrial parks, so that a goal airport may not be an airport any more. Regular fliers subscribe to local sectionals. Practice plotting the latitude and longitude of points. S.S.A. badge applications, State Soaring record forms and all contest distance points are based on the latitude and longitude of the take-off, release, and landing points, yet many experienced competition pilots are still not totally competent at this simple task.

When ordering charts, order an extra set for the crew so that on position call-backs, both pilot and crew work from the same map. The crew must learn to read a sectional; the aeronautical symbols are confusing to one used to reading a road map. This eliminates unnecessary confusion.

Navigating sailplanes cross country is complicated by several unexpected factors. One is lack of cockpit room to open, refold or even store charts. Try sitting in the sailplane on the ground with the canopy closed, strapped in for flight, then unfold a sectional chart and refold it to see the portion showing your course line. Do it all with one hand (the left, preferably), because you must fly the ship with the other.

Height variations from the top of one thermal to the altitude at which the next is intersected is a second difference from normal airplane navigation. Positions must be plotted carefully during straight flights on course, notice the exact compass heading of the desired course while cruising so as to roll out on this heading again as the top of the thermal is reached. One should always note the flight's compass course for ready reference.

Draw and label 5-, 10-, 15-, 20-, 30-, 40-, and 50-mile radii from the planned landing point on your chart, using a semi-thin, felt-point pen with a bright contrasting color (red or orange). These circles are vital in final-glide computation. Draw the anticipated flight path with a straight edge and mark one-mile intervals for at least the final 30 miles along this line. One should be able, at any time during the flight, to glance at the map and position oneself on it and, by noting the previously drawn circles and mileage marks, and know exactly the number of miles from the goal.

Extra equipment

In addition to the sailplane, barograph, trailer, and parachute, many small items are required of all entries in a national contest that make good sense and should be part of every cross country sailplane's equipment, including first-aid gear, a tie-down kit, a quart of drinking water (in addition to that carried for use in flight), some high-energy food such as dried fruit, hard candy, Gatorade, etc., the tools essential to disassembling the sailplane, and a small flashlight (with fresh batteries). The first-aid kit should contain a large triangle bandage, some Spirits of Ammonia inhalers and first aid cream. One more handy item that will save time is an extra set of fresh batteries for any on-board electrical equipment. The sailplane batteries should be checked the night before the flight; a fresh set in the car saves a lot of last-minute searching when one is found to be too low in voltage for safe use. In general, make and work with an effective check list.

Personal check list

Everyone has his own personal style in clothes, but no one accompanies the pilot on solo sailplane flights, so dress comfortably. Take along a jacket (a nylon windbreaker will do in the hot summertime) for it gets cool in the evening while waiting for the crew and trailer. Wear shoes in which one can comfortably walk a long distance, because this chore is the normal ending of a great cross country flight. Carry along some sun protection–a light hat and some effective suntan lotion or 'screen' if sensitive to the sun. These are often needed at the end of short, disappointing flights while sitting in a pasture warding off domestic animals and waiting for help. Sun glasses, while not essential, add comfort and safety when flying toward the sun.

Remember to carry along cash and some blank checks. Include in the papers the basic sailplane insurance facts–name, address and phone number of the insurance agency, as they attest to the pilot's financial responsibility when landing among strangers who may not be soaring enthusiasts. Every active soaring pilot has a telephone credit card; carry it, and give the crew the number with which to call the base as necessary. A nationally recognized credit card is convenient to write addresses on, and serves as an introduction to the many people who will be met and of whom favors may be needed at the end of the flight.

Task selection

Selecting a task for each flight is extremely important. It is unusual for any competent sailplane pilot, paticularly a competition pilot, to plan any flight without first considering its specific task. In the immediate post-elementary training period, there is a great urge to fly just to see if one can stay up. Since many sailplane pilots get little additional advanced training beyond this point, it is natural that they sometimes keep flying aimlessly around the airport at the tops of thermals until they finally become bored with the sport and drop out.

Although one cannot rule out an occasional introductory passenger hop, such aimless flying around the airport develops very bad soaring habits. Specifically, if one fails to establish a challenging task for each flight, one will not strive for optimum climb, center thermals properly, enter or leave thermals at the correct time or in the correct way, fly at optimum speed and learn to be extremely time conscious. These seven skills are vital for efficient cross-country soaring.

Task types

The F.A.I. badges make an excellent progression of tasks and are the most common measure of performance and progress. Most experienced pilots agree that the altitude legs and five-hour duration are rather meaningless, although they are good practice for beginners. The goal and distance tasks are somewhat better. The beginning sailplane pilot can become accustomed to flying tasks less ambitious than the F.A.I. tasks and then progress considerably beyond them.

The three important types of tasks are triangles, goal and return, and distance. Triangles are popular. They are easy on the crew, since the pilot hopefully ends up where he started. In laying out triangular tasks, it is advisable to adhere to the F.A.I.'s 28 percent rule whether or not a State or other type record is being attempted. Goal-and-return tasks are also easy on the crew for the same reason and may be better than triangles in some instances, particularly under certain anticipated terrain or weather conditions. Distance tasks are worse for the crew and the retrieve but are best for maximum distance if no air-mass change is anticipated en route, or if terrain is suitable. Anyone who aspires to be a top pilot must concentrate on triangles and goal-and-return tasks.

Terrain selection

Terrain in the task area must be considered. Naturally, areas with more landing sites are best. In the eastern U.S., goal and returns are popular parallel to the ridges (generally crosswind) where one can fly over the ridges' lift sources in range of the valley landing areas. Near the coast or other large bodies of water, triangles may be required, particularly on a peninsula or where the water is close to the downwind side.

One should plan tasks over high ground where lift is better, with good landing valleys adjacent to your planned route. Obviously, avoid large areas of rough terrain if possible. We, for example, in flying out of Cumberland, Maryland, have favorite valleys that we like to fly up and down, certain narrow valleys with poor fields that we generally avoid, and other areas of extremely rough terrain that we avoid religiously. A good idea is to survey your proposed routes with a power plane.

Wind considerations

If you have a choice, it is generally best to fly downwind legs first. This may not always be true for short tasks in the middle of a strong day, but ordinarily, if you start early, it is better to drift while climbing before conditions get strong. Flying the downwind leg first means less time climbing while drifting backwards, because all or part of the last, upwind leg will be the final glide home. In contests, one usually does not have a choice, except with distance tasks. When flying into a turnpoint, go into upwind turnpoints low and into downwind turnpoints high. This procedure takes advantage of the drift while climbing, which may help considerably in completing a task.

Navigation

See whether a task can be selected over terrain where navigation is easy—for example, where prominent landmarks and terrain features are plentiful. This can vary greatly with the general topography and geography of your area. Pilots accustomed to flying in the Midwest of the U.S., where they can either follow section lines or maintain a constant angle with these lines, sometimes are shocked when they go east or west and must fly in the mountains.

When laying out initial practice tasks, take advantage of a good interstate highway (or, in the U.K., a motorway). These and other similar excellent landmarks are always welcome on a flight, especially when the visibility is limited. Actually, ease of task navigation is less important than good terrain or wind orientation selection. If your experience level is such that you are not positive that you can navigate easily with a sectional while soaring, this topic of task selection for navigational ease is more important until more experience is gained.

In summary, it should be emphasized (and we hope you will agree) that soaring around the airport on the tops of thermals soon loses its challenge, whereas completing even a modest soaring task that taxes your soaring abilities is one of the most satisfying experiences in soaring. Completing tasks is really what the sport is all about. It is the very essence of advanced soaring.

2
STARTING AT CHAVENAY, 1959
How is your technical French?

by GEORGE MOFFAT

Soaring didn't really start for me in Chavenay, a tiny village twenty five miles west of Paris. It really started back in the late Thirties when as a boy I discovered a copy of Terence Horseley's SOARING FLIGHT in the local library. I must have pretty well worn out their copy, mooning over pictures of the then fabulous Minamoa, reading accounts by the great Philip Wills, becoming utterly entranced with the idea of silent flight.

Soaring and money both being in short supply for young boys in the 'thirties, I had to wait through school, army and college before I could even take up power flying in 1953, with a transition to gliding always in my mind. As way led to way, I wasn't to see a glider until 1959, when I soloed in the U.S. after a ten-minute ride with an instructor who himself had soloed only the day before (soaring was somewhat casual in the 'fifties). After only a few flights in the stodgy two-place trainer, I became bored. The handling was poor, the performance terrible. There seemed no connection with the early dream.

That summer, while living in Paris, I was invited to dinner in the country by a cousin. While sitting on the lawn, sipping *apèrtifs*, I heard a power ship pass low overhead. Glancing up, I saw a sailplane attached behind it. After a few questions, I found that one of the largest flying training fields in France was only a mile away. Needless to say, the next day my trusty old *Deux Cheveaux* was chugging over to the glider field. There, a swan among ducks, was a Breguet 901, the best sailplane in the world. It fairly gleamed among the trainers. A few questions in my half forgotten French elicited that, *Mais oui*, one could fly there. *Le prix?* It worked out around fifty dollars a month for all the flying I could fit in. When could one start? *Maintenant, naturellement.* Almost before I knew it, I was being strapped into the Caudron 800 two seater for a check ride with M. Melleton, *Le Chef de L'Aérodrome.*

I was about to discover that check rides in France are different. As the tow plane revved up (a 1921 vintage Moraine-Saulnier, originally designed to be the nemesis of the Fokkers in World War I) so did M. Melleton's French. Since I could understand only an occasional word, I just did a normal take off. The French torrent settled back to METO, so I judged that all was well. A couple of turns and stalls were accomplished satisfactorily, and since we were now down to pattern attitude and the word *piste* (runway) seemed to crop up increasingly often in the non-stop flow of idiomatic French information, I entered a normal pattern.

Downwind was OK, base looked just about right, but as I settled into final, M. Melleton went to War Emergency Override on tongue power. Not able to deduce what I was doing wrong, I dodged a couple of trainers zig-zagging back and forth in the way, thinking they would really catch it from *M. Le Chef* when they landed. We touched down just where everyone else seemed to be landing and rolled up to the end of the line. But then I caught it, or at least so I gathered. Something obviously had been very wrong.

Finally a lanky U.S. Air Force Captain strolled up and translated my sins. It seemed my tow and air work had been adequate, even good; *mais sacré bleu, quelle atérissage!* What was wrong with the landing, I wondered. I thought I had done rather well considering all those idiots roaming back and forth in the pattern. Patiently the Air Force type explained the French method of flying patterns.

One, it seems, flies normally until entering final. At that point Gallic individuality can be restrained no longer and each ship begins a series of wide S turns until down to fifty feet, whereupon it lands. The fact that three or four different ships might be S-ing on down the final at one time seemed to bother only my rigidly regimentalized American mind. As was so often to be the case in the next couple of months at Chavenay, I was to discover that apparent madness was actually French logic in disguise. Yes, at the airfield, perhaps, the S turns gave the pattern a certain random appearance, but the pilots were being trained, not for the airfield but for the inevitable off-field landings when they started cross county. Getting high and S turning into the field is still the best approach.

Once M. Melleton understood that my disgraceful pattern flying was not ineptness but merely a result of the barbaric practices to be found in non-French nations, he decided that I might forego an additional check ride. I was ready for the single seater.

The single seater to which I was introduced was no Breguet. The Emouchet was a sturdy French version of the famous Grunau Baby–the *dernier cri* (literally) in soaring, vintage 1934. As it lay on its skid in 1959, looking rather weary, this particular Emouchet was perhaps fifteen years old and the veteran of many a solo. With a 40-foot span an open cockpit, the ship was reputed to have been capable of a 15/1 glide ratio–when new. As I climbed in, however, she instantly transformed herself into the wonderful old Minamoa I had seen in Horsley's book so many years before. Once aloft, the air rushing over my face, the wings seeming extentions of my arms from the narrow cockpit, I knew that this was the experience I had dreamed about.

It would be nice to say that I wound into a thermal immediately off tow and soared off into the middle distance as awed onlookers on the ground cried "Who *is* that masked man?" In practice, I was back on the ground in ten minutes, watching some other student take over my lovely bird. That day, late in the evening, Camille Labar, member of the French National Team, skimmed over the field in the Breguet after completing a 440 km triangle. There were, it seemed, a few things to be learned.

Every sunny day saw me and Bob Litle, the Air Force type, out at the field. Most of them saw us back *on* the field after flights of ten, fifteen, sometimes twenty minutes. Once I beat the tow plane down. Gradually, through Bob, and as my aeronautical French improved, I began to learn the customs of L'Aeroclub Gaston Caudron and a few things about the air. Both were frustrating. How, I wondered, could anyone learn to fly if, promptly at twelve, just as the good thermals were starting, everyone knocked off for lunch? The sacred *l'heure de déjeuner* was just as sacred on the air field as anywhere else in France. The thermals were starting? Let them wait! Lunch was a matter of a certain seriousness, not a quick-bite-and-back-to-flying affair. The five courses served in the club house (seventy five cents, *vin compris*) took the full two hours that Frenchmen devote to these matters of importance. It was delicious and included a bottle of wine between each two diners. Brought up on the U.S. idea of plenty of time between bottle and throttle, I was appalled at first, but people seemed to function pretty well afterwards.

Two o'clock finally arrived, the requisite belches were belched, pants tops rebuttoned, and flying recommenced. That is, it did if the tow plane would start. Starting the Moraine-Saulnier's vintage radial was rather an art—an art requiring six people and a lot of patience. Five of the six joined hands, last man grabbing the lower end of the ten-foot prop. Man six, in the cockpit, yelled *coupé* (switch off) and away went the daisy chain at high lope. The propeller moved reluctantly through three cylinders. On cylinder two, the daisy chain being clear, the cockpit man cried *Contact*, and turned on the switch.

If the engine caught on the remaining cylinder, all was well and a miracle had occurred—a miracle I was not to witness during two long months of prop pulling. Twenty minutes was par, and a good deal of wine had usually gone up in sweat before the big engine finally began to tick over. Once started, the brakeless Moraine moved jerkily over to the line, wing walkers assisting if there was any weight to the wind.

Meanwhile the other club members were hauling the sailplane fleet out to the line—by hand. Apparently to encourage physical conditioning, no cars were allowed to assist with what was sometimes a half-mile pull of a dozen or so sailplanes. It was a decidedly mixed bag of a fleet. It started with the lowly Emouchet and moved on up through the AV-36 flying wing, the Nord 2000 (designed for Olympic competition in 1939), the Weihe (a top mid-thirties design, this particular specimen so elderly that it creaked even when being moved on the ground) and finally the lovely Breguet. The Breguet was pulled out if Labar or one of the other handful of pilots privileged to fly it was there.

Takeoff was in order of excellence of performance, with the lords of the sky off on their seemingly impossibly long 200 and 300 km cross countries going first. Finally, somewhat after three as a rule, we tadpoles were able to fly. Looking back on my log for June 1959, I see six flights of under twenty minutes–mostly in booming weather–before the triumphant entry of 2:05 hours with a Silver C height gain of 1800 meters thrown into the bargain. I must have managed to learn something, since the next four flights were all an hour and a half or more. I felt I was getting somewhere. So, it seemed, did M. Melleton.

During the long clubhouse lunches, while I tried to revive my college French, I had begun to gather that the aero club was strongly subsidized by the government. This was why flying was so incredibly cheap. Further, I began to learn that size of subsidy varied sharply with results produced and that results were measured solely by the number of F.A.I. badges won. These badges graduated rapidly in difficulty from the lowly B, which merely involved staying above release height for five minutes, on to the formidable silver C with need of a five hour duration and fifty kilometer distance flight, on up to the Gold and Diamond C's. The latter had an incredible requirement for a 500 km distance flight, a feat only accomplished three times to that date in France, first by the redoubtable Labar. Monsieur Melleton's policy was one of rather forceful encouragement of pilots to try badge flights–a sort of coming-ready-or-not approach.

Knowing this, I should not have been too surprised at what happened when I showed up at the club one Sunday morning. Mostly I had come out to have a good lunch in pleasant surroundings, basking in the adulation of those mere mortals, the spectators, who flocked to the aérodrome on weekends. Flying was seldom possible on weekends as ships were reserved long in advance and members of the barbaric hordes from developing nations (i.e., non French) were naturally rather far down the totem pole. Scarcely had I arrived on the field, however, neatly dressed in jacket and tie, than I was collared by M. Melleton: "*Ahhh, Monsieur Moffat* (pronounced Mo-Fa)! *C'est le jour de cinq heurs.*" Even as these words were pronounced I was being jammed lunchless, and still in coat and tie, into a particularly elderly specimen of Emouchet. Or at least most of me was. The Emouchet was not designed for Americans, and the top foot and a half of me always hung refreshingly out in the breeze that whistled past the open cockpit.

The day turned out to be really good, with lovely cumulus spaced three or four miles apart. In no time I was up to a fat six thousand feet, happy, hungry and a little chilly. The Emouchet climbed beautifully at its customary 30 mph, showed off its best fourteen-to-one glide angle at 40 mph and fairly screamed through patches of sink at a breathtaking 50, already getting a bit close to the redline at 60. Most of the clouds had 500 fpm thermals; it was a beautiful day.

Those readers who fly modern sailplanes may not realize that the operative word in the last sentence was *most*. Missing an occasional thermal in a modern ship means only a bit of exasperation for the pilot as he bombs on to the next cloud. In the Emouchet a missed thermal could cost 3000 feet; miss two and you were back on the ground waiting for the next suitable five-hour day, something that occurred possibly one day out of ten. Furthermore, we had strict instructions not to land off field, so thermal searching had to be within range of the airport. All of these factors made "Get high and stay high" the order of the day.

Was it during the second hour or the third when I began to notice how chilly it was at six thousand feet? Was it the third hour or the fourth when I began to be more worried about freezing to death than staying up? Some time around the fourth hour, tie wrapped three times around my neck for a scarf, collar turned up, every last possible inch of me scrunched into a cockpit designed for midgets; the vibration started, quietly at first. Soon the whole ship was shaking on a cycle of three times a second or thereabouts, and I became thoroughly alarmed. Everything I could see seemed to be in one piece, but I couldn't help but think of all the elderly bits of plywood held together by 1940-vintage glue. Had that been a good year for glue, or did it, like some wines, "mature quickly and lose its body"?

The shaking increased. I thought about my club-issue parachute, a beat-up specimen held on by one enormous band around the chest—and nothing else. Bob Litle and I had often wondered what kept the wearer from simply slipping out when the 'chute opened. The problem was rapidly becoming less and less theoretical. By now the shaking was violent. I could easily see the wings shudder against the horizon.

I don't recall at what point, while searching frantically around for some cause of what seemed to be a rapidly disintegrating glider, I noticed my hand. By now I was so cold that I was shivering uncontrollably, my hand on the stick shaking back and forth over an inch or more. Could it be . . .? I took my hand off the stick. Instantly the ship resumed normal flight. I grabbed it again. The shaking recommenced. A surge of affection for my trusty Emouchet engulfed me. How could I have doubted that noble collection of sticks and fabric? How could I have failed to appreciate the heady strength of the glues of 1940?

As anyone who has done his first five-hour flight will know, solving one problem usually gives sufficient time for noticing another. This one was the trivial matter of chronological time. What time had I taken off? With all the bustle of rounding up a barograph, getting declarations signed, nailing a towplane—(which had been attempting to slink quietly away for lunch)—I had quite forgotten to note the time of departure. Around twelve, yes; but was it a quarter of or a quarter after? Painfully, my cold-congealed mind attempted to stave off starvation signals from my stomach long enough to consider the matter. No luck. Finally I decided to assume a quarter after, to be on the safe side.

Slowly the hands of my watch reached five. Clouds were beginning to dissipate. There had to be just one more thermal, surely? I slid in under a small cloud and felt the wonderfully manic lift of the Emouchet in the pulsing air. This was it! At cloudbase the hands read ten after the hour. I started a long, slow circuit of the field, letting the altitude I had been conserving all day trickle slowly through my fingers, almost forgetting the still uncontrollable shivering in a feeling of accomplishment, almost one of regret that the test was over.

As the Emouchet slid to a stop on its skid, dozens of clubmates rushed up to congratulate me. The duration turned out to be 5.40. As soon as I could, I broke away to the small restaurant to some long delayed lunch. *Le déjeuner á cinq heures? Mais non, monsieur! Monsieur* must surely realize that the lunch is over at two?" Impasse! Fortunately a clubmate happened by and explained to the chef the reason for my dilatory behavior. "*Bon!*" Very soon I was attempting to eat a delicious omelette. One problem remained: my hands were still shaking so hard from the cold that bits of omelette refused to stay on the fork.

The following day I arrived at the club in time for lunch, thinking to do a little local flying and perhaps admire the AV-36 a bit. Only the Silver 'C' distance leg remained and already I was beginning to dream of flying a more advanced ship. The French club very wisely didn't let students out of the Emouchet until the Silver C badge was complete. Only then did one get to try more advanced types, moving slowing up the ranks from AV-36 to Nord 2000, to the venerable Weihe, and finally, for a lucky few, the Breguet. With total Gallic logic the French moved students, not by the ease or simplicity of the next type of ship, but by its cost. As it happened the AV-36, a flying wing, was a fairly tricky ship to fly, especially on landings. But *ça ne fait rien*–it was cheap.

As usual M. Melleton's ideas and mine didn't coincide. No sooner had he seen me than a gleam came into his eye. He rushed over, grabbed my shoulder, and started hurrying me out to the line. "*Ahhhh, Monsieur Mo-Fa! Pour aujourd hui, La Distance!*" Fortunately I had managed to have lunch before he saw me. Not so fortunately, at least in view of his mandates, I had a date in Paris at seven with a girl who didn't look as though she was used to being kept waiting. M. Melleton, who sometimes understood my aeronautical

French, seemed totally deaf to my social equivalent. To every objection he merely cried "*A Chartres!*" in more and more positive tones. "But I have no map," I protested. One was found. "But how will I get back?" I asked. A torrent of French emerged, amidst which only the word *remorqueur* (trailer) rang a bell with me. Meanwhile, I was being packed bodily into the Emouchet, over my admittedly weakening protests as I began to realize that the coveted Silver C was practically within my grasp.

Once aloft, I immediately found a 600-fpm thermal right up to cloud base at 5500 feet. Dropping the nose a bit, the Emouchet and I set off to the South at a breathtaking 45 mph–and a glide ratio of 12/1. Fifty kilometers–Silver C distance–is just a one or two thermal jaunt in most modern ships. In the Emouchet it was a challenge and an adventure.

Speeding along, high and happy, it took me about ten minutes to get lost. Out came my borrowed map, disarmingly entitled *Les Environs de Paris.* Unfortunately it turned out to be about three feet square with a scale of one inch to three kilometers. Every ten minutes of flight required another massive refolding effort, and you haven't lived until you have wrestled with several square feet of stiffly folded paper in an open cockpit while attempting to make some pretense of flying. Fortunately the flying was fairly easy and I seldom got below 4000 feet.

An hour or so after takeoff–not exactly lost, but perhaps not exactly pinpointed as to position–I was anxiously scanning the horizon for Chartres. Surely the great cathedral, which I had first met through Henry Adams remarkable book *Mont St. Michel et Chartres*, should be at least visible, with its two so differing spires? Surely in an hour I must have flown at least forty kilometers? Increasingly uncertain of my whereabouts, I scanned first map, then ground. The former had an embarrassment of riches, mainly cultural. The latter just sort of sat there, waiting.

Was it the tenth or the twentieth look, in a desperate attempt to find something–anything–that made sense, that I saw it? Far below and somewhat behind me, surely there was something distinctive about the church in that town of many

Suzanne and George with the Standard Cirrus

towns so lately passed? Slowly the pattern fell into place. Of course, *there* was the river, *there* the airport. Chagrined, with five thousand feet to spare, I orbitted the town, watching the cathedral, familiar from so many pictures, grow into life.

Once landed, my papers signed, elation high, I began to think more and more about getting back. There was, of course, that girl. Perhaps . . .? Queries directed toward the local people were little help. They assumed that a *remorqueur* would come for me—in time. Quickly an idea formed: why not fly back? Coming had taken only an hour in excellent lift. A good deal of excited sign language indicated that I would like a tow. Gallic heads were shaken, glances exchanged, misgivings furtively expressed, shoulders shrugged. If the mad American wished a tow, *pourquoi pas*?, why not? Naturally, as in all things Gallic, no undue haste was allowed to upset the natural order of events. It was almost 4:30 when I finally towed off.

On release, I expected to hook immediately into another 600-fpm thermal. After all, I had turned up my nose at anything much less on the trip from Chavenay. But things had changed. To stay in the air at all I had to take a paltry 200 feet per minute, watching the altimeter register gained altitude with maddening sloth. Topping out at a mere 4500 feet, I began almost immediately to realize the difference between a five mph headwind and a five mph tailwind. One hour of hard work later, with the shadows beginning to lengthen, I was scarcely half way home. Painfully, over Rambouillet, I climbed back to 4000 feet with perhaps twenty miles to go.

No longer confident, I set off into a cloudless sky towards the North. Slowly the altimeter unwound, slowly the landmarks crept past. Finally at six o'clock, position uncertain in a dying sky, I was low over a small town in zero sink. Endless circling in feeble lift only resulted in drift to the South–away from home. One last glide and, suddenly, I was quite low over a hilltop town, sure the airfield was only a few miles away, but uncertain of the exact heading. Abruptly, concern over getting home was replaced with concern over my first off-field landing. The uncut grainfields looked less than promising. Below me some farmers stopped to look up. Five hundred feet.

In one corner of a large field a swath of new-cut grain appeared, perhaps seventy yards long. Nursing the dive brakes, I grazed the tops of the uncut grain, felt the last of my speed fall away, and plunked down in the single narrow strip. The ship slid to a stop in the quiet of evening. I hadn't made it back.

A garbled phone call, an hour's wait, and the rickety old trailer arrived, driven by M. Butin, one of the instructors. It appeared I had landed within seven miles of the airport. Butin was furious, thinking he had had to make a retrieve for a Silver C distance aspirant who had managed only a paltry seven miles in four hours. I couldn't understand his rage, or what all the shouting was about. After all, I had made the distance–something not everyone did on his first try. Gradually, as I identified individual words from his tirade, I understood. Going back to the glider, I retrieved my papers signed by the people at Chatres and presented them to Butin.

There was a long silence. Suddenly Butin's face broke into a smile. "*Il a fait le retour*" (he has made the return), "*Il a fait le retour.*" I was unique. Apparently no one else had ever tried to fly back from a Silver C distance attempt. Wine appeared as if by magic. Toasts were toasted, there in the field. The ship shed its wings and took to the trailer. We drove back to the airfield, Butin still smiling, shaking his head at the madness of Americans, muttering, "*Il a fait le retour.*" I had my Silver C, but did not make my date in Paris!

Years later when I returned to Chavenay, by now holder of three world's records, M. Butin's first words on seeing me were "*Il a fait le retour.*" The whole clubhouse broke up in laughter once more, as they had on that night back in 1959.

3
SOARING TIPS
Some 'never forget' pointers

by RICHARD E. SCHREDER

Over the years, every time I've made a mistake and found myself sitting down on the ground watching other ships pass over head, I've gone home and written down something I thought I should remember and never forget in future flights. And I keep reading these things over before a contest, trying to remind myself not to make mistakes that I've made before. I think these things may be of interest to you because they'll probably help you with your own soaring and allow you to profit from my mistakes.

To start with . . . always take a full tow to 2000 feet. There is an awful temptation, when you go through the first thermal, to pull the release and thrill everybody on the ground by going up at a phenomenal rate of speed and passing everybody else. But every once in a while, in fact quite often, something happens to that thermal and you can't find it anymore after the first turn, and you find yourself back on the ground, maybe too far away from the airport even to try to get back. If you're in a contest or trying for that badge leg, such a maneuver can really lose you a lot of valuable time.

Thermaling

Stay with the first lift you find at 2000 feet or below. When you're in a contest or going cross country and you get low and you find a little bit of lift, don't leave it, because even if you can just maintain your altitude, if you circle in that lift long enough, it will eventually develop into a thermal because there is a thermal there and these things are building and dying. Of course, if you are unlucky it may fall apart and you'll still go down, but you're a lot better off than to go looking for something better when you're down that low.

My procedure in working thermals is that I decide what thermals I'm going to stop for and what thermals I'm going to pass up. If it is a good day and the thermals are running about 5 meters, as long as I have altitude, I watch my total energy rate of climb as I go through and if it doesn't get up to 5 meters, I don't even slow down; I keep right on going. Of course, as you get lower, your ideas and your standards drop considerably.

Also, in entering a thermal, I try to watch; I try to sit very relaxed in the seat and give the wings a chance to seek their own level. And if I go through a thermal and the right wing tends to come up a little bit, I wait until I pass the maximum lift and then rack it up in a right turn. If the left wing comes up a little bit, this indicates that the core is on the left and I go to the left.

I don't think there is any such thing as all thermals turning to the right in one hemisphere and into the left in the other, like the vortex in a bathtub drain, because we kept a record down in Puerto Rico all one summer of thermals. We had a lot of thermals that went over the place and would pick up the leaves, and you could see the rotation. We found that there were exactly as many that went to the left as went to the right. So, until you have some definite indication that your thermal is turning one way or the other, you might just as well go the way you think that the center is. Then, if you can look down at the ground and see a lot of dust being kicked up and see that there is rotation, then, of course I think you're better off to go against the rotation, because your rate of turn will be slower and you can make a smaller circle.

I usually thermal about 5 miles an hour above stall speed unless the thermal is unusually large, and then you can slow down until you're right on the very edge of the stall. If thermals are big, you can, of course, make much larger circles; if they're small, you have to make just as small a circle as you possibly can.

Out on course

Don't leave the vicinity of your take-off airport without gaining some altitude, because if you get up to 2000 feet and just find little bubbles of lift, don't take off going cross country unless you're willing to land close to the airport and have to make a retrieve.

Of course, a lot of these things may be very obvious to you, and I may be telling you things you know as well as I do, but when you're low, always steer for the downwind side of dark dry areas, ground fires, tops of hills or ridges that face the wind, because when you're low, you need every bit of help you can get from the terrain, and these different features are thermal producers. If you fly over something that is liable to produce a thermal, you're more likely to find some lift.

Of course, your best indication of lift is cumulus clouds. If you see good, sharp cumulus clouds and you're over a thousand feet AGL, the best thing to do is to go to the part of the cloud where you've been finding lift. Whenever the thermal strength falls below average, leave on a course paralleling the ground wind, if possible. I'm sure most of you have been in lift where you have twin thermals. You'll circle in one and you'll look over and see somebody else circling and almost running into you when your circles touch or come closer together.

So I think thermals have a tendency to repeat downwind, and, of course, this is why cloud streets develop. Now, if you can't find a thermal and you've gone quite a way downwind without finding one, then you'd better turn and go crosswind because you may be in one of those troughs between lines of thermals, and you won't find anything at all.

Using other ships

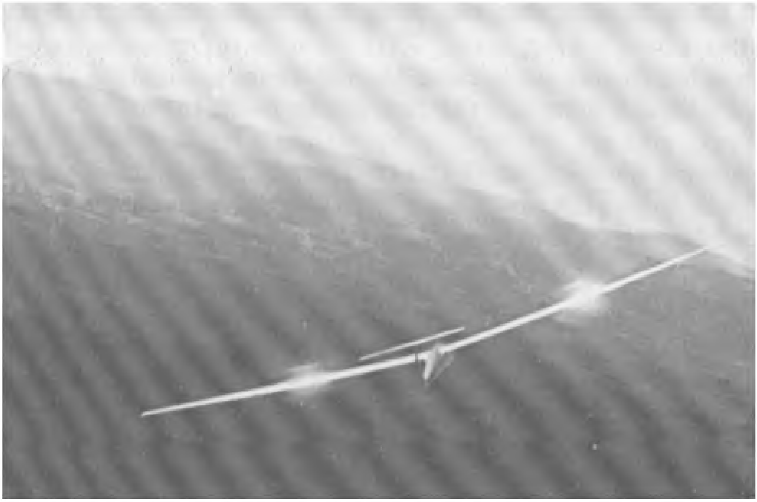
When you're following another sailplane and he's at the same altitude as you are, you can gain on him if you put your wing tip into his vortex. I'm sure you have all seen ducks flying in formation, and this is what they're doing. There is always one fellow who wants to be the leader, and the rest of them let him get out in front and do all the hard work, and then they fall in behind and take advantage of his tip vortex. What happens is that the lead ship is spinning the air off his wing tip, and if you can come along behind him and take the spin out of that air, you are gaining some energy that he is throwing away. It's surprising how often you can work this in a contest. If you can get your wing at just the right elevation and right in line with his tip vortex, you can pick up on him and pull up right alongside.

Of course, it goes without saying that you should fly under cloud streets whenever possible, because you have a continuous source of lift and it is your very best bet for staying up. Of course, it helps to slow down when you're in that lift and then speed up in between, because the longer you can stay in that lift, the more you're going to get help from it. If you fly through it very fast, your time in the lift will be very much less.

Speed rings and 'formulas'

I don't use any fancy speed rings or any formulas or anything for flying. I just fly strictly by ear. I have a general rule that if the thermals are running 3 meters, I cruise at 3 meters down in between thermals–if they are running at 5 meters, I cruise at 5 meters down.

If you are flying cross country and you see a large area of open sky, and cumulus all around that area, don't go across that hole unless you absolutely have to, because there is some reason why there are no clouds there, and usually it means there's less lift. Also, avoid areas shaded by high cirrus or cu-nims. If you fly in the lead of a thunderstorm when the ground is being shaded and the sun is cut off, you've 'had it'–the thermals will be very weak. Of course, if you're in a spot and you are trying to stretch your glide, or just looking for thermals, you'll get your very best help by favoring slopes that are facing the bright sunlight. If the slope is facing the sunlight, it's going to get warmer than the flat ground or one facing away. So you're more likely to find thermals kicking



ARMITAGE

Diamant over Calistoga

off of slopes that face the sun, and they're every bit as good as ones facing the wind–in many respects better because of the higher temperatures.

Also, I think a mistake that most pilots make is that they stay with thermals too long. When you are in a contest and you're climbing in a thermal and the rate of climb begins to drop off, you're better off to get out of it and get going and spend your time in the best part of the next one than you are in the weak part of your last one. Also, if you are running on a triangle, you want to be sure that you gain as much altitude as possible while you're drifting with the wind. If you are coming into a turn-point, get all the altitude you can while you can still drift with the wind, because you're getting that wind speed for nothing. If there is a 20 or 25-mph wind blowing along course, even when you're circling you're making 20 to 25 mph over the ground toward your next turn-point. If you go into a turn-point low and then have to come back against the wind from down low, all the time you're circling you're losing 20 to 25 mph, or whatever the wind velocity is.

On a distance day, especially in a contest, I always like to start as early as possible. I try to take off as soon as it is possible to stay up because then if things suddenly get good, you have a jump on the rest of the pack. If conditions are weak, you get warmed up by getting a lot of experience in working the weak stuff and then, when it does break, you're ready to go. It's much better to be up there waiting than it is to be down on the ground waiting.

Greed

I think that one of the mistakes that all of us make is that we get greedy—wait too long on a day that there's a speed task. We wait too long for the weather to get just right so that we can bracket the best time of the day with our dash around the course. And so many times you'll get started on a task and get out on the first or second leg, and a big high cirrus cloud goes over and everything goes to pot, and you're lucky then if you even make it back to the field. So it's much better over the average to start a little too early than a little too late because if you don't make it around the course, you don't get many points for not finishing.

4
THERMALING
The art of going up

by GEORGE R. BROMLEY

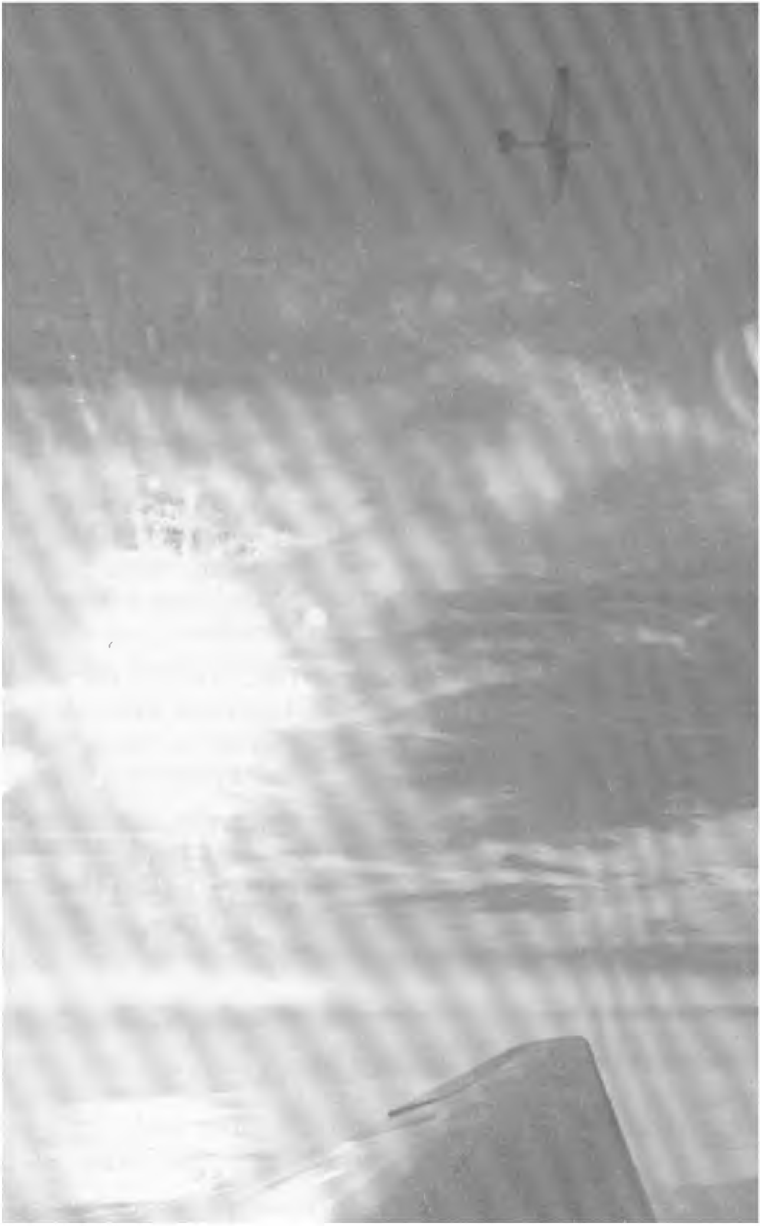
"How do you do it . . . what's it really like?" These are undoubtedly the most frequent questions heard at a glider field. Though they crave simple answers, good explanations seldom come, "Decrease bank when lift increases . . . keep a steady bank . . . turn toward the wing that rises . . . ," or more often, "it's something that can't be explained; you have to teach yourself," are all too often the replies.

Learning to soar over Germany in 1962, I found the scraps of lift no match for the thermals of Texas and Arizona. And like the Germans, I had to learn to thermal in whatever lift the weak sunshine and damp ground might produce.

Logging more than three or four minutes of flight off the German winch meant thermaling from the downwind leg of the traffic pattern. Two problems were critical: how to recognize a thermal (was it lift or did I just pull back on the stick?) and, how to work the thermal–a thing I had never done before.

I looked to the Germans for help. "You have to teach yourself," they said. I watched what they did and asked questions but there seemed to be few fixed ideas. "Every thermal is different . . . ," my instructor one said, "you just have to know from experience how to vary your turns."

While I got nowhere with the thermals, my winch launches and landings were going great. So I started searching through old issues of SOARING and the few books I found on



ARMITAGE

Up . . . up . . .

gliding. Still not much help—writers were vague even about how a thermal works, let alone the best way to maneuver in one.

Even today, little more has been written about thermaling. For readers who can find a July, 1964, copy of SOARING, there is a good article, "How To Fly Thermals," by Jack Lambie. The SSA instructional manual, "The Joy of Soaring," also has a good discussion. For readers with a sense of humor, regular doses of Wolters and Siebels are recommended, and highly instructive! The writings of Derek Piggott (GLIDING) and Anne and Lorne Welch with Frank Irving (NEW SOARING PILOT) are also most helpful.

Fundamental concepts

Piloting ability is only one of the prerequisites of soaring. The gliding performance and manueverability of the sailplane must also be sufficient for the weather at hand. And, of course, the weather must cause some air to rise! Thus, the ability to stay up depends on recognizing the part that weather analysis and performance limitations play in thermaling technique. The technique used in a broad, powerful, West Texas thermal, for example, will probably be ineffective in a wispy thermal off a cool New England countryside.

A pilot transitioning from a 2-33 two-seat trainer to a single-seat 1-26 finds that, although the same basic principles apply, some new 'tricks' will work with the 1-26, whereas the 2-33 was simply too unwieldy. An advanced pilot working the same thermal in a high-performance ship such as a Libelle will optimize his climb by using still another style of flying. The higher wing loading and speed of the Libelle will not permit the tight, pirouette-like turns that the 1-26 does with ease. On the other hand, the Libelle's ability to fly off to the side of a thermal, to explore the lift and return without the altitude sacrifice of a less slick 1-26, illustrates the role of aircraft performance. How to thermal thus depends on more than just what the thermal itself is doing.

Nevertheless, all techniques have at least one thing in common; they all depend on the pilot's ability to visualize his position with respect to the center (or centers) of lift. The intuition that a pilot uses is something like that of a man groping in an unlighted room; he feels around until grasping something tangible and then, exploring in several directions, he determines where things are, trying all the while to visualize the layout in order to return at will to any preferred spot. The soaring pilot, likewise, must scout the 'invisible lift' of each part of the thermal until he can visualize the overall pattern. Thermals are much more difficult than dark rooms, however, because they constantly change. The pilot should continually update his mental picture by re-evaluating the thermal every 360 degrees of turn.

Pilots tend to categorize thermals by their prevailing patterns of air flow. These patterns are determined by the intensity and type of source, the amount of entrained air and its instability. For detailed information on meteorological aspects, *"Meteorology for Glider Pilots"* by C. E. Wallington, is very comprehensive (and is, of course, cited in the Appendix).

What do thermals look like?

Writers have attempted to model thermals. Admirable as these efforts are, pilots seldom encounter thermals that fit any one of the models well. One model idealizes the thermal as a bubble or parcel of extra-warm air that breaks loose from a heated spot of ground and floats upward, much like a bubble in a glass of beer. The circulation within the bubble is thought to form a 'vortex shell' (sometimes termed a 'vortex ring' or simply an 'isolated thermal'). This theory considers the bubble to be essentially round with a defined top and bottom so that, if the sailplane is above or below the bubble, it will not feel its effect. Figure 1 shows a vertical cross section of the flow pattern through the center of a vortex shell (bubble) which is rising through the surrounding atmosphere. Sometimes a stream of these bubbles emanate from the same spot of ground, whereas under weaker conditions only an isolated bubble arises. In the latter case, a small cumulus cloud may form when the bubble reaches the cloud level, and then the cloud fades away when there is nothing more to sustain it. A complete explanation of the vortex-shell model

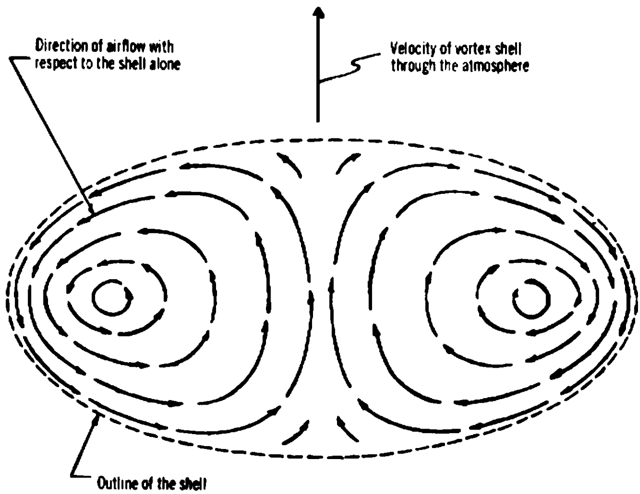


Fig. 1. Cross section of airflow in the vortex shell: The net velocities are a combination of flow relative to the shell itself plus the velocity at which the shell rises. This gives a net upward velocity even at the outer edge.

is given in "Theory of Soaring Flight in Vortex Shells," by C. D. Cone in the April-May-June, 1961 issue of SOARING magazine, if you can find it.

Another model depicts the thermal as a continuous rising column of air, with a horizontal rotation or corkscrew motion as it rises. In the Western and Southwestern States of the U.S. these thermals are often seen as columns of dust (dust devils) rising for thousands of feet. More often, the dust is not present so that the thermals, though still present, are not visible. These thermals are usually associated with strong conditions, while the bubble analogy seems to fit weaker conditions better (although lift strength in the center of a bubble may still be very good).

All thermals don't begin on the ground. Occasionally, conditions exist in the atmosphere that spawn thermals directly from the air aloft. These thermals tend to be less dependable and more like the bubble model. They can occur over the open sea as well as over land.

What do they feel like?

Experienced pilots usually interpret a thermal more by the feel of their sailplane as it reacts to the air than they do by observing the sky or watching a cloud more than 1000 feet above them. They may experience a thermal as 'smooth', 'ragged', 'sharp', 'powerful', 'tricky', 'weak', or 'narrow', and these are the words they use. And some act like very large, broad masses of air swelling upward; one can soar here and there and the rate of climb hardly varies. In contrast are sharp, jagged thermals that have dimensions perhaps less than a wingspan, but can be very powerful. These latter thermals are close to what might be called mere turbulence. It is proper to think of them as thermals, however, so long as they are produced by the tendency of warmer, less-dense air to float upward.

Thus there are two types of thermals–broad and narrow; and there are, respectively, two basic soaring techniques to match them. When a thermal exists between the two extremes, the best soaring technique combines the two basic techniques, as will be discussed later. If the lift is smooth and steady, the pilot will not sense it, and must depend on his variometer. Most thermals, however, seem to have a mixture of vertical and horizontal wind shears that the pilot feels as his sailplane is forced up or down (even before the instruments respond). A passenger may find this uncomfortable, but to the pilot it is like a sign telling him what he needs to know about the thermal. The job of a beginner (with respect to soaring flight) is to learn this subtle sign language.

A Working Example

Let's consider an example. Sometimes, when watching a large cumulus cloud, parts of the upper edge (particularly on the leeward side) can be seen flowing out and curling over. By watching closely, one can see that the motion is quite strong, particularly when compared to the rate at which the rest of the cloud is changing. Actually the same thing occurs at various levels in a thermal below cloud level, even though it is not visible. It is not necessarily on the downwind side either, although the effect is usually more pronounced there.

Now, if a sailplane is flying from the strong rising air in the thermal core straight out to where the air is curling over, the rate of climb will be highest immediately before leaving the lift, then, in an instant, the sailplane will be not only out of the lift but will suddenly drop in the descending air. This has a 'double-whammy' effect that any pilot can recognize. Unfortunately, however, all signs are not so obvious. Much more subtle signs are the rule, such as the distinctive tremor that a sensitive and experienced pilot senses in his ship just before reaching the edge of the thermal. If he recognizes it in time, the pilot may be able to tighten his turn and avoid flying out of the lift.

Thermals are often referred to as if they are round; it's far better, however, to make no assumptions about their shape until after flying through them sufficiently to know. Some thermals are elongated and do not have the best lift at their center. Often several thermals are closely grouped, with only weak lift or slight sink between them. Sometimes several of these can be encompassed within 360 degrees of turn to good effect. Still other times, cloud streets (described by Wallington) form where thermals merge aloft into long lines stretching for miles. When this happens, it may be possible to climb just by weaving along under the line of cloud.

The milling of the air in a thermal not only creates vertical shears which the pilot senses as 'bumps', but it also creates horizontal shears that strike the yaw string. Strong horizontal flows usually tend to push the sailplane away from the strongest lift, just as a really strong core can pitch a ship sideways out of lift. An exception can occur under a storm cloud (see "Dunderhead's Thunderhead" by George Worthington) or near the ground, where the surrounding air feeds into the base of the thermal.

The foregoing discussion has stressed the wide variety of thermal conditions, to emphasize the importance of not thinking about the thermal as though it 'should be' a certain way. Even after flying in a thermal for some time, the thermal can change radically with little or no warning. Be alert for this.

Recognition and tactics

A thermal is usually felt first as a mild bump followed by a shifty feeling as the ship snakes through the turbulent air. At other times, particularly very late in the day, a thermal may exist that has no clearly defined boundary. Instead of bumpiness, the thermal then reveals itself by a smooth, gradual transition from calm air to rising air. On still other occasions, especially when thermals are powerful, heavy sink may be encountered just before reaching the thermal. Don't turn back in this instance; the quickest way to the lift is to continue straight ahead at reasonably high airspeed.

Working a thermal demands high levels of pilot concentration, with continual spur-of-the-moment decisions (largely subconscious) based on an ever-changing assessment of the thermal structure. Knowing when to turn, which way and how sharply–plus the ability to do so with precision and coordination–is very important.

The first decision, made at the earliest sensation of thermal activity, is whether the lift is stronger to the right or to the left. The best indication is a brief, involuntary roll *away* from the stronger lift caused by the unbalanced lift along the wing. This is usually very slight and is easily missed by an inexperienced or inattentive pilot. Nevertheless, even a suspicion is surprisingly reliable for many pilots, and often that's all there is to go on. Secondary effects, however, sometimes reinforce an impression; for example, a strong gust can throw the yaw string momentarily away from the side with better lift. Each individual sailplane is likely to have its own peculiar traits that can be used to sense the air, provided the pilot is sufficiently familiar with his sailplane. Roll response and directional stability (i.e., tendency to fishtail) can either conceal or amplify the sensations felt by the pilot. Occasionally, after striking a thermal, a pilot may recall a brief, involuntary aileron correction that he had made; this would have been toward the stronger lift. If no impression is gained, a turn is probably not in order; the center of lift may be straight ahead, or the bump may have been mere turbulence. The differences can be maddeningly subtle.

Assuming that the turn direction has been decided, the next decision is when to start the turn. This depends on the size of the thermal, as judged by the permanence of the lift. As soon as the lift shows any sign of slackening (ignoring rapid fluctuations), the pilot should start his turn. If the thermal seems broad, he uses a gentle bank (say 20 to 25 degrees). If it seems to be highly localized, he uses more bank (up to 60 degrees). Figures 2 and 3 show the effect of turning either too soon or too late due to misjudging thermal size.

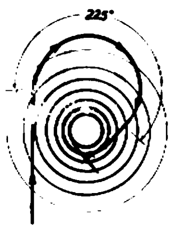


Fig. 2. Initial turn made too late.

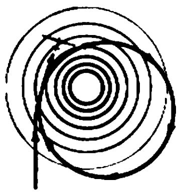


Fig. 3. Initial turn made too soon.

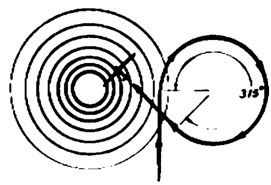


Fig. 4. A turn in the wrong direction.

Referring to Figure 2, if the lift persists after the turn is started but disappears prior to turning 90 degrees, the correct turning point was probably overshot (the lag in the variometer's indication may contribute to a late turn). In this case, the pilot holds the bank constant, rolling out after approximately 225 degrees; or he rolls out immediately if the thermal is re-entered sooner. If the lift is lost from 90 to 180 degrees after starting the turn, the turn was probably begun too early (Figure 3), and, he should maintain a constant turn rate for slightly more than 360 degrees before rolling out. After rolling out, he must be prepared to roll immediately into the next turn in the same direction and then repeat the procedure.

If the lift is lost almost immediately after the pilot begins turning, the turn was probably made in the wrong direction (Figure 4) to regain the thermal, he should continue the turn, holding whatever bank was first chosen. Holding the bank constant forms a uniform circle, from which he rolls out after about 315 degrees. The orientation procedure is repeated as soon as the thermal is re-entered. Every time the thermal is re-entered, its location and size become more evident.

The value of these manoeuvers depends vitally on flying a uniform circle. This demands co-ordination (yaw string centered) and keeping the turn rate and airspeed constant (disregarding fluctuations due to turbulence). The disadvantage of the technique? It assumes that the thermal is more or less round. If it is not, this will become apparent after a few circles; then the technique can be modified in line with the following discussion in which two diametrically opposed methods of centering will be considered. Each is suited to a particular condition and demands a different degree of skill. A pilot may switch from one technique to the other in the course of five to ten minutes, depending on the space in which he must manoeuver.

Steady-state thermaling

In the first technique, the pilot rolls *out* when lift starts to increase, and in the second technique he rolls *in*. For convenience, the first technique will be called the *steady-state* method. Basically, it is little more than a continuation of the entry-and-orientation procedure. A series of smooth, constant-bank turns are flown, interspersed with short periods of wings-level flight. Although this may not always cope with the narrow or more irregular thermals, it is easier and less confusing for a beginner. It should always be used when the area of lift is large. If lift increases while circling, the pilot levels the wings until the rate of climb almost comes to a peak and then re-establishes the turn. If lift vanishes, he re-enters the thermal according to the earlier instructions. Sometimes when lift increases, the pilot may simply use less bank instead of straightening out. This refinement makes the centering more precise so long as the pilot can visualize his flight path. There is no finesse, however, in losing track of position. This, then, is the steady-state method; a series of constant-rate turns tailored to fairly broad thermals.

If the steady-state method were used on a small thermal, or on a narrow core of lift, the sailplane would theoretically fly around the best portion of the lift, and the flight path would be far from optimum. To milk out the best overall rate of climb in this situation, the second technique is required. For contrast, it will be called the *dynamic* method.

Dynamic thermaling

To illustrate the dynamic method, a somewhat extreme example will be used to show how the best average rate of climb can be attained in a strong thermal core that is too narrow for the sailplane to remain in continuously. A core is recognized by a sudden surge of lift that may be several times stronger than the surrounding lift. The instrument indication is a jump in airspeed, followed (with its inherent lag) by a healthy rise in the variometer reading. Particularly in cockpits that are well vented, a rush of air is unmistakable by the sound. It's usually fair to assume that the ship will not remain in the core for a full turn because strong cores are typically very narrow. The technique now becomes one of continually driving into the core and turning in such a fashion as to get the most height before sliding out again. As soon as the pilot feels the core, he allows the nose to come up smoothly, kills off the air-speed surge, and simultaneously rolls some lift from the side of the fuselage.

If the core is strong and narrow, it is unlikely that too much bank will be used; nonetheless, the pilot should guard against a stall-spin and should use no more bank than necessary, especially if the core has a reasonable dimension. Caution: starting the bank in time prevents the nose going so high above the horizon that an awkward stall recovery becomes necessary. Rolling out as much bank as feasible at the top of the pull-up and holding the airspeed down to just above stall, prolongs the time in the core and minimizes the turn radius while still exposing as much wing as possible to the rising air. At this point some pilots have an inclination to 'rudder it around' with a slight skid; the merit of this is debatable.

At the first indication of leaving the core, the pilot picks up a good margin of airspeed so that the sailplane slides out of the lift without mushing. A medium bank is established in order to return and repeat the procedure. Sometimes, if the core is elongated, the wings can be held level for an extended period as the sailplane 'tiptoes' down the length of the core. The edge is often so sharply defined that the pilot can feel one wing tremble and try to drop away as it extends out too far; a turn can then sometimes be expedited so as to recover within the core. Otherwise, the effect of shear clutches the whole sailplane. Under these conditions, a steep descending turn, with a slight zoom and roll-out when the core is reentered, makes the best recovery.

Summary

The most important thing to note about the dynamic method is that when the lift starts to increase, the rate of turn is also increased; whereas, in the steady-state technique suited to larger thermals, the rate of turn is decreased or removed when lift starts to increase.

Soaring, as practiced in general, is a combination of the steady-state method plus dynamic soaring with the proportion of each depending on the thermal characteristics, pilot proficiency, and aircraft performance. Short-span sailplanes and those with light wing loadings and quick responses are better suited to the dynamic technique. This contention is supported by the ability of some of the older, featherweight designs (such as the Weihe) to outclimb the late model highly loaded competition machines (for example, the Libelle), even though the minimum sink rate of the former in calm air is often greater.

Which technique a pilot follows at any given moment is, of course, a matter of judgement (and judgement is vitally important!). Frequently, he switches from one method to the other while working the same thermal in order to optimize his flight path for the best overall rate of climb.

And while theory is all well and good, there is no substitute for experience and practice. So be prepared to take advantage of the coming season . . .

5
WAVE SOARING
The techniques that really work

by JACK HARRISON

There are many misconceptions about wave soaring. Perhaps the worst mistake pilots make is to expect that every wave will produce a Gold or Diamond height, and are disappointed when it does not. Most of the wave in England is usable to 7–8,000 ft. only, unless you happen to be in a particularly favorable area, or conditions are quite superb. If wave soaring is approached with the attitude that it offers some enjoyable flying, but is unlikely to produce certificates, greater success is probable.

Aero-tow into wave

An aero-tow direct to the wave is by far the most reliable method of contacting wave. If aero-towing is available (and finances permit), I invariably take a high tow to the wave rather than have all the frustration, time wasting, and far less certain success of, say, a winch launch to hill.

Before I decide to launch, there must be some indication of wave. With a well marked cloud pattern, I can be reasonably confident of success. But I may just have an inspired hunch. I study the map and make a guess where the wave should be. The primary wave is relatively easy to pin-point. But the position of further waves downwind is more difficult and the cloud pattern becomes less distinct.

An aero-tow perpendicular to the wave system should at some point go through lift. If possible I have a tow to the primary. In phase hills can be treated in isolation, each hill in effect producing its own primary wave. If I cannot reach the primary, I have a tow into wind across the wave.

Release height

If the object of the flight is purely enjoyable soaring, then the tow should be as high as possible. It is great advantage to release 1,000 ft. or more *above* cloud base. Lift does occur lower down, but it is far less workable. Above cloud base, the lift has usually settled down to make smooth and relatively straightforward soaring. In the absence of low cloud, the tow should be above the inversion. Below the inversion, the lift is often (though not always) broken, intermittent, turbulent and far more difficult. So my advice is normally to have a tow to well above cloud base, to say 3,000–4,000 ft. If, however, it is hoped to achieve a Gold or Diamond height, then the release must be as low as possible. If there is any doubt about releasing though, the advice is–don't. Unless the tow is to a hill, I would recommend never releasing below 2,000 ft. except in very rare circumstances. It might seem extravagant to have such high tows. From any experience, it can be a waste of money to try to economize with lower launches.

Aero-tow to hill

This is straightforward, and would often be an alternative to a winch launch. All that is necessary is to ensure sufficient height before releasing to be able to reach and use the hill lift. Getting into wave from the hill will be described later.

If a certificate height climb is hoped for, it is important to get a good low point on the barograph. Hill lift can be so powerful that, unless a positive low point is marked, there may be difficulty with the subsequent claim. It is not sufficient to pull out the air brakes for a few seconds. This will *not* mark the trace. Once you are certain that the hill is working, make a definite descent (or level off if you are not confident) and hold this low height (with the use of brakes) for a couple of minutes at least. A quick dive and climb will not mark the trace. Time and time again, heights have been missed by a few hundred feet, which could easily have been achieved by going lower on the hill at the start of the flight.

Technique on tow—good wave

I will describe two typical launches—one into strong, easy lift, the other into indifferent blue wave.

From the airfield, I could see, some six miles upwind, what looked like a wave gap in the strato-cu sheet. Its position was about where I would expect the primary. Overhead was a thinning in the strato-cu, and I suspected another wave trough. The tug pilot was asked for a climbing tow to the gap upwind, leveling off if necessary to avoid going into cloud. When at the gap, he was to continue climbing in the clear, and I would release, I hoped, into lift.

Immediately after take-off, we were climbing rapidly in rough, broken lift. After a mile or so, the climb on tow became the more normal 4 knots. Soon we were at cloud base, 3,000 ft., by now some 4 miles upwind of the airfield. Then we hit some of the most severe turbulence in my experience, and soon were descending at 3 knots. I assumed that the tug pilot had throttled back to avoid cloud, but I learnt later that he was still at full throttle. It was quite obvious at the time that we were in strong sink, probably rotor. Suddenly we began climbing again and just cleared the front of the cloud at the wave gap. At 3,500 ft. with the vario at 8 knots, I pulled off. I had done so a shade too early, and had to push forward at 60 knots to get fully into the clear and into the best lift. I slowed down to 40 knots IAS with 7 knots on the vario. The lift had only just begun to decrease at 14,000 ft. when I had to break off as I had no oxygen.

I will discuss in more detail later exactly how I worked the lift.

Indifferent wave

The sky was clear with poor blue thermals. There was no visible indication of wave. But the wind was in the right direction, and the right strength. There was an anticyclone to the south-west of Britain, and I presumed that the lapse rate was favourable. Unfortunately, however, the humidity was so low that no cloud could form. I took a chance and risked wasting money on a high tow.

I briefed the tug pilot to do a climbing tow on heading 290 degrees (into wind, perpendicular to the hills that might be producing wave). I asked him to fly at as constant a speed as possible so that variations in the rate of climb were real variations in the vertical speed of the air. I would release when I judged it right.

The tow went as planned. Below the inversion, among the last of the day's thermals, it was mildly turbulent, with no real pattern of lift and sink. By 3,000 ft. we were in the smooth air above. At 3,200 ft. the vario showed 5-6 knots; 2-3 miles further on, we were barely climbing. Then after another 2 miles, the vario increased again to 6 knots. I watched it carefully, and when it was just passed its peak reading, I released at 4,800 ft. I eased back 200 yards, and set up a track parallel to the hills (some 30 miles upwind). The lift worked to 7,000 ft. I then used the wave for a 150 km out-and-return, landing 4½ hours later at sunset. My expensive gamble had paid off.

Wire launching

If the launch can be made directly on to the hill, this might be the ideal method, particularly if height gains are hoped for. A wire launch at a flat site requires a great deal of luck to succeed. Almost certainly, thermals will have to be used initially, so familiar thermal techniques will have to be used (described later).

Becoming established in wave

This is perhaps the most difficult part of any wave flight. The techniques involved are unfamiliar to many pilots, so although wave can be a common occurrence at many sites, it may be infrequently used. I will describe in detail the methods I adopt by using successful flights as examples.

At the start of the flight in good wave described earlier, I had released too early with the cloud still forming around me. So I had to press forward fast to make headway into a 35 knot wind. As it is vital not to get too far back and into cloud, I took no chances and flew forward too fast rather than too slowly. When I was positively clear of cloud at

3,500 ft. (base 3,000 ft.), I slowed to minimum sink speed. If the wind had been more than 40 knots, I would have flown at such an indicated air speed as to give zero ground speed. I fixed my position over the ground. It is not easy to see vertically downwards, so I normally use a couple of features on either side of me, and maintain position by reference to these. Flying directly into wind gave a few knots positive ground speed. The vario was steady at 7 knots.

With only 35 knots of wind, it was therefore necessary to beat along the wave. By the time I had reached 5,000 ft. the cloud pattern was quite clear, so tracking was easy. It was only necessary to turn out of wind by a few degrees to achieve the necessary forward ground speed of 35 knots. I went ¾ of a mile or so one way before turning back a few degrees to be flying the other side of the wind.

I was by now passing cloud tops at 6,000 ft., and with very clearly marked lift there was little worry that I would completely lose it if I explored the wave. I flew at 40 knots at right angles to the wave and moved slowly forward. It was difficult to assess accurately the wind speed and direction, so constant reference to ground features was necessary. It must be remembered that as height increases the indicated/true airspeed relationship must be taken into account. At 10,000 ft. 40 knots indicated is nearer 50 knots true air speed. However, frequently, the true wind speed increases with height by roughly this same factor so no adjustments to IAS are required, for example, to maintain zero ground speed.

As I moved forward I watched the vario. In the smooth lift small changes in the rate of climb were readily apparent. I noticed where I had the peak reading and then set up the beat to pass through this point. Now I had established how far into/down the wave the best lift occurred. If the lift had decreased as I initially moved forward to explore, I would then have eased back by turning well out of wind, first one way then the other. Only in light winds (25 knots or less) would I risk a circle. When exploring, I always go forward first. It is easy to get downwind again if I have made a mistake. If I went downwind first and made a mistake, I might never get back into the lift.

I now explored along the line of the wave, maintaining constant distance in front of the cloud. The strength of the lift varies along the wave. So as I tracked, again I noted the vario. In smooth wave lift changes in rate of climb cannot be *felt* as easily as in thermal. I stopped where I had the best climb. In fact, I had a good visual guide as to where the best lift should be. I merely positioned myself directly downwind of the biggest lee slope of the mountain.

Sometimes, I explore the wave the other way round, tracking along the wave and then easing forward. With experience, both techniques can be used simultaneously. But a word of caution. If in doubt, don't explore. Stay with what lift you have.

During the climb, I made small, continual explorations, all the way up to 14,000 ft. As I climbed higher, my positioning was made more by reference to the cloud than by ground features. At 14,000 ft. I broke off the climb and set off across country. Cross country techniques will be covered later.

Blue wave

The blue wave was far more difficult to use. At 4,800 ft. release, I slowed to minimum sink. The wind was only 25 knots, so considerable tracking was necessary. I noted my position and, guessing the alignment of the wave from previous experience of the area, set up a small beat of no more than ¼ mile. I just dared not leave the place where I knew there was at least some lift. Slowly, at a mere ¼ to ½ knot, I climbed. At 6,000 ft. the lift petered out. I had nothing to lose now by a little gentle exploring. I moved slowly forwards, then backwards, left and right, and observed results. I crept up to 7,000 ft., but not an inch higher. I then set off cross country. The waves upwind were better, and at one time, I climbed at 1½ knots to 8,400 ft., although in general I had to be content with ¼ knot.

From thermal into wave

Another example brings out most of the major points. I was on the return leg of a small out-and-return thermal cross country. The cumulus at 4,000 ft. was streeting nicely. My track was 45 degrees to the wind. My technique was to fly the streets into the wind and then cross rapidly at right angles to the next one. Suddenly the street I was using collapsed immediately upwind of me and a hole in the cloud appeared. To my right, a band of what looked like overdeveloped cumulus linked my street to the next. I hesitated whether to cross the gap to the remains of my street upwind, or to turn 90 degrees and fly under the band of cloud to the next street. It wasn't far to the next cloud upwind, so I chanced it across the gap. To my surprise just upwind of the cloud street (in the gap) I was still in lift. It was broken but gave bursts of 2 knots. Although totally unexpected, I immediately recognised wave. Below cloud tops, wave lift frequently is rough and broken. The picture now became clear. The streets were collapsing, and instead wave bars were lining up across wind (Figure 1, below).

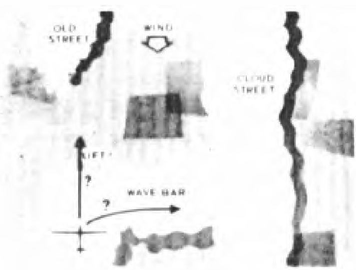


Fig. 1

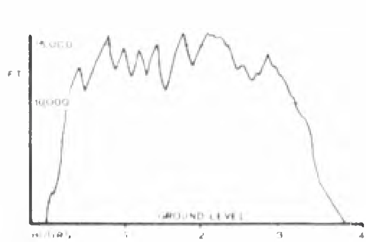


Fig. 2

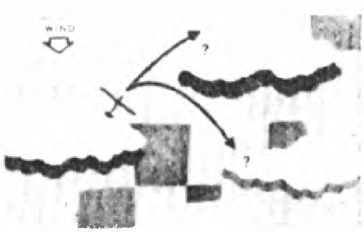


Fig. 3

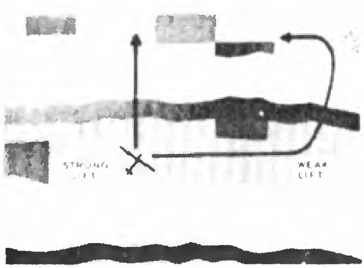


Fig. 4

I established my position over the ground. I was some miles downwind from any hills, but I guessed which ones must be producing the wave. Because the wind was so light at my height, 20 knots or less, much tracking was necessary. I stayed in front of the best bits of cloud as they formed. I would allow myself to drift back gently, and even threw a few cautious circles. But before I had drifted back too far (even though I might still be in lift) I would press forward, although at that stage there was no cloud upwind of me. Then as anticipated, more wisps of cloud would form, and with them, more lift. Slowly, and unsteadily, I climbed. I resisted the temptation to allow myself to drift back too far even with the biggest lumps of cloud. This would have been fatal, as I could so easily have found myself engulfed in cloud and in sink.

At about 5,000 ft. the lift settled down into pleasant, smooth, 4 knot wave. I then began to explore.

This thermal into wave flight was fairly typical. If ever I find lift immediately upwind of a cloud, I consider that it could be wave, and treat it accordingly. I try to work this type of lift by staying clear of the cloud. But some pilots favour a climb in a particular impressive cumulus, and then fly out into wind, and into wave. When these types of wave cloud are seen from above, it is easy to see how the alternative techniques can produce the same result. The cloud climb not only risks icing, but makes it all too easy to drift too far downwind.

I have explained at length how I work the wisps of cloud as they form. This is the crucial part of getting into wave from thermal. Lift comes in bursts. I cannot stress too much how vital it is to keep pressing forward, even though at the time you might appear to be leaving lift. Getting up to cloud base is, of course, necessary before pressing ahead in front. Normal thermal techniques are used. Often a few circles are needed, then flying straight into wind. Then a few more circles, and so on.

From hill into wave

On fortunate occasions, a wave coincides with the hill, and it is possible to climb straight from hill lift into wave. Once I realize that I am climbing higher than ordinary hill lift, I treat it as wave and adjust the beat accordingly to align with the hills I think are producing wave. It is often mistakenly thought that wave lift can occur on the upwind side of the hill. Wave is essentially a lee phenomenon. Hence, when wave is found coinciding with hill lift, this wave must have been caused by another hill upwind.

Usually, the wave does not so conveniently coincide with the hill. It may be off one end of it, or out in the valley. In this case, it is necessary to get enough height on the hill to be able to reach the wave, and still return to the hill if the wave doesn't work. It may be possible to thermal soar from the hill to the wave, but often more complicated techniques are needed. So here goes with another story.

Benarty Hill, Portmoak. The wave cloud was clearly visible three miles upwind over Loch Leven. I kept climbing as high as possible on the hill, going forward at 60 knots, but always just failing to reach the cloud. I had some good low points on that hill as I spent a frustrating two hours listening on the radio to some impressive rates of climb. The wave bar suddenly came back, towards the hill and to its left. From maximum height on the hill, I just managed to reach the broken (thermal type) lift at the right hand end of the cloud. I circled, flew into wind, circled, and so on. Just as suddenly as the wave bar had moved back towards the hill, so it moved forward again. I had to dash with it at 50 knots. Now I was where I had been trying to get those previous two hours, over the Loch at 2,000 ft. After a further 20 minutes or so, I was climbing at 6 knots in front of the cloud. There had been just this one opportunity to get into the wave. I wouldn't have got another chance. An aero-tow direct to the wave would have saved all that frustration. Incidentally, I learnt an important lesson on this flight. I left lift at 12,000 ft. as the vario dropped below 6 knots. How I wished I had stuck it out instead of over-confidently trying cross country speed flying. That wave apparently picked up again to 8 knots a few thousand feet higher, and took one pilot to over 24,000 ft.

Cross country

Cross country flying in wave is an entirely different dimension from that in thermals. You can still be local soaring 100 kms from base. Fourteen thousand feet is a moderate height, corresponding to perhaps 4,000 ft. in thermal. It *is* no more than a number on a dial. 5,000 ft. can be lost in 3 minutes. I once called on the radio "descending through 10,000 ft. and getting worried". I wasn't joking. I was about to drop out of the bottom of the wave, and landing could have been 10 minutes away. The pundit who talks about cruising at 14,000 ft. at 100 knots is no more boasting than the pilot who talks about 10 miles wings level under a cloud street. The barograph trace (Figure 2) shows a typical, successful cross country. (265 km triangle–3½ hours.)

Let us start at the point where we are established in wave, above cloud. The exploration techniques of tracking along the wave can be extended. It may be necessary to increase IAS in strong winds to make progress along the wave (i.e., if the climb has been made at zero ground speed). The climb, at reduced rate, may be continued along the wave. Alternatively, speed may be increased to give a reduced, or even negative rate of climb. No doubt some mathematician can work out the ideal cruising speed, but as a (no doubt incorrect) rule of thumb, I fly at a speed to give me about 1 knot down. When I find a strong area of lift, I slow, and perhaps turn into wind and climb again. At all costs, I avoid flying so fast that I risk dropping out of the bottom of the wave.

In very strong winds, the heading required to track along the wave is only slightly out of wind, so the achieved ground speed is low. Care must be taken to avoid getting downwind of the lift. It is easy to forget and head directly towards expected lift, e.g., a wave gap. I recall one occasion when I headed for a wave gap in a confused sheet of stratocu. I realised too late that the gap was jumping upwind. I should have tracked towards where the gap would be by the time I got there.

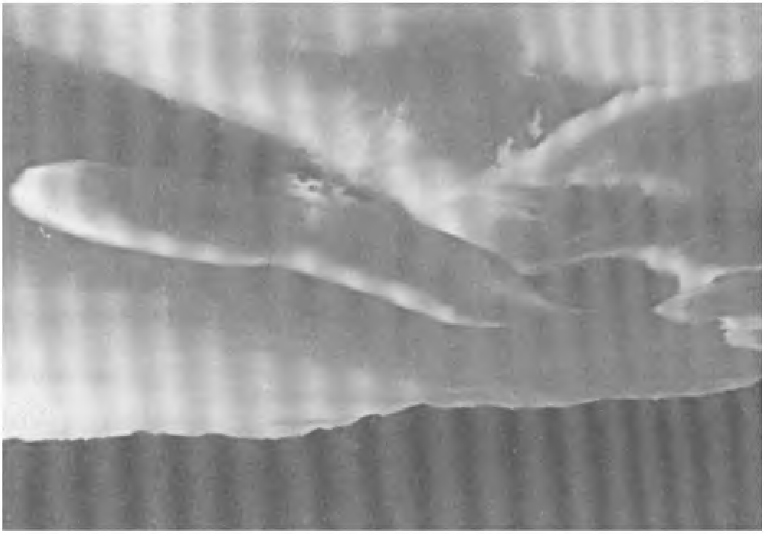
The line of lift is rarely straight. It usually has to be followed like a gently winding road. Sometimes there is a 'road junction', and the decision must be made whether to cross upwind or slightly downwind to the next wave (Figure 3). Usually it is better to go upwind.

After a climb it may be desirable to jump waves by flying directly into wind. The height lost can be quite phenomenal. I have regularly lost over 4,000 ft., and on one occasion it was over 6,000 ft. There are two techniques available, with intermediate variations. Assuming that I have been climbing in the strongest part of one wave, by flying very fast directly across the wave I will arrive at the best part of the next wave. But on the way, I will fly through the strongest sink as well. Speeds of up to 100 knots may be necessary. Height loss is great. However, this technique has the advantage that you fly straight into the best lift, and the time taken to reach this lift is only a few minutes.

The alternative technique is to track to a weaker part of the wave, cross through the weaker sink, and into the weaker lift of the next wave, and then along to the strong lift. Height loss in this method is much less. But it is less easy to find the best lift, and the total time to get there is long (Figure 4).

I tend to favor the quick dash with the large loss of height. The agony is over quicker. It is a more satisfying and exciting method. However, as up to 6,000 ft. can be lost, it is essential to ensure sufficient height at the start, so that the arrival at the upwind wave is comfortably above cloud. Thus, when the lift does not go very high above cloud, I use the 'long' method. With the quick dash into wind, in the heavy sink between waves, the vario is often hard against the stop. Don't panic (although on one occasion I was picking landing fields from 8,000 ft. over Loch Tay). This is a good sign that the lift ahead must be strong. It can be very tempting to chicken out and turn back. Unless it is certain that the next wave cannot be reached, do not change your decision. A very long time may have been spent gaining sufficient height to be in a position to jump waves. Do not waste the opportunity.

Flying downwind has its problems. It is easy to fly straight through the wave lift as it will be crossed in a few seconds only. If I wish to fly downwind, and use wave lift on the way, when I am approaching where I anticipate lift, I turn, perhaps almost into wind again and allow myself to drift back only very gently. Only rarely have I successfully flown downwind directly into the lift, done a quick 180 degree turn and been perfectly positioned.



Evening wave over the Rockies

A long glide out with the wind has less success than might be expected. The lift and sink do not seem to cancel out, and the sink wins. So don't expect glide angles of 1:60.

Navigation

Map reading above large amounts of cloud can be very difficult. My technique is to establish my position very accurately over each wave gap. Speed flying techniques may have to be temporarily abandoned as I stop and wait over a gap, and find my position. Fortunately, of course, wave gaps are usually associated with lift at their downwind edge. Perhaps at the wave gap, only a few fields may be visible. It is essential to find exactly where you are. I once spent 15 minutes trying to identify on the map a bend in a road which ran through a wood, although my natural impatience made me want to press on and find better lift. Had I done so, I would almost certainly have become lost.

If regular fixes are obtained, it is fairly straightforward to use dead reckoning techniques. The drift/ground speed must be calculated so that when the next wave gap is reached, there is a reasonable idea of where you are. It is important to get used to estimating distances above cloud.

It must be stressed that wandering around above cloud must be treated with the utmost caution. Don't do so if the cloud base descends on to the hill tops. Certainly prolonged flying above cloud is not for beginners.

The future

I have in all seriousness set off on a 500 km triangle in wave. I failed, but that is another story. Sam St. Pierre has several times flown from Dishforth to Edinburgh and back (450 kms), only failing to turn Portmoak for Diamond distance because of cloud cover. A flight from Lincolnshire to Inverness and back may be a dream, but is not impossible. But techniques will have to be developed for navigating safely above 8/8 cloud, and perhaps at night.

The geography of the hills is often reproduced in the cloud pattern. I have used radio assistance from the ground to compare the cloud gaps as I saw them from above with the cloud gaps as seen from below. It was pleasant to be reassured that cloud base was well above the mountain tops.

Undoubtedly, in the future, multi-channel radio will be more widely used. Unlimited possibilities will be opened up, for example, by the use of direction finding bearings from many stations. Air traffic control may be helping rather than hindering our activities by providing radar fixes. Instrument let downs at night will become common place. Competition organizers will have to use radio aids to prove that a pilot has rounded a cloud covered turning point. Thermal soaring will be in danger of becoming a forgotten art.

6
INTO WAVES FROM THERMALS
A safer route to altitude

by ALCIDE SANTILLI

A pilot who begins his 16,000-ft. Diamond Altitude climb from a 10,000-ft. tow ends up where simple mishaps can be deadly. A lower thermal start commends itself to the safety-minded.

Thermals reach up to fair-sized waves more frequently than has generally been admitted. It is undoubtedly because weather conditions in spring and autumn favor high-rising thermals under moderate waves with bottoms at about 10,000 ft.; a confirmed 32,000 ft. is attainable as of this writing. By comparison, the giant record-breaking waves prefer to surge alone mainly during late autumn and winter months. Investigation indicates thermal injection to waves should enjoy a six-to-four preponderance over waves that require direct-towing injection to establish contact. To date, written accounts of thermal soaring to waves lack enough details to encourage general exploitation by our soaring brethren who do not have ready access to an extensive bibliography, or who may not have the benefit of established professional contacts.

As a valuable cross-country tool, run-of-the-mill waves have already been very useful here in New Mexico. A soaring research team from New York started from Mountainair (in mid-New Mexico), and progressively working waves by thermal soaring up to some of them, reached mid-Colorado. The distance was not outstanding, but the methods were indeed creditable from a pioneering aspect. The first Altitude Diamond earned in 1971 out of Moriarty, New Mexico, had a thermal start. At an opportune time, transition was thermally made to a downstream wave, then by wave-hopping upwind to the primary wave, a suitable maximum of 25,600 ft. was reached. Again, this was nothing unusual, but it beat climbing stairs to get there.

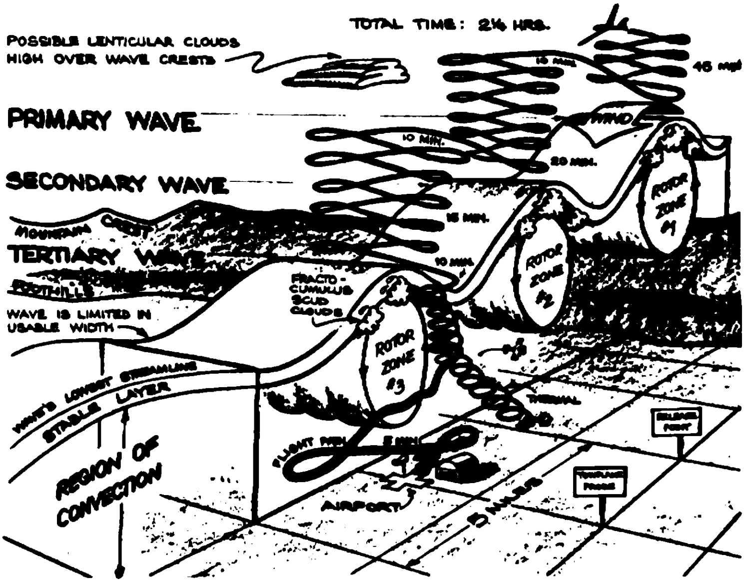
Early transition flights

Lest we appear unduly smug, let us realize that thermal soaring to waves has been old hat for years. At a time when quite a few self-styled expert stateside pilots held that when you had waves you didn't have thermals and vice-versa, European pilots had already been thermal soaring up to waves of their choice. During 1963, at the 9th OSTIV Congress in Argentina, Signor Rovesti presented a paper describing an unusual, thermal-initiated wave flight near the Italian Alps ten years prior to the Moriarty Diamond. At the 1966 Reno Nationals, the author transitioned from thermal to wave; the event wasn't considered unusual, as several other pilots had mentioned soaring thermally to waves. It is understandable that contemporary descriptions of those flights stressed the competition facets and slighted any constructive details on how the transitions were made from thermals to waves. Today, soaring to waves is done without much fanfare at Truckee and Estrella, and at several other established soaring sites.

When the Albuquerque Soaring Club moved to Moriarty, which is located several waves downstream from the Sandia, Manzano, and Ortiz Mountains, the possibility of wave contacts with thermal starts was established. A few resulted from pure chance. The common denominators underlying these flights were assessed by the local pilots, and later some remarkably consistent successes were realized in good wave flights. For a while the quest reaped failures as well as accomplishment. Waves, as well as human beings have been found to perform quite capriciously.

The connection

How do you connect with a wave by soaring up to its bottom on thermals? It is simple. For a starter, let's hope that some part of the wave structures are marked by clouds



to keep you from fumbling blindly. If safety considerations mean anything, select a downstream wave that isn't too turbulent to tow under, and with good emergency landing terrain underneath. Choose a particular themal, upwind of that wave's rotor zone. If you don't mind a little extra fumbling later, select any thermal upwind of the rotor zone and let the wind drift you to an eventual connection with the rotor zone. Spiral up and avoid getting dumped when lift narrows and speeds up in front of the rotor. Both wave and rotor may shift and spill you out anyway, so don't feel too bad if it does. Top off in the thermal and transition to an upwind penetration run at the correct time and place. Recognize the laminar-flow wave lift when you get to it, and there's your wave.

This is hardly a satisfying set of guide-lines for a newcomer, admittedly. The foregoing is about as much as could be coaxed and summarized from a few pilots who have accomplished the feat. Of course it contains many clues that an experienced soaring pilot might need to try for lucking out on his own. Yet, what if there are no clouds–no lenticulars to neatly mark the wave trains, nor scud (frac-to-cumulus) to mark the rotor zones? What if he makes a random selection of a blue thermal which starts legitimately, but which gets whacked to pieces prematurely as it vainly tries to punch a hole against the bottom of a wave trough?

Transition advantages

With such complications a possibility, what justification would there be for preferring to inject into a wave via thermals instead of towing directly into it? One consideration would be a substantially lower release altitude–a good altitude gain added to a low 'low-point', permits a lower maximum. Less oxygen is then needed, less unwieldy clothing, and even, ahem, panty-hose may be relegated to their primary function. There are fewer differential thermal stresses on sailplane canopies; strain cracks will not have to be stop-drilled. Rivets are less likely to pop. A safety factor is that by thermal soaring to a downstream wave in a train of waves, the underlying terrain is usually more friendly in the event that the pilot gets dumped out of thermals that start getting 'squirrely' near the rotor. Almost all the better known wave primary sites have forbidding terrain under their primary waves–either close-packed trees, close-packed rocks, or close-packed buildings with close-packed human beings around. If the primaries are reached by penetrating from wave to wave upwind, the altitudes usually are enough to return the pilot back to his home field with only some rough turbulence to contend with on the way.

Another advantage is that the process, though taking a longer time than direct tow, permits a more gradual cold pre-soaking of the sailplane. Transient differential stresses tend to be relieved in the basic structure and control members–an important consideration in some glass sailplanes. The advantage of being in free flight under the rotor has no comparison with having to tackle its worst part while still connected to the towplane.

The majority of soaring pilots are more knowledgeable at soaring thermals than they are at negotiating waves. For that reason, the conditions pertinent to the thermal soaring phase are given less emphasis herein. The wave soaring phase, however, seems to merit more complete treatment.

Thermal-to-wave prerequisites

For success in thermal soaring to waves, a few necessary conditions must be met. Thermal soaring should be possible to a level comparable with the tops of the rotor zones. In this layer the lapse rate, (temperature-altitude relationship of the actual air mass at the time), should be understood and studied by the pilot, if he doesn't want to trust completely to luck. The lapse rate may be unstable, neutrally stable, or stable only to the degree that the rotor zone may be attained with a trigger temperature less than the forecast maximum for the day. In such stable lapse rates, the thermals will more likely be of small diameter, fast-rising, far apart, and have strong downs in between, assuming dry thermals, and not the

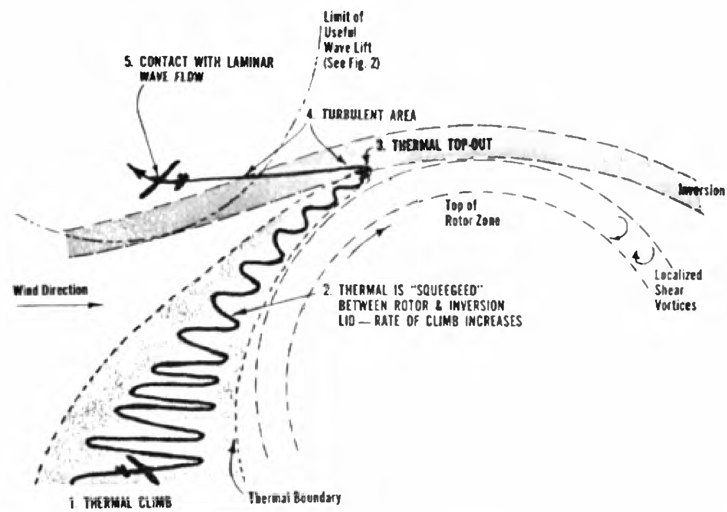


Fig. 1. Follow the numbers for a typical wave capture from thermaling.

notoriously damp 'humidals.' Unless one spirals in a steep bank to stay completely within their boundaries, he may mistakenly believe that he's encountering small bubbles. This is characteristic of lift ahead of the rotor zones, so it would pay to refine that portion of your flying skill and learn to cope with it.

Conditions to be satisfied for waves occurring above thermals are generally the same as for 'solo' waves. There must be at least a minimum wind speed at the ground feature (ridge, escarpment, etc.) causing the initial wave disturbance. Its numerical value may be determined either by experience, or approximately theorized by using the equations amply covered by the outstanding basic wave literature. There must be a certain kind of temperature inversion at or about the level of the rotors. Above that inversion level, the wind must have a positive velocity gradient; the wind must increase in velocity as the altitude increases. The amount of increase determines the type of wave. There must be some consistency to the directions of these winds, otherwise shearing turbulence may complicate matters. The aforementioned inversion must be pronounced enough to form an effective 'lid' which will contain, and even force downwards any underlying thermal activity. (The curling back downwards of cloud tops under the rotor crests may give visible evidence that the inversion is holding intact.) After enough thermal activity occurs to raise the energy levels of thermals colliding with the lid, the stronger thermals may start punching their way upwards. When enough strong thermals punch through to make a veritable sieve, the lower laminar flows of the wave are disrupted and the wave may quit at that level. Whether it quits at all levels may depend on conditions in the overlying layers. It is a unique feeling to be started on a morning wave, get 4000 feet above the tops of the clouds, just hang there for about a half hour, then have the bottom drop out and you're back to thermal soaring until maybe the wave re-forms in late afternoon.

Humidity—a key factor

Thermal soaring to waves seems to be more pronounced early and late in the day, and generally ceases to be possible during the hottest hours because the wave then quits. The duration of on-off-on behavior depends upon the time of year, seasonal temperature differences between a lower air mass and the ground, and the seasonal amount of solar radiation actually impinging on the ground. Humidity throughout the vertical section of air is a key factor on at least two accounts: firstly, if humidity exceeds a critical value, then, shortly after the moist thermals build clouds up to the top of the rotor zones, the heat liberated by condensation will rapidly deteriorate the inversion within an hour or so and the wave will quit.

Under the foregoing conditions, thermal soaring to a wave may be possible for about an hour early in the day, and may not resume in the late afternoon when cloud overdevelopment cuts off the ,source of heat for useful thermals. Secondly, a very low humidity will mean that no clouds of any kind will be available for you to orient your entry in front of the invisible rotor zone. Neither will you be able to vector yourself to a favorable position after contacting the wave because no lenticular clouds may exist. Such dry waves have been successfully negotiated, although initial inexperienced tries may require a lot of poking around to match up theory with findings on the spot.

Sequence timetable

What sort of a timetable would you expect to follow? If waves-on-thermals are expected to yield a 17,000-ft. gain, and if you contact a downstream tertiary wave via thermals, a typical early-day run, where only rotor scud is visible, would suggest this approximate schedule: tow–5 minutes; thermal soaring up–20 minutes; transitioning and probing the wave–10 minutes; topping-off in the tertiary wave–15 minutes; penetrating to the secondary and vectoring–10 minutes; working the secondary to an insurance altitude where you won't lose your shirt penetrating to the primary–20 minutes; penetrating to the primary and vectoring–10 minutes: climbing the primary to where it should make you happy–45 minutes. In all, it comes to some two and one-quarter hours. Early-day waves-on-thermals which last two and one-quarter hours before they quit seem to be plentiful at good locations in early spring and late autumn. As you gain proficiency, you can modify your procedure to reduce the time and you'll find more situtations you can exploit. A 50-percent time reduction is typical.

Thermal soaring to waves which re-form late in the afternoon involves similar considerations. You get high and stay high during the afternoon, alert for indications that conditions are changing. You start probing, and may have to repeat your attempts at transitioning. If you're doing things correctly, it is just a question of time before you have snagged your wave. Time then seems to run out fast, as sunset usually isn't too far away; it can be embarrasing to try getting home in the dark. The late afternoon wave seems to be more demanding than the earlier one. Transitioning must not be delayed, otherwise the weakening thermals may deny you a next try.

Preflight information to get

Assuming that you are motivated to trying the system, here's what you may do: from the National Weather Service of the National Oceanic and Atmospheric Administration (NOAA), through your nearest Forecast Center, you are informed of the probability of wave conditions. You confirm the presence and nature of any inversion at, or about the anticipated rotor level. You get the ground temperature for triggering thermals. You are told the maximum temperature forecast for the day, and the maximum height to which you can thermal-soar about an hour after initial triggering. You obtain the height of the condensation level for lower cloud bases. You make a copy of the winds at significant altitudes so you can have it with you in the cockpit. You determine if the jet stream is expected to stay in the vicinity throughout the day. (A nearby, overlying jet stream tends to insure the persistence of wave conditions because it contributes to the necessary positive wind velocity gradient.) Check on the possibility that a cold front system or one of its horizontal frontal 'waves' (another breed of cat), will not sweep over the area and knock out your vertical waves. Lastly, investigate the probability of a region-wide high cloud cover developing or migrating overhead to block out the sun and end thermal activity.

Tow technique

At the field, your next step would be to recognize what's happening at the time. If you are like most of us, you will get airborne as soon as the Club's Guinea Pig stays up. You will keep your senses honed, especially on tow. Cumulus clouds, if there are to be any, may not have formed yet. Waves are what you're after, and they should already be established. Rotors should already be in motion, with their rotational axes parallel to the ridge lines. Your first probing should occur on tow. Arrange for the tow pilot to circle the field when at a safe altitude for turning. The bottom of the rotor may be scraping the ground. Having circled to a sector downwind of the field, arrange for the tow pilot to make a straight tow upwind. Most definitely ask that he not circle in thermals en route. The reason for the initial circling back for the straight run is to increase the chances of both you and the tow pilot being able to land at the field in the event of an emergency. It has been most disconcerting to have tow pilots with radios on 'whistle-stop,' go directly out for ten miles from lift-off before climbing 1500 ft. When thermals are small and squirrely, it puts you in a bind. An upwind towing pass of about five miles should tell you all that you are seeking to find out. You then will have the greatest probability of probing a rotor zone from stem to stern. Downstream rotors tend to be less severe than those related to the primary. However, be prepared for a rough tow. Respond with alertness to any deviations from tow position. If you have been towed through waves and rotors before, you will recognize rotor behavior and not be tricked into releasing in the first phenomenal burst of high lift that won't be there as you spiral back. Be patient. Complete your probing run.

Mentally map the suspected rotor in what you conceive to be its horizontal cross-section. In the climb-up on tow, you will undoubtedly be sampling a horizontal line far below the rotor's major axis of rotation. At the downwind rim of the rotor there are strong, choppy downdrafts which may seem prolonged because you are traveling horizontally, and the rotor rim is at an oblique angle to you. Over where the rotor is scraping the ground, there appears to be slightly choppy air, and if any thermals have survived the slicing action at the surface, whatever thermals you encounter may be small and decidedly transient. Further on upwind, where the rotor rises again, you will encounter choppier strong lift which may last about two seconds at towing speed. These are the imps that start the towplane circling up in one direction while you may be tracking down in another, so bore on through. Upwind of this zone is where you should be prepared to release in one of the first good thermals which begin to last more than four seconds at tow speed. Going any further upwind would put you under a wave trough, and although the thermals seem to be the same size and as good as ahead of the rotor, the low wave trough subjects them to a premature 'lid,' breaking them off at a lower level. If you do release in one of these and climb to its top-off level, stay with it, even at zero sink, because the wind will eventually drift you nearer to the rotor, and the thermal has a good chance of re-generating, but this is not a promise.

After release

The windward boundary of the rotor zone may curve on up at an angle so that its furthest limit may be overhead, possibly a thousand feet higher than where you released. Your thermal will expand before it gets to that level, but until you know for sure that it has done so, it would be wise to spiral tightly to establish yourself. At the level where the rotor zone has curved upward to the perpendicular, it seems that there may be a vertical speeding up, combined with a thinning in cross-section of your thermal. One theory holds that the thermal may be subjected to entrainment by the rotor flow. At any rate the net effect is certain–the thermal speeds up, in fact, more so than if it were in free air without upward-dragging influences. You should then start re-tightening your spirals.

Even though your spiraling drifts you at wind speed, you'll probably be above, and in front of the rotor zone where the rotor-rim flow is at about 45 degrees with the horizontal. The thermal now undergoes a supplementary speeding-up action as it becomes 'squeegeed' between the rotor rim on one side, and the lowermost wave laminar flow on the topside. Keep spiraling tightly until the downs balance the ups. You will usually be forewarned of this stage. No matter how rigorously you try to hold constant airspeed, you may notice that on some headings, mostly windward, your airspeed will momentarily whoosh upwards some 15 mph. When this first occurs, you may re-center around these jets of intense flow, as the altitude boosts they furnish are worth the effort.

Snagging the downstream wave

As soon as you are aware that you've in fact struck a balance between ups and downs, peel off straight upwind at a speed about 20 mph better than at best L/D. You will be severely buffeted, and any higher speed, such as would be suitable for inter-thermaling penetrations, might scoot you out and beyond the wave lift. (If you are better attuned to your ship and instruments than the average pilot, go ahead and give it a high speed try, but don't say you weren't cautioned. It has been done, but there have been a lot of misses.) Back at cruising speed upwind, the rough random turbulence should last about a couple of minutes. Then you will feel a surging sensation similar to that of riding in a boat under the influence of tidal swells. Those who haven't enjoyed boating probably won't be distracted, so they can go about watching their instruments, checking position over ground, setting up distant landmarks, and doing whatever they feel may be necessary to vector themselves for maximum effect. The wave has been snagged. What you do next has already been so amply documented by experts that only what has not been given wide publicity will be introduced here. You are now in an ascending zone which may pulse in time, veer in position, quit altogether, or even have clear-air-turbulence at some level.

Assuming the wave stays put for analysis, what would the boundaries of such an ascending zone look like if they were visible? Visualize a vertical, cross-sectional plane of intersection parallel to the wind flow. The locus of zero-sink conditions will be essentially an ellipse with its vertical major axis tilted slightly upwind with altitude. Consider the bottom of the ellipse to be resting on the lowest wave streamline ahead of the rotor. The primary wave has the maximum tilt of the ellipse's major axis. Each succeeding wave downwind has less and less tilt. Within the elliptical boundary, the best lift is close to the major axis. Waves have lateral limits where zero-sink occurs. In your vectoring, mark these lateral limits with respect to the ground.

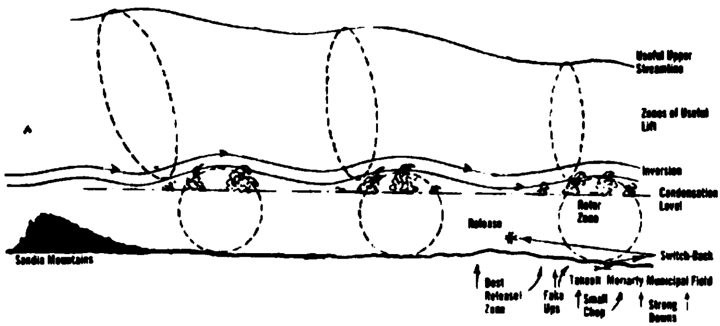


Fig. 2. Horizontal section looking north (small clouds drifting at wind speed).

Pushing for the primary

When you have attained 'insurance altitude' in your own little downstream wave, remember that if you want to max the situation, your objective is the primary wave. Here you have a couple of choices. Bear in mind that the closer you get to the primary, the more severe will be the wave downdrafts because of the increased windward tilting of the lines of maximum lift. It is possible to wipe out all your wave gain downstream in one careless, underestimated penetration to the next upwind wave. One choice depends on your having a super-sailplane. Start picking up speed where the lift is strongest, and red-line it straight through to the primary, perhaps even ignoring intervening waves. You'll lose a few thousand feet in each wave downdraft, but so long as you intercept the primary where the lower part of the ellipse is wide enough for you to recognize it as the wave, you are ahead of the game.

The second choice may better befit some of us who can summon up little better than an L/D of 35 from our sailplanes. You may want to progress upstream by getting off to one side of the wave's lateral boundaries which you should already have noted. Pick up airspeed in the best lift and veer off to an end run as if you were carrying the ball for the Green Bay Packers with no blockers in sight.

When the handy-dandy computer between your ears tells you to cut in for the next wave, slow down enough so that you don't barge on through it. You can zoom off your speed excess once you've located the wave. This end-run is most economical on altitude loss because your only opposition will be the head-wind in near-zero-sink air.

Additional tips

For those who may be trying waves for the first time, these few added gems may help a little. You've eyed your oxygen reserve, tightened the straps on your mask, re-set your altimeter to where ATC wants it, contacted ATC on the radio to let them know what you are up to, set the ventilators to strike a balance between window frosting and human freezing, loosened the ball bearings on your neck swivel so you can spot the fast jets, wiggled your toes to fluff up the wool in your socks, eased the pressure on the rudder pedals so your heel bones don't freeze, and then maybe your ears will start playing tricks with you. That sudden silence–did the barograph stop? Crank up the squelch threshold on the radio–is the battery freezing up, or have you been blessed with germanium transistors that de-rate at low temperatures? There may be funny noises from the sailplane. You check your controls for signs of binding. Was low temperature lube used on the controls the last time you got rambunctious with the oil can? Most wave fliers have these moments, so don't feel singled out–it's natural.

So far, you may have gotten where you are without any clouds, a complete dry-blue operation. Now, at altitude, you look beneath you and, lo, there are small clouds downstream. Yes, they are small clouds within the rotor zones. But wait, didn't the textbook say that rotor clouds hold stationary over the ground, building up on the windward edges and dissipating at their downwind edges? These smaller puffies do no such thing! They seem to grow fast, drift with the speed of the wind, build up to the top of the rotor which curls back isolated wisps that would like to punch through, and then quickly disappear. These clouds are the result of a marginal humidity which is incapable of completely filling the rotor zones. One phenomenon faithfully agrees with the textbook, however. There seem to be forbidden zones where such clouds never form. They mark the wave troughs.

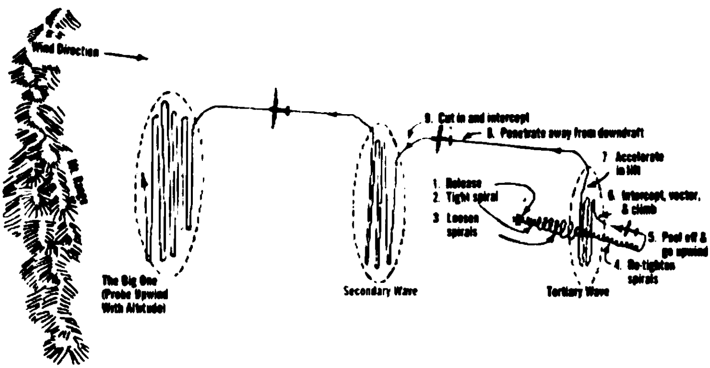


Fig. 3. Overhead view looking down on a successful soaring course.

When and if lenticular clouds appear, stay out of them. It probably would mean icing over on the *outside* of your canopy, and the ice buildup on your wings may be enough to freeze your controls. A specific example comes to mind. In penetrating through a lenticular cloud going from secondary to primary, a daring pilot experienced ice buildup where his ship's aileron counterbalances jut out and downward from the wings. He was able to detect it in time, but it took some hefty sidewise whacks at the control column to break the ice that had already formed. Fortunately the sailplane was sturdily built by the Elmira factory, so the pilot was able to tell the story first hand. Here, the end-run technique would have been wiser, but not half as exciting.

Getting back

On letting down, follow the book. There are little goodies to observe like regulating your descent so you can easily pop your ears, but not the rivets or glue joints. There are foehn winds to watch for if you plan landing under the primary. (Imagine a wind strong enough to flip over and keep rolling a Cirrus low trailer with the bird still inside—in pieces!) Be prepared for a wave that quits suddenly or quickly veers to another position. If you are low in the primary and this happens, with no good landing spots underneath you, the only good fields may be downwind. To get to them, you have to penetrate the rotor downwash. The textbook fails to inform you that if a wave quits, the rotor may still keep going long enough to shorten your downwind range, even if you red-line it. Half an hour later, everything may quiet down and settle into normal thermal conditions, but by that time you've already made your outlanding.

During the first stages of your tries you may be lucky. If clouds start popping while on tow, or thermal soaring, you can re-assess your position and move to a more effective location, if necessary. Since these visible crutches take away some of the guesswork, go ahead and climb within the rotor zone under one of the fattest clouds. However, also be prepared for a longer penetration run when transitioning. Be even prepared for another go-around. Obviously, if lenticular clouds are also overhead, you've got it made.

Admittedly, only one of many aspects of waves via thermals has been presented. Wouldn't it be useful to know more? Can we get more on record about this interesting type of activity? Direct towing to waves has its place, of course, and it still remains the fastest way of hooking a wave that doesn't want to be bothered with thermals underneath.

Good luck on your thermal-soaring to waves, and if you don't hack it the first time, remember the remarks at the bottom of SSA Item *L*3: "Just *smile*, charge it up to good experience and *try again*."

7
CROSS COUNTRY WEATHER
Air-mass type and season favoring long flights

by CHARLES V. LINDSAY

The purpose of this chapter is to relate the data of long cross-country soaring flights over a period of five years to weather type and season in order to give the soaring pilot and forecaster a better understanding of the conditions most favorable for long flights.

While experience is probably the best teacher, a study of weather conditions associated with actual long cross-country flights is at least a partial substitute. A detailed study of some of these flights should give both the meteorologist (forecaster) and the soaring pilot a better understanding of the weather types that are most promising for similar successes.

Changing weather conditions which may be of little or no concern to the powered pilot may mean the difference between success or failure to the soaring pilot. Even with favorable conditions, deteriorations may be rapid, and timing becomes critical if a successful flight is to be attained. Consequently, the need for a clear understanding of atmospheric conditions best suited for long cross-country flights is essential.

History of long soaring flights

The Soaring Society of America includes data on long cross-country flights in *Soaring* each month, as reported to them by pilots throughout the United States.

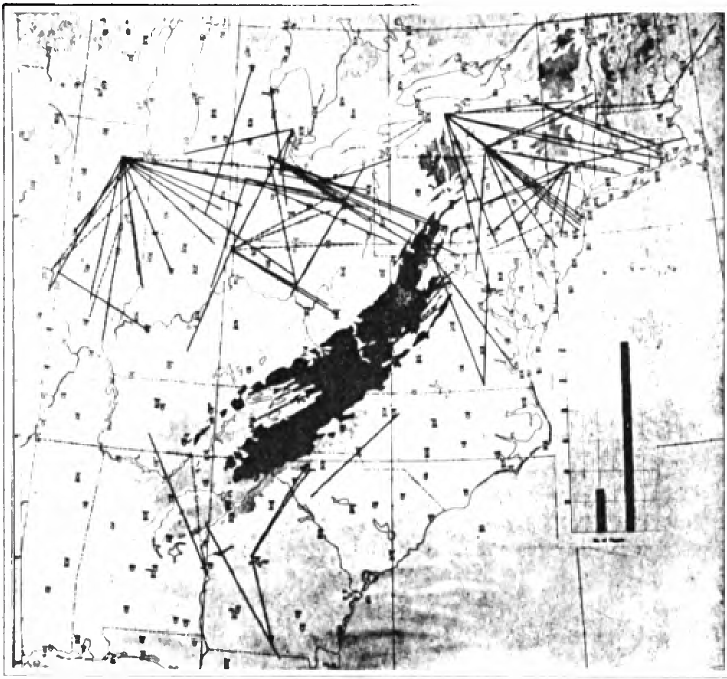


Fig. 1

During the five years 1962-1967, some 153 long cross-country flights were reported to the magazine by pilots from the eastern portion of the United States. A plot of most of these flights is shown in Figure 1. There were several flights over approximately the same flight tracks. Of. course, the tracks do not represent the actual flight paths, as they are seldom in straight lines. Long triangle flights are included in the data, but are not indicated on Figure 1. The tracks do represent the general direction of the flights, which is the important point. Note that most of the flights were made in a direction ranging from east around through the south and south-southwest of the originating point (as indicated by the solid lines). Also note that relatively few were made in other directions (as indicated by the dashed lines). The proximity of the Great Lakes did affect the choice of direction to some degree at several sites.

Over the central portion of the United States and from the Rocky Mountains westward, long flights have been made mostly in directions toward the north around through the east, as reported by pilots in *Soaring*. Among these flights was the world record distance flight of 647 miles by Al Parker, made toward the north. Also, Paul Bikle completed a flight of 557 miles toward the northeast, and Dick Johnson one of 535 miles toward the northeast. The weather conditions most conducive to long flights in one part of the country may not be the most favorable elsewhere. Also, weather types that occur in one locality may not occur in other areas, or at least not in the same form. For instance, steering of cPk air masses from Canada in late spring and summer normally brings them into the northeastern part of the country. Therefore, you would not expect to find this kind of air mass over the southern plains or from the Rockies westward, and only infrequently would it be found over the southeastern United States.

The weather conditions for each of the 153 flights in this study were checked, and it was found that 125 (or 82%) were made after a cold front had passed and ahead of the following high-pressure center. Generally they were flown in cP air. Twenty-eight of the flights (or 18%) were made in the relatively warmer air in advance of a cold front, and to the west of a high-pressure center, in mT air or air that was becoming mT. The barograph on the right side of Figure 1 shows the number of flights in each of the two basic types of air masses. These two types may be in various stages of modification, depending on the time and distance from the source region.

Definitions of cP and mT weather types

Air masses by definition are bodies of air which have remained over an extensive area of the earth's surface for a sufficient time to acquire characteristic temperature and moisture properties imparted by that surface. Air so modified becomes identifiable as a distinct air mass.

For the eastern United States there are two main source regions of such air masses. Canada is one region, and the air mass that originates there before moving southeastward over the eastern United States is known as Continental Polar (cP), labeled "cold and dry" on Figure 2 (which shows typical paths taken by air masses entering the contiguous United States). As this air mass moves southward over warmer surfaces, it gradually becomes modified–and during this process is further classified as cPk. This modification results in instability even with very little daytime heating, and instability sometimes occurs at night as the cool air moves over warmer surfaces.

Fig. 2

The other air mass most commonly found over the eastern United States has its source over the Gulf of Mexico and/or adjacent Atlantic Ocean area. This air mass is called Maritime Tropical (mT), indicating its origin over a water area of tropical or sub-tropical latitude ("hot and humid"). As its origin implies, this air mass is relatively warm and moist; and it, too, becomes modified in its northward progress over the eastern United States. Its designation as mTw indicates that it is warmer than the surface over which it moves. However, during the summer it may be heated still further as it moves northward over land areas. This mT air invades the central and eastern portions of the United States with high temperatures and humidities at the surface, but both temperatures and humidities decrease rather rapidly with altitude, often producing a state of conditional instability. In summer, as this moist air mass moves over warm land areas, surface heating is sufficient to start convection, resulting in frequent and often heavy thunderstorms.

Advantages and disadvantages to soaring in cP and mT air masses

Advantages in cP Air Masses:

a. Daytime heating of cP air masses from below, while being cooled aloft by advection, produces a dry adiabatic lapse rate to relatively high altitudes, resulting in stronger thermals.

b. Convection normally begins earlier in the morning and lasts longer in the afternoon due to the fact that that the air is relatively unstable to begin with.

c. On the average, cumulus develop with higher bases than in the mT air due mainly to the drier air.

d. Since there is generally less moisture at all levels, not only are there less cumulus clouds produced, but there is little or no middle or high cloudiness to cut down on surface heating.

e. The wind and lapse rate structure of cP air masses is frequently the type that produces "streeting" of the thermals, whether they be marked with cumulus or are of the dry type.

f. Good visibility normally marks the cPk air mass, which is very important for navigation.

Disadvantage of cP Air Masses:

a. Cumulus clouds are generally relatively flat with little vertical development. This becomes a disadvantage if a pilot desires to fly in cumulus to gain additional altitude.

Advantage in mT air Masses:

a. Cloud flying would be better, as cumulus will build to high altitudes in the cumulonimbus stage. It might be added that flying on instruments in clouds is prescribed by the Federal Aviation Regulations and is less restricted in uncontrolled airspace.

Disadvantages in mT Air Masses:

a. More cloudiness on the average can be expected at all levels, which frequently inhibits surface heating.

b. Often one has to contend with showers and thunderstorms, with the latter in lines at times. Lines of thunderstorms can be more of a disadvantage than an advantage to the average soaring pilot.

c. Areas affected by showers will become stable, which can be the end of a cross-country flight.

d. Visibilities are often poor due to haze and smoke.

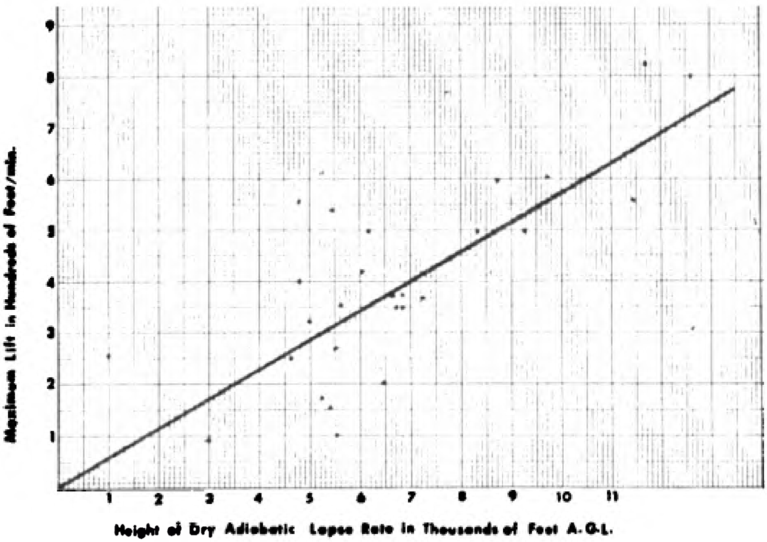


Fig. 3

Height of vertical convection and thermal strength

Figure 3 is introduced to show the importance of an air mass that would produce dry adiabatic lapse rates to higher altitudes, and in turn produce stronger thermals. To relate the heights of vertical convection to thermal strength, the experience of one soaring pilot, Mario Piccagli, was used (Figure 3). Using data for 26 of his flights, this pilot computed his maximum lift from his barograph records. An attempt was made to show that there is a useful relationship between the maximum height of an unstable layer, as shown by the dry adiabatic lapse rate for a given day, and the strength of the thermals encountered by the sailplane. The same sailplane, a Standard Austria, was used for all of the flights. The line of best fit on the figure was computed by the method of least squares. The data produced a correlation coefficient of 0.73, which gives a useful relationship for forecasting by offering a more objective approach. The data indicate that with one exception this pilot did not encounter lift of 200 feet per minute or greater until the lapse rate had become dry adiabatic to about 4500 feet.

Specific examples of flights

Let us take a close look at several of these flights in the cool cP air mass and one in the warmer mT air mass:

(a) On April 14, 1964, Neal Ridenour, flying a Prue Super Std., flew from Naperville, Ill. (near Chicago), to Stow, Ohio, a distance of 360 miles in 6 hours and 5 minutes, to earn his Diamond distance (Figure 4; the Two black dots beneath the line representing the flight path show the locations of the upper air soundings discussed further on in conjunction with Figure 5). Also on this same day, John Slack flew an LO-150 355 miles from Naperville to Akron, Ohio, in 5 hours and 10 minutes, which is near the track of the previous flight. This was the second Diamond distance flight on that day.

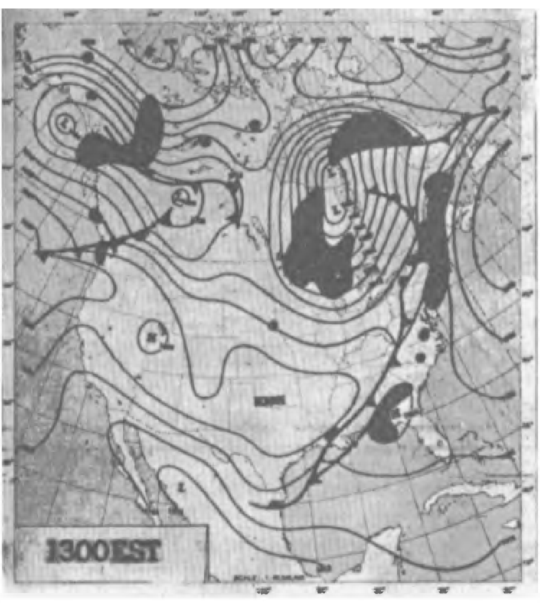
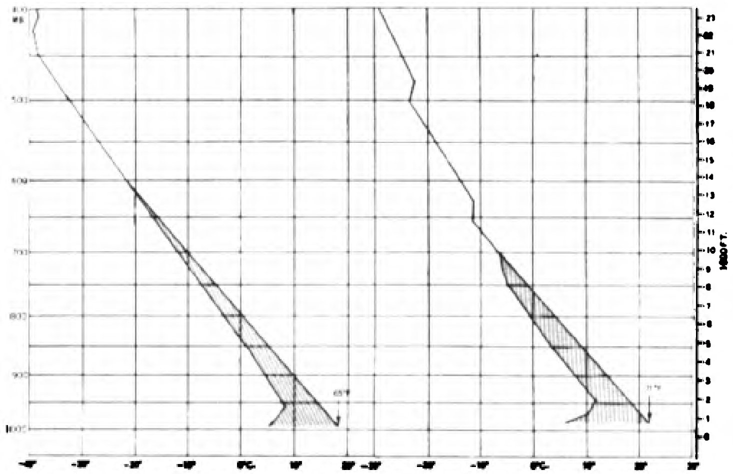


Fig. 4.



Peoria, Ill. *April 14, 1964 12Z* *Dayton, Ohio*

Fig. 5.

As this cooler, unstable air mass moved eastward, bringing with it excellent soaring weather, it enabled another pilot farther east to make a good flight the next day. On April 15th, David Seymour, flying a Ka-6CR, flew 194 miles from Danville, New York, to Schenectady in 5 hours and 25 minutes, to earn his Diamond goal and Gold distance.

The 1200 April 14, 1964, GMT upper air soundings (Figure 5) for Peoria, Ill., and Dayton, Ohio, show the type of vertical temperature structure that represents the conditions encountered by the two excellent flights made on that date. Conditions on this day were typical of the cPk air mass. With maximum surface heating to 65°F, the Peoria temperature sounding became unstable, with dry adiabatic conditions to near 14,000 feet. Farther east, the Dayton sounding, with a surface maximum of 71°F, became dry adiabatic to near 10,000 feet, and the Pittsburgh, Pennsylvania, sounding (not shown), with a maximum temperature of 61°F, was dry adiabatic to near 6500 feet. The cold front had not passed the Pittsburgh station too long before the sounding was taken, and thus the sounding did not show conditions to be as good as those farther west.

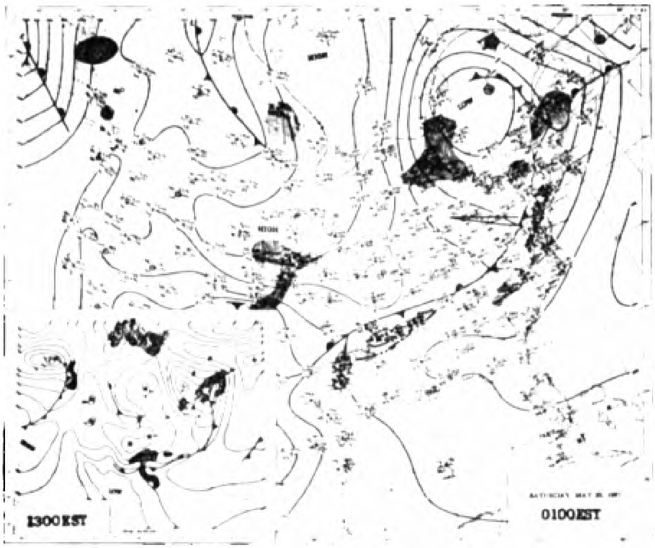


Fig. 6

(b) On May 20, 1967 (Figure 6), Rudy Mozer flew a Ka-6E 360 miles from Adrian, Michigan, to Clear Springs, Maryland, for Diamond distance. On this same day Robert F. Nichols earned his Diamond distance, flying 324 miles in 6 hours and 50 minutes from Adrian to Martinsburg, Pennsylvania. This flight (also shown on Figure 6) ended a little to the north of Mozer's flight.

On the next day (May 21st), excellent soaring weather continued over this general area in the same air mass, and Edward Frappier flew a Ka-7 274 miles from Bryan, Ohio, to Connellsville, Pennsylvania, in 7 hours and 20 minutes to earn Diamond distance.

(c) To the east of the Appalachian Mountains, over the states of Maryland and Virginia, on July 5, 1964 (Figure 7), five soaring pilots made long flights in the same cP type air mass, with cumulus bases to near 7500 feet agl (for full details, see the reference at the end of the article). Two of the flights were made from Cumberland, Maryland ("A" on the figure), 216 miles southward to Emporia, Virginia, for Diamond goal and Gold distance. One pilot, George Nash, flying a Ka-8B used cloud streets on the flight. He encountered 500-ft./min. lift, with 1000-ft./min. the best of the day. Mr. Nash landed at Emporia at 1603 EST. He stated that he was getting 900-ft./min. lift just prior to landing and that cloud streets extended downwind as far as he could see from an altitude of 7500 feet asl. If he had not declared Emporia as a goal, he felt he could have made Diamond distance.

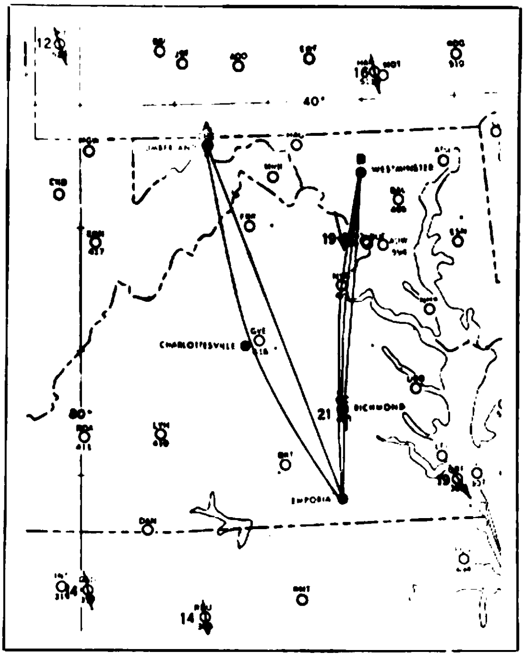


Fig. 7

The other three flights were made from Westminster, Maryland ("B" on the figure). The best was by Gene Wilburn in a Bergfalke II. Gene flew 203 miles south to Emporia. He experienced good lift and flew mostly above 4000 feet to 7300 feet. For about 50 miles he flew under cloud streets. He stated he had frequent lift of about 1,000 ft./min. along with strong sink between thermals.

Gordon Bagora, flying a Schweizer 1-26, made 200 miles to a point 3 miles north of Emporia with a late start. He had maximum lift of 1500 ft./min. and also flew along cloud streets without having to circle in thermals. For these flights the winds aloft in the thermal layer were from the north-northwest at 15 to 20 knots. Cumulus coverage was less than 5/10, with bases to about 7500 feet. Figure 8, the Washington, D.C., sounding, shows the temperature structure at 7 a.m. EST and with maximum surface heating which reached 89°F.

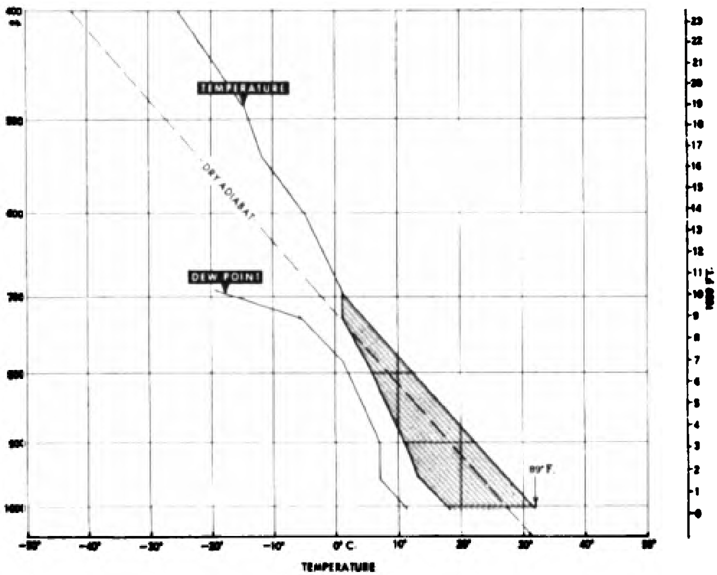


Fig. 8. The dry adiabatic lapse rate is the rate at which an ascending body of unsaturated air will cool due to expansion only —a rate of decrease of temperature with height approximately equal to 5½°F per 1000 feet. The standard atmosphere lapse rate is 3°F per 1000 feet.

(d) For comparison a flight (Figure 9) in the warmer air to the east of a cold front is shown. On May 4, 1963, Kai Gertsen flew a Ka-6CR from Danville, New York, to Newberryport, Massachusetts, a distance of 350 miles, to earn Diamond distance. This flight was made in a southwesterly flow in advance of a cold front. The cloudiness in advance of the front did not appear to affect the flight. The 1200 GMT sounding at Albany, New York, and

Portland, Maine, indicated dry adiabatic conditions to about 9000 feet at the time of maximum heating.

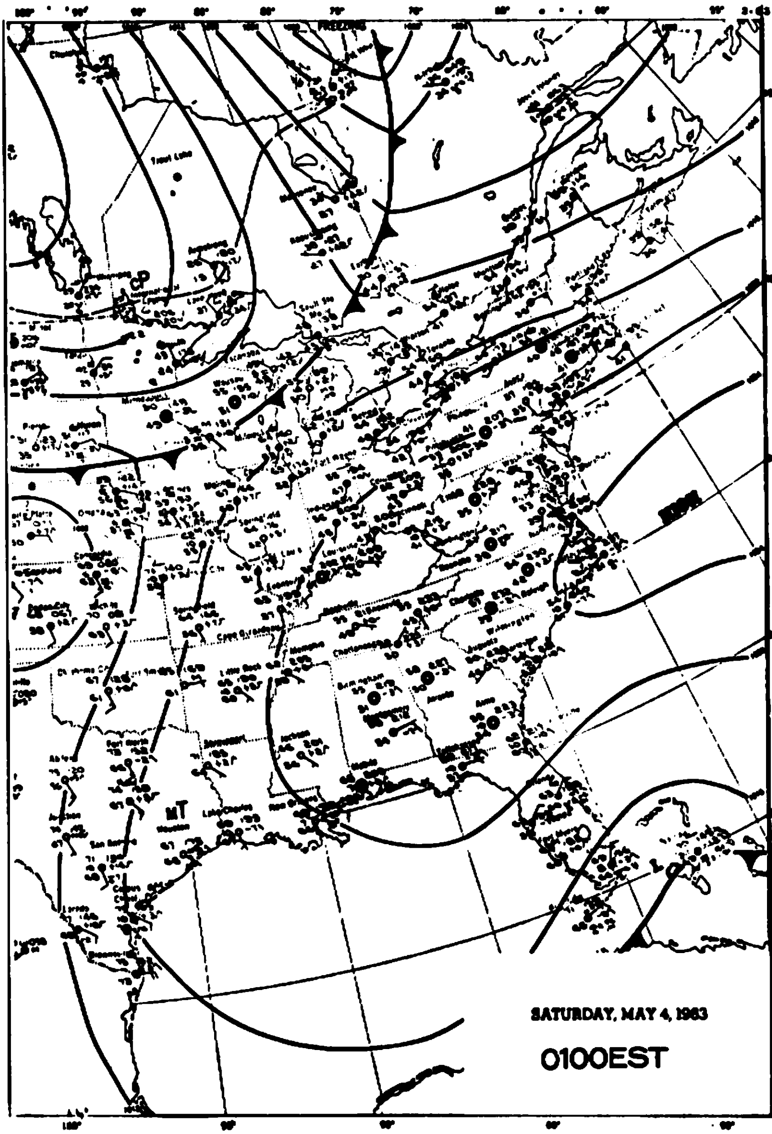


Fig. 9

Months best for long flights

The 153 flights were tabulated by month, as shown on Figure 10. Sixty-eight percent of the flights were made during three months of the year, namely May, June, and July.

The total possible number of hours of sunshine for each month is also plotted (thin, upper line). Note that the three months with the most long flights coincide with the months of the greatest possible hours of sunshine.

The number of flights with durations of six hours or longer are also indicated at the top of Figure 10. The maximum number of flights of six hours or longer occurred in the months of June, July, and August.

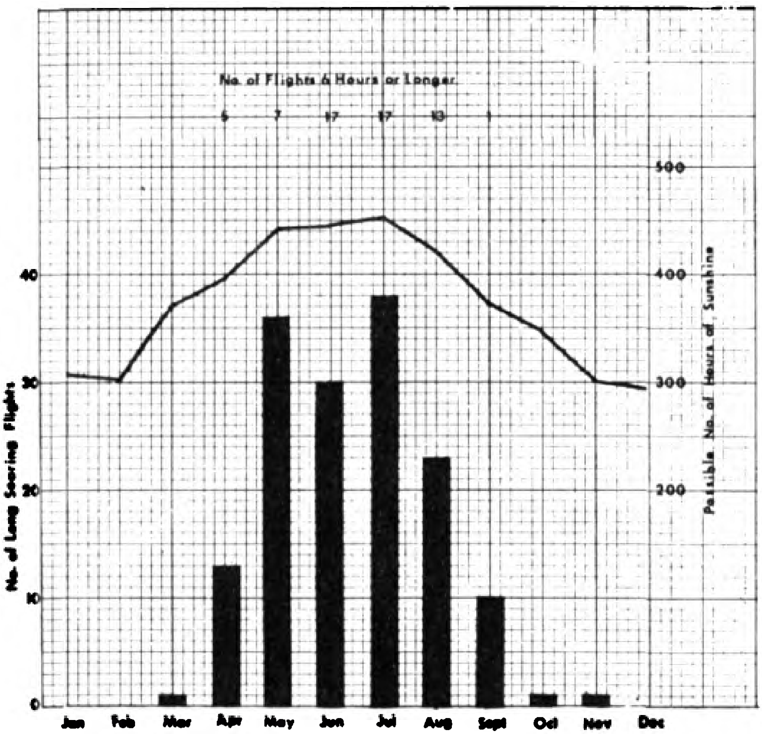


Fig. 10

Conclusion

The record in this study show that the cool cP air mass offers the best chance for long cross-country flights during the months of May, June, and July. A few good flights have also been made in other months and in a warmer mT air mass.

Soaring pilots will find that from April to September the best conditions for long flights are associated with the passage of cold fronts. The passage or expected passage of a cold front should alert the soaring pilot to get ready for an attempt at a long flight. However, upon occasions, immediately to the rear of a cold front when the wind is too strong, it tends to break up or distort the thermals. Strong winds also produce marked turbulence effects, making flight difficult.

The duration of most favorable soaring conditions over a particular area in a cP air mass is limited by frontal cloudiness, changes in lapse rate, and strong winds. Areas of most favorable soaring conditions can be identified and tracked. An attempt can be made at forecasting the future movement of these areas, with consideration given to improving or deteriorating conditions.

It is hoped that this will assist the soaring pilot and the aviation forecaster in better understanding the weather types and the time of the year a pilot can expect to have the best probability of making a long flight in thermals over the eastern United States. A study of this type should also help to determine the best time to hold a contest. Following the procedure used in this study, one could determine for all areas of the world the air mass types and time of year that are most favorable for long cross-country soaring flights.

SAILPLANE SELECTION

8
SAILPLANE PREPARATION
It's the details . . .

by PAUL F. BIKLE

When asked originally by Byars and Holbrook to review the preparation of sailplanes for maximum performance, I was somewhat dismayed. I didn't think I had anything particularly earth-shaking to say about it. So I asked a lot of pilots what they considered most important. After I considered the overall problem, I found that there was a great deal to talk about, although little that was particularly earth shaking. But the thing that most of the people mentioned first, when I asked them, was the matter of smoothing wings by sanding, and how much this might be expected to provide benefits. I will thus save the subject for detailed discussion at the end of this chapter.

Time–the precious ingredient

Pilots spend a great deal of time sanding wings. Many seem to find that the best time to do this is during the contest practice days, even during the contest itself. I think we might consider whether this is the best way to spend time and effort, or maybe work on things that really don't take so much effort and might have a better chance of payoff. Most of us, in buying a sailplane or pursuing any other interest, have a limited amount of time, so one should try to get the most out of the time you spend preparing your ship.

Reprinted with permission from *Soaring Symposia*.

The pilot factor

Before I talk about some of these other things, I would like to make it clear that success in competition is going to depend primarily upon the pilot. All the preparation in the world won't make up for piloting deficiencies. On the other hand, even the best pilot may be all but eliminated from contention by problems–usually pretty mundane problems–that could have been prevented by more careful sailplane preparation. In a sense, this type of preparation is an extension of Moffat's comments, when talking about winning by not losing. All these things are associated with being very careful and making a detailed inspection of the sailplane, cleaning everything up, correcting any deficiencies and providing tools and spare parts for quick repairs or replacements during the contest. There are so many items to be considered that there is not time to do much more than list them. On the other hand, these are simple things that are easy to discuss.

The basics–inspection

We shall start with inspection and cleaning. This may sound mundane, too, but actually open everything up where it is easy to get at. Take a look at things so that at least you understand what is in there. Then, if you have to do something during the contest, you won't spend half your time trying to figure out how to get in there and fix it. Look at all the fittings, brackets, rod ends and bolts and be sure that the safety devices are in place.

When I got my new SHK some years ago, and I took the time to do this, I found that a castellated nut on the little elevator control stud–the one that drives the ruddervators–didn't have a safety. If this had worked loose it could have ruined my whole day. How many people ever check the rigging on their ship before a contest? I never realized the problem was so great until we started running serious performance tests. We found flaps rigged as much as 5° off from the cockpit control readings used to match the flap setting to the airspeed for best performance. Aileron droop has been as much as 5° different from that specified- that's just like carrying 5° of flap when you don't need it, over some 30 percent of the wing span. It can also affect thermaling and stalls in the thermal. Things like this can really hurt in some cases. I have measured aileron travel as much as 10° less than specified, and this loss in aileron power can degrade thermaling and roll response in general. Improperly rigged elevators and rudder controls can influence spin recovery and, again, could ruin one's whole day.

Speed brakes not rigged and sealed properly can cause many problems. Check them while your ship is rigged by loading your wings on the ground and ensuring that the speed-brake controls go over center and stay latched. A.J. Smith once told me that his speed brakes came open twice while flying the LS-1 at Marfa in 1969. Regardless of how much checking we do on the ground, the best way to do it is in the air. While testing the speed brakes, examine the fit. Be sure that all the seals are tight and there are no air leaks around the brakes, under load as well as statically. This isn't always too easy to do. Looking at the 20 ships that we tested in one of our programs, at least half had bad air leaks around the speed brakes before they were sealed.

The air leak problem

The general problem of air leaks is probably one where, for any given amount of effort expended, a pilot could make the greatest gain in preparing for contests. Every air leak isn't necessarily going to ruin performance, but we have had enough cases where it does so that it looks as though the best thing is to eliminate them. Wheel doors obviously should be sealed and, to make doubly sure, you should have a wheel well that is airtight around the gear. Air leaks in this area show at least as much drag as carrying a fixed gear—not an extended retractable gear, but a good fixed gear.

Klaus Holighaus has discussed in the past the necessity for sealing flaps and ailerons. This usually is not too difficult and is probably high up on the list of work you can do with a good chance of a worthwhile payoff. This will be payoff not only in the sense of drag but also payoff in the sense of effectiveness that might even be more important than drag.

Probably the worst leaks are on canopies. These are not easy to check but can be extremely costly. We've had one case with a ship, with an L/D of around 40, where the aft canopy seal was lost. The performance dropped to an L/D of 33 and was brought back up to 39 instantly by resealing the canopy. On the other hand, some pilots fly with cracked canopies. I am sure there are some cases, depending upon flow around the canopy, where it probably doesn't cause very much trouble. But you have no good way to know this. Once again, I would suggest that a good place to spend some time is sealing these things up. Of course, air leaks around the wing roots can hurt your slow-speed performance and increase stall speed. Most ships have some provisions for sealing around the roots, but if there is any question at all I certainly recommend taping in this area. There is equally good reason to tape gaps in the tail.

The grubby details

Think about those little, common sense things. Certainly check your tire for wear and cuts and replace it if not in first-class condition. Remove and inspect the wheel(s) and grease the bearings; check the brake and its adjustment. Carry a spare wheel assembly with tire and axle, spare wheel-well doors, and a spare tail wheel and axle. On many occasions I have seen pilots lose the best part of a day trying to repair or find spare parts for wheels or tires. If I remember correctly, George Moffat lost most of a day at Nationals with such problems. This is probably more common than we realize–maybe only two or three times in a contest–but if it happens to you, all the other things you do may be of no avail. On brakes, there is nothing I appreciate more than knowing that my brakes are going to work when I am going into a small field. Obviously, such a 'detail' can be the difference between just a retrieve from a small field or working on a ship all night to repair a bashed-in nose or a wingtip.

Cockpit comfort

Pilots rarely mentioned cockpit comfort. For most of us, this is an item of top importance and I do not think you should wait for takeoff before worrying about it. First try it in flight–you should be able to fly for six or seven hours without discomfort. While doing this, make sure everything is secured in the cockpit so that you are not losing things behind you, nor having anything come loose to jam things at the wrong time.

I can remember watching one pilot sanding his wings. It might sound that I'm particularly hung up on sanding wings, but this pilot did it practically up to an hour before takeoff. At the last minute, right on the takeoff line, he decided that his cockpit was not very comfortable so he pulled out the seat back to give him a little more room to stretch out. He took off, but soon dove back to the field, because he found he couldn't get his gear up because his chute jammed the landing gear. After a quick ground adjustment he was off again and got his gear up O.K.; he flew his competition flight like gang busters, until he crossed the finish line at 50 feet. Then he did a low 180 for a landing, only this time the chute was jamming the gear in the up position. He didn't lose very much–except a night's sleep while he repaired the gear doors and the bottom of the sailplane!

While in the cockpit area, there is the simple matter of a clear canopy; get rid of scratches; make sure you can see through it well. A.J. Smith has spoken of the importance of looking out and evaluating micro- and macro-weather, the activities of the competitors, and the next tactical decision. But if you are going to do this to your maximum you have to have a clear canopy. It is not just a matter of being able to see through a bad canopy–you find that optical or vision problems are distracting and it detracts from your ability to see what is important.

Instrument calibration

I'd certainly recommend–and this isn't a lot of work–that you remove your instruments and have them calibrated and bench checked at least yearly. At the very least make sure that they are working properly. You should have some spare instruments,–a spare airspeed indicator and a spare variometer, certainly. These should be in good shape and checked each year also. As in the case of a spare wheel, there are always two or three cases during the contest where somebody is madly dashing around looking for an airspeed indicator because the needle fell off of his or because it's got a bad case leak. This happened to me at Adrian in 1965 and Ben Greene lent me an instrument. Sometime somebody is not going to be around to lend you one and then you are going to be in deep trouble.

I am always surprised at how many sailplanes have leaks in their airspeed systems; about 30 percent of those we have tested have had bad leaks. You can't always say this is going to cause you trouble. In many cases it doesn't but it can cause you a lot of trouble and it isn't that hard to correct and make your system leaktight. One of our test sailplanes leaked so fast when we put the leak checker on it we couldn't even raise the pressure in the line. A brief check showed that the trouble was primarily where the Tygon tubing slipped onto the back of the airspeed indicator. In this instance, it was just slipped onto the shipping plugs in the instrument. I talked to the pilot and he said he had questioned the setup when he got the sailplane but the dealer told him that was a standard way of doing it so that's the way it was! It also happened that on that ship we also found leaks in the variometer. I don't think these are too uncommon; it's just that if you don't look for them you're never going to find them and they can cause you real problems.

It is probably not a good idea to hook the altimeter up to any of your static lines; just vent it to the cockpit, where at least it will not be a possible source of leaks and you are not adding unneeded lag. Much has been said about variometers recently. When you pull the instruments for a bench check, the variometer should be checked for both calibration and total-energy compensation. Of course, anything you do on the bench you must repeat in the air anyway, but it is well worth doing. Total energy compensation has been treated extensively by many others, and I will not try to go into too much detail here.

Total energy compensation–altitude effects

Total energy compensation and the altitude effects on the compensation have been covered well by others. Its importance depends pretty much on the individual and what reliance he tends to place on the speed ring. If he uses it for anything, then obviously the relationship between speed and sink rate should be meaningful. I have been curious about this; many ships were found to have relationships that were as much as 20 knots off. You could conclude that it might be better not to have a speed ring under those occasions. These errors may come from not taking into consideration a gross instrument error either in the rate of climb or the airspeed indicator. On ships where there are large errors in the airspeed static system, I have never seen anyone take these into account. There is one other thing that can be done easily although I seldom see anyone do it, and that is to take into account that you are flying at some altitude above sea levels. You get speed and rate-of-sink relationships from looking at a sea-level polar; here, of course, indicated airspeed and sink rate can be used directly, because indicated and true airspeeds are the same. If you are flying at 10,000 feet average density altitude, as one does in the Western U.S. quite frequently, this could cause an error in the relationship of as much as 20 percent. If you are flying in the East, where you might consider your average density altitude as 5,000 feet, the error would be closer to 10 percent. You might think 5,000 feet is a little high for the Eastern U.S., but normally one flies on days that are warmer than standard and thus average density altitude tends to be 1,000 or 2,000 higher than shown on the altimeter. This may not be really important, because the whole speed-ring idea depends on what you think is going to happen in the next thermal. Whether you need to be any more accurate than a guess–which on many occasions may have a 40 percent uncertainty in it–I don't know. It does seem that if you do fly by airspeed a lot, you might as well have the best information you can.

Oxygen

Of course, if you carry oxygen, check the system; leaks are unacceptable, or you will find that your bottles are low in pressure and you don't have what you thought you were going to have. I've seen many ships that do not have an accessible fill valve, and this can cause delays and annoyance in the 'oxygen line'.

Radios

I wanted to talk a little bit about radios and I might first say I certainly enjoyed Gren Seibel's book PILOT'S CHOICE (see Appendix), where he managed to wedge in about four, five or six choice remarks about electronic marvels and cans of worms. I couldn't help but think of this as I watched a moon shot on TV and listened to Al Shepherd and Ed Mitchell tinkering with Al's suit radio for an hour before they could go out for their first walk on the moon. Radios are probably the greatest single source of a pilot's frustration. Obviously, you want to have your radios checked (by somebody who knows what he is doing) and tuned up before a contest.

It is probably a good idea to carry a spare but I think the really best advice would be to be fully prepared to carry on without radios. Once radio troubles start, the frustration probably affects your flying a lot more than any real problem caused by the lack of one. The only conflict with that advice is the general dependence on the radio for giving and receiving information at the starting line.

Water ballast

A whole talk could be given on ballast tanks. Some pilots fly around contests sitting in half a foot of water because their ballast tanks leak into the cockpit. That might be just an inconvenience and may not be too important. Of greater concern, there have been several known cases of structural damage caused by plugged or sealed vent lines. I do mean sealed; in one instance the pilot had taped off the vent line and as he climbed the pressure change across every square inch of wing where the bags were lying caused noticeable surface deformation. There was damage in the epoxy joints. The entire flight became a very risky operation, not to mention subsequent ones. Of course, there is no sense in tying off the vent lines but I have seen cases of plugged vent lines.

Cameras

Preparation of a sailplane for serious competition and badge flying should include the turnpoint cameras. If you think about it, the camera is a fundamental part of the sailplane under the present rule. Again, do the obvious things. Have them cleaned and make sure they operate properly without jamming. Be sure you have at least one spare with you (I always carry two). Make sure your camera mounts are rigid and properly aligned, and checkout this condition in flight. It pays to make practice turnpoint photos from the pilot's proficiency standpoint. Examine the photos afterwards and make sure that you can aim the cameras easily with the wing tip, and that you know what you are going to photograph when you press the button. Also, check to see if the marks on the canopy show up as they should—the first contest day is late to find out that you have troubles here.

Wing surface smoothness

It might be of interest to examine just what people are achieving with their sanding efforts and surface smoothness.

A 57-flight evaluation of nine sailplanes delivered plots of the surface waviness measurements that we made on their wings. The first was an LS-1C flown by one of the French pilots at Marfa in 1970. We plotted surface-gage data at six span stations along the upper surface in Figure 1. The scale along the bottom is in inches of wing chord with the vertical dash line drawn at 50 percent chord for reference. Each vertical increment represents 0.001-inch curvature in a two-inch arch for each increment of scale along the left side of the plot. The curved dash lines are mean surface lines while the heavy lines shows the actual surface and the difference gives a fair picture of surface waviness. The left hand side is toward the leading edge. We found several waves, some as great as 0.004 inch in two inches on the forward part of the wing.

The plot of Figure 2 shows the same kind of data for a Standard Cirrus, of which the wings had also been sanded. It was the ship flown in the U.S. Nationals in 1970 that placed the highest of the Standard Class sailplanes. It had waves about 0.004 or 0.005 inch in two inches and these waves tended to occur just in front of the 50 percent chord line at a place where they could be expected to cause early airflow transition.

Figure 3 shows the same type of curves for the Standard Libelle. The wings were just as they came from the factory–not sanded, but clean and dry. On the whole, the waviness is about the same order as shown before, except for the one wave on the left inboard part of the wing, which is a bit worse, with a double amplitude to about 0.005 inch in two inches. Figure 4 is of an AS-W 15 wing as delivered from the factory. At first glance it looks as though it has more waves; but the deviation is less–about 0.003 inch in two inches.

Figure 5 represents the measurements made of the Schweizer 1-34; there are more waves and the amplitude is greater than the other sailplanes–more than 0.015 inch in two inches. Figure 6 shows similar data obtained on the Laister LP-49. It is smoother than the 1-34, but still almost twice the amplitude of the waves measured on the fiberglass sailplanes.

In Figure 7, we measured the wing of the Diamant 18 with which Ross Briegleb won a National Championship. He did a great deal of sanding on the wing before the contest, but although the best, we saw it still had a few waves–as much as 0.004 inch in two inches.

Figure 8 was one of the three AS-W 12 wings we measured. In this case, the wing was just as it came from the factory except for cleaning. It is not bad–there are some waves that are 0.004 or 0.005 inch in two inches–but it is in factory delivered condition. The waves of significant amplitude seem to be quite far forward on the leading edge, where it might be anticipated that they wouldn't cause too much trouble (at least waves of this magnitude) although we don't really know.

Shown in Figure 9 plots the second AS-W 12 we tested. This is the ship Rudy Mozer flew for a number of years, which he had completely refinished. As you can see, it is by far the best of those measured. Generally, you could say that all waves are less than 0.002 inch across two inches.

Figure 10 is the surface data shown in SOARING for Ben Greene's AS-W 12 as measured after a National contest and shortly after the time he flew the ship to a new World's

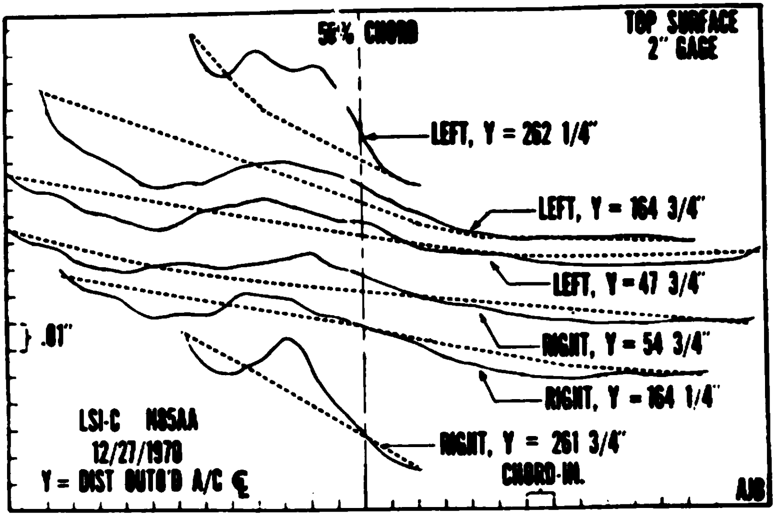

50% CHORD
TOP SURFACE
2" GAGE
LEFT, Y = 262 1/4"
LEFT, Y = 164 3/4"
LEFT, Y = 47 3/4"
RIGHT, Y = 54 3/4"
RIGHT, Y = 164 1/4"
RIGHT, Y = 261 3/4"
.01"
LSI-C N85AA
12/27/1970
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 1

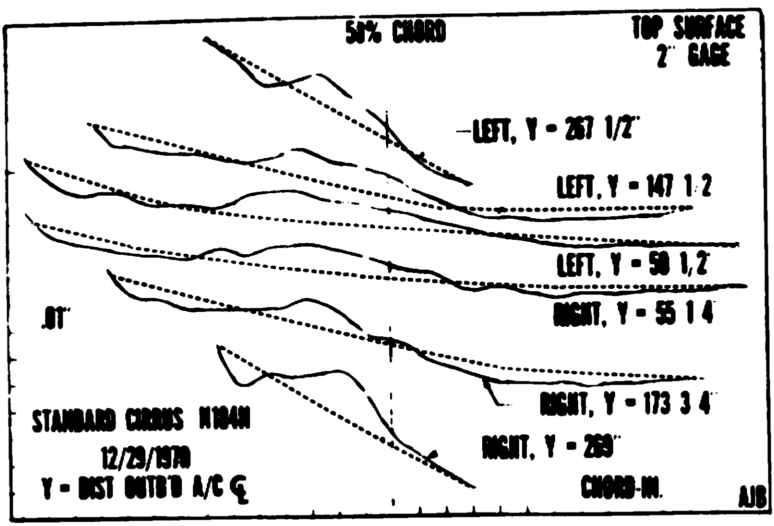
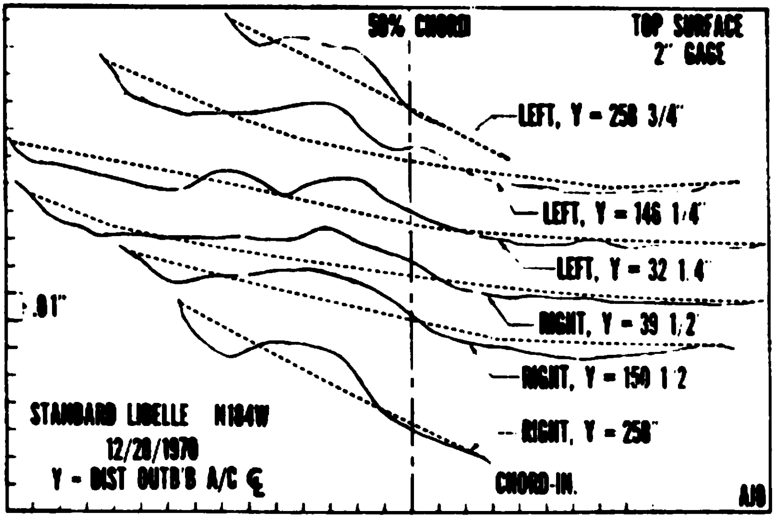
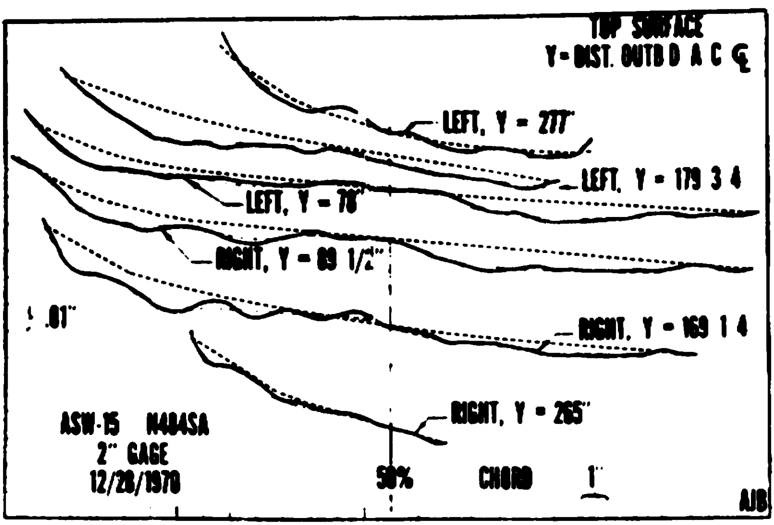

50% CHORD
TOP SURFACE
2" GAGE
LEFT, Y = 267 1/2"
LEFT, Y = 147 1 2
LEFT, Y = 50 1,2"
RIGHT, Y = 55 1 4
RIGHT, Y = 173 3 4
RIGHT, Y = 269"
.01"
STANDARD CIRRUS N104N
12/29/1970
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 2



50% CHORD
TOP SURFACE
2" GAGE
LEFT, Y = 258 3/4"
LEFT, Y = 146 1/4"
LEFT, Y = 32 1/4"
RIGHT, Y = 39 1/2"
RIGHT, Y = 150 1/2
RIGHT, Y = 258"
.01"
12/28/1970
CHORD-IN.
AJB

Fig. 3



TOP SURFACE
LEFT, Y = 277"
LEFT, Y = 179 3/4
LEFT, Y = 78"
RIGHT, Y = 89 1/2"
RIGHT, Y = 169 1/4
.01"
RIGHT, Y = 265"
ASW-15
2" GAGE
12/28/1970
50%
CHORD
1"
AJB

Fig. 4

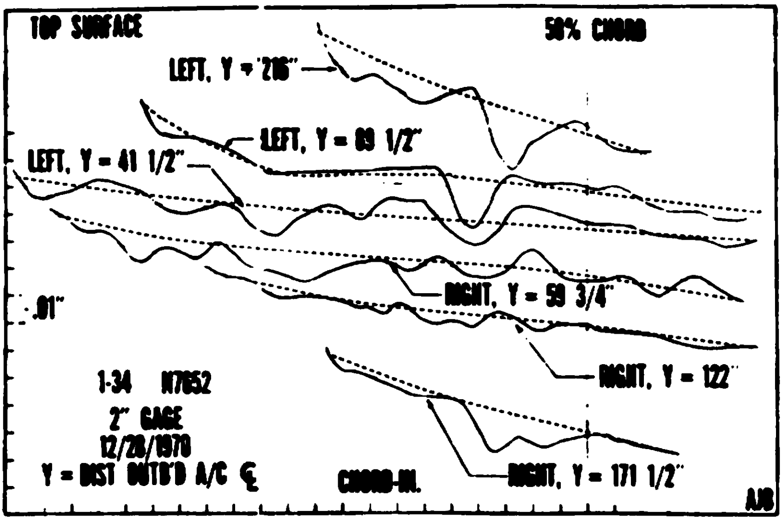

TOP SURFACE
50% CHORD
LEFT, Y = 41 1/2"
RIGHT, Y = 59 3/4"
RIGHT, Y = 122"
RIGHT, Y = 171 1/2"
.01"
2" GAGE
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 5

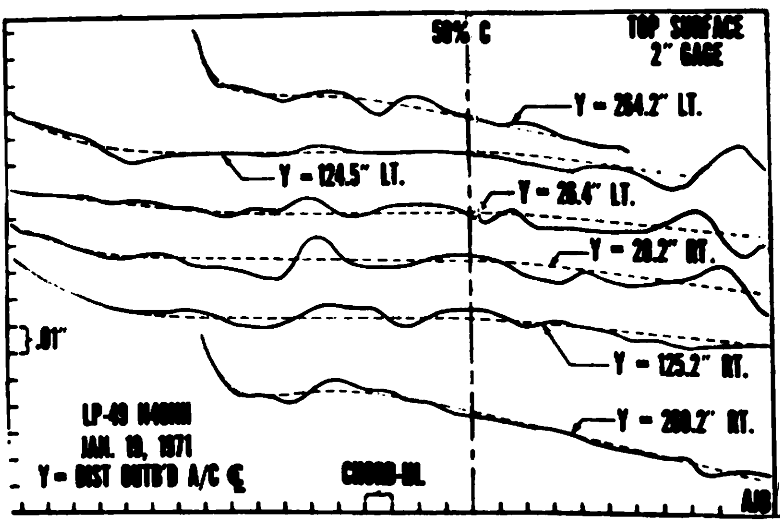

50% C
TOP SURFACE
2" GAGE
Y = 124.5" LT.
Y = 125.2" RT.
.01"
Y = DIST OUTB'D A/C ℄
CHORD-IN.

Fig. 6

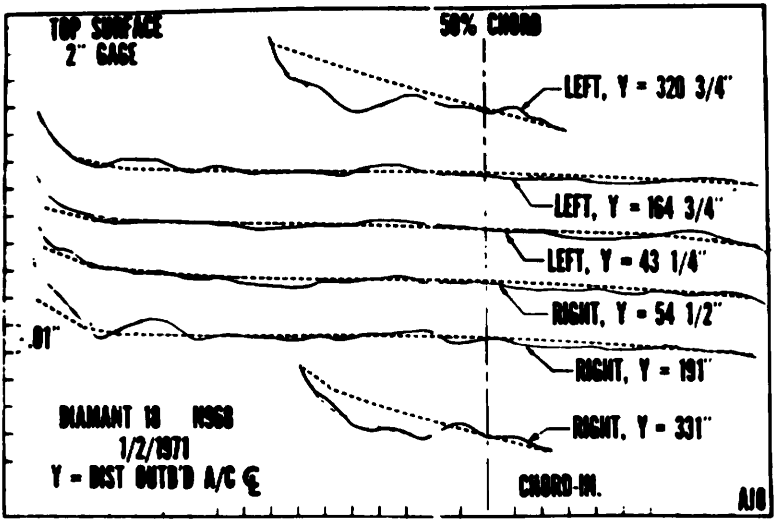

TOP SURFACE
2" GAGE
50% CHORD
LEFT, Y = 320 3/4"
LEFT, Y = 164 3/4"
LEFT, Y = 43 1/4"
RIGHT, Y = 54 1/2"
.01"
RIGHT, Y = 191"
RIGHT, Y = 331"
DIAMANT 18 N968
1/2/1971
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 7

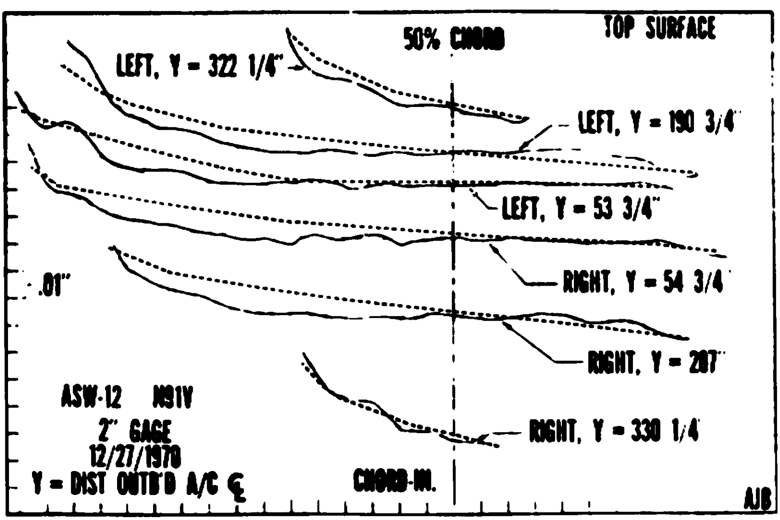
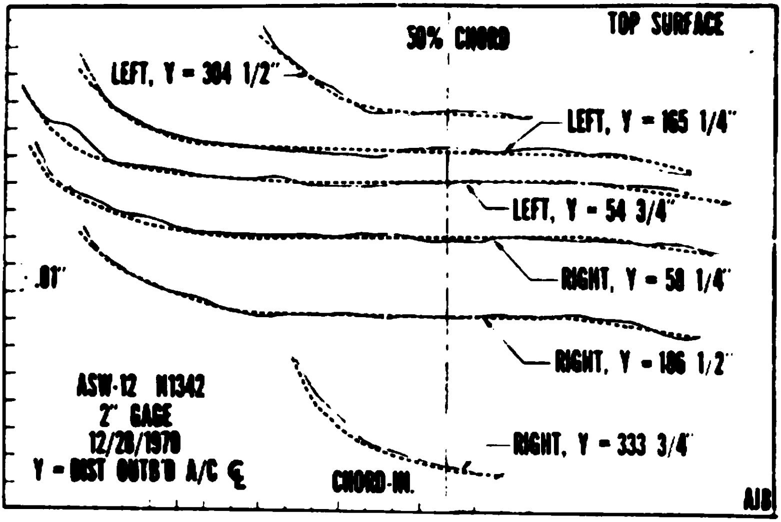
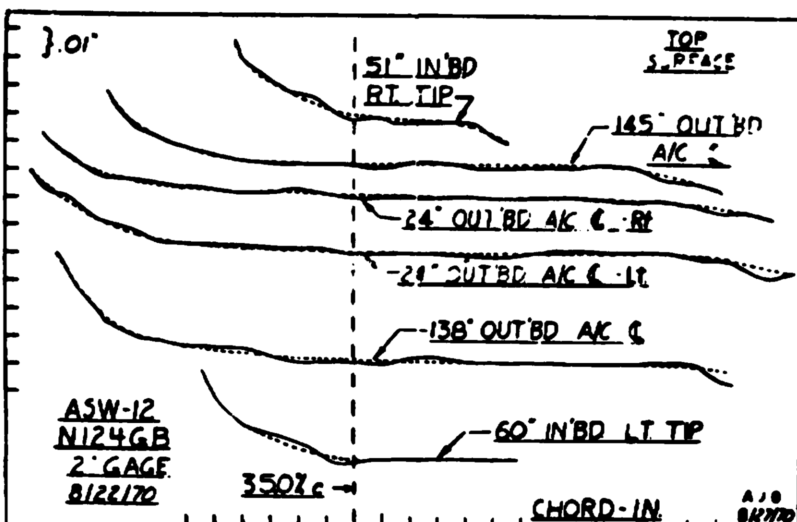

50% CHORD
TOP SURFACE
LEFT, Y = 322 1/4"
LEFT, Y = 190 3/4"
LEFT, Y = 53 3/4"
RIGHT, Y = 54 3/4
.01"
RIGHT, Y = 207"
ASW-12 N91V
2" GAGE
12/27/1970
RIGHT, Y = 330 1/4
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 8



TOP SURFACE
50% CHORD
LEFT, Y = 304 1/2"
LEFT, Y = 165 1/4"
LEFT, Y = 54 3/4"
RIGHT, Y = 58 1/4"
RIGHT, Y = 186 1/2"
RIGHT, Y = 333 3/4"
.01"
ASW-12 N1342
2" GAGE
12/28/1970
Y = DIST OUTB'D A/C ℄
CHORD-IN.
AJB

Fig. 9



}.01"
51" IN'BD RT. TIP
TOP SURFACE
145" OUT'BD A/C ℄
24" OUT'BD A/C ℄ - Rt
24" OUT'BD A/C ℄ - Lt
138" OUT'BD A/C ℄
60" IN'BD LT. TIP
ASW-12
N124GB
2" GAGE
8/22/70
350%c
CHORD-IN.

Fig. 10

Libelle cockpit

distance record. We measured somewhat less than 0.002 inch in two inches.

What does it mean?

The most that we can hope to get from this kind of data is some idea of wing waviness. What does it all mean? Obviously, the LP-49 and 1-34 are not competition sailplanes although the wings were filled, painted and sanded to some extent. The resulting waviness is too much for consideration in this discussion, although the LP-49 wing had about the same degree of waviness as my T-6 and was actually good for conventional American metal construction. It's not very good, but it's about the best normal mortals can do. All four of the fiberglass sailplanes had waviness of 0.004 or 0.005 inch in two inches. It would appear, just from looking at the curves, that the differences between the two that were sanded and the two that were not sanded were minimal; there was probably some slight improvement. The LS-1C was also polished; although we had no way of really determining what this did, we couldn't see that it helped nor hindered. The Diamant 18 wing was somewhat smoother–about 0.004 as we measured it. I might mention that, on the four Standard Class sailplanes, we couldn't see any correlation between performance and wing smoothness. However, this is a rather gross evaluation and I don't think we could have seen those changes unless they had been fairly large.

In the case of the Diamant, I thought it was interesting that this ship was quite a bit smoother than the Diamant 16½ that we tested earlier. When we corrected the performance of the two for the difference in the aspect ratio, the polars fell right on top of each other, indicating that, within the accuracy of our measurements, the extra smoothness did not help the 18-meter Diamant, although that again is a rather gross type of judgement since they were two different sailplanes.

In the case of the three AS-W 12s, the data may be a bit more interesting. Here the 'as delivered' wing was better than those of the Standard Class sailplanes. The second one was very smooth–about 0.002 inch in two inches; the third was about the same, although I felt maybe a little bit better over-all. Here there was also a difference in measured performance, with the better performance consistent with the degree of smoothness observed in the wing.

Smoothness and performance–A summary

One could conclude that wings with less than 0.002 inch waviness in two inches did perform better. On the other hand, I really think that one should be careful about drawing such conclusions because, as is often the case, the wings that had the most work done on them and were the smoothest were on the sailplanes whose owners probably had the greatest motivation. In addition to wing smoothing, they had sealed all the air leaks and had done all of the other many little things one can do to improve performance. I think it may be just as likely that the added performance came from those other sources as it did from the wing smoothness–but I really don't know.

The main point is that some people spend one tremendous amount of time on sanding wings. I would say that, except for very few cases, they haven't really achieved any great degree of increased smoothness. I'm not even sure that when you do you get smoother wings, that you achieve any great degree of performance improvement. And, of course, all this work won't do any harm. If you have the time to do it, by all means go ahead and do it. But it shouldn't be done at the expense of some other items that may be important and are much easier to do.

In spite of what I said about surface finish, you should check over the surface finish on your wings and while you are doing it look at the fuselage nose and the portions of the tail where there might be a chance for laminar flow. You should repair any of the obvious cracks and other defects.

I have seen surfaces on two fiberglass sailplanes where there was evidence of continuing curing after the wings left the molds and this has become evident after the sailplanes have been in this country for awhile. They look almost like the old plywood ships when we brought them up into the desert and they dried out; not nearly that bad but they had that general appearance. These actually look worse than they really are; most of these defects have been only a matter of a few thousanths of an inch, but since you can see it running along the spar all the way, it looks terrible. Where you have such a discontinuity, it is obvious that you will want to do some filling and smoothing and it is not that hard because you can see where it is and you can work it out easily. Unless there are obvious problems like this, just give the wings a light sanding to clean off all the small defects and wash them and wipe them dry before each contest day. If you plan to do more than that, it should be looked upon as a major modification--type effort that should not be attempted in a month or so before the contest. If you try to do it at the last moment, you are going to end up doing that and probably not doing the other things. It should be the kind of thing you do in mid-winter.

In conclusion

I mentioned spare parts. You also should be ready to make repairs, as Fred Jiran has covered in another chapter. As he suggests, you should lay out the tools that you need and pack them carefully along with your spares. Don't just throw them into a big box out with everything else, because when you do need them you want to get at them right away, and so you should store them carefully. They ought to be in the car or trailer where you can get at them quickly. While you are at it, you ought to go over your car and trailer in the same way and use the same care as the sailplane. I make up spare kits for these too and I would certainly suggest providing for carrying spare gasoline and water because the failure of the car or trailer can have a shattering effect if you land 15 miles out on a good contest day if you don't get back again. As mentioned earlier, the problem is not one of what are all of the things you would do if you did all of the conceivable things you could think of. It gets down to the matter of what can be done best in the time available—where should you spend your efforts—what is the most likely to pay off.

I have discussed sanding wings and suggested that there may be better ways to spend your time. Maybe you should forget my negative comments because I think there are some people who get some sort of a philosophical or a mystic recharge out of going out and sanding and polishing wings at the last minute. George Moffat says this is true of A.J. Smith, for example, but A.J. has yet to be heard from about George. In essence, if this helps the pilot's frame of mind, I would say go to it. But also make sure your lucky penny is stuck under the instrument panel, and that you have your lucky hat. If any of these improve the pilot's state of mind, they are more important than all of the other things put together.

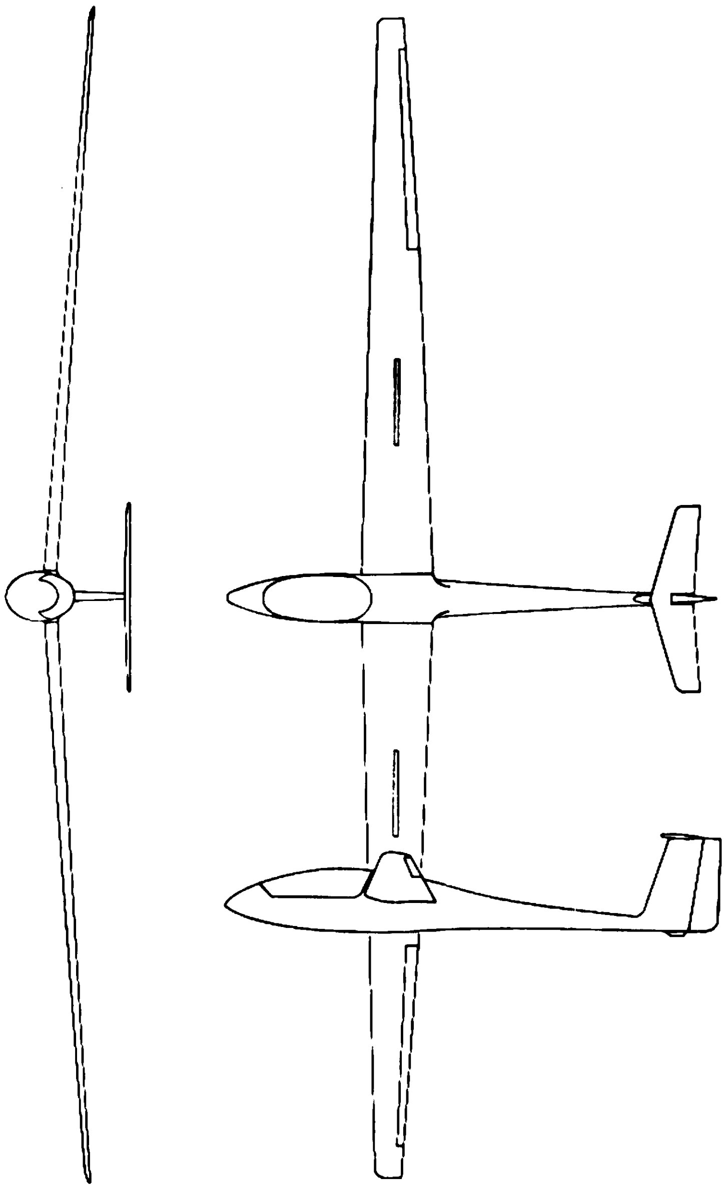
9
BEST OF THE STANDARD CLASS
Gentlemen, choose your weapons!

by DICK BUTLER

To be competitive in the Standard Class requires the acquisition of one of four ships; the Standard Cirrus, Libelle, *LS-1, or AS-W 15. Of these four sailplanes, all are generally regarded to have the same performance, meaning that a little good or bad luck on the pilot's part may place either of these ships in first or last place on a given contest day.*

Although we all agree with this statement, we still find ourselves striving to ascertain which of these ships might give us an ever so slight competition edge. We are all familiar with various comments by top U.S. competition pilots – the Standard *Cirrus* is better at high speeds, the LS-1 outclimbs the rest, the Standard *Libelle* is slightly inferior in the glide, etc. Although I am sure these comments have been experienced by all of us under various conditions, the problem still exists that the majority of these observations were made without regard for sailplane wing loading, wing-surface condition, air turbulence, or endless other variables which may drastically alter a ship's performance. If a valid sailplane performance comparison is to be achieved, corresponding wing loadings and air mass environments must be adhered to.

To this end I would like to share with the reader a collection of both experimental data and general observations concerning Standard Class sailplane performance obtained in a known environment.



Standard Cirrus

Flight test data

Presently, the only authoritative data obtained in the U.S. under controlled conditions are those originally obtained by Paul Bikle. Looking at these data, presented below in Figure 1, one's first impression is that the Standard *Cirrus* is slightly superior with the Standard *Libelle* depicted as the poorest. Let us now take a more critical look at these data.

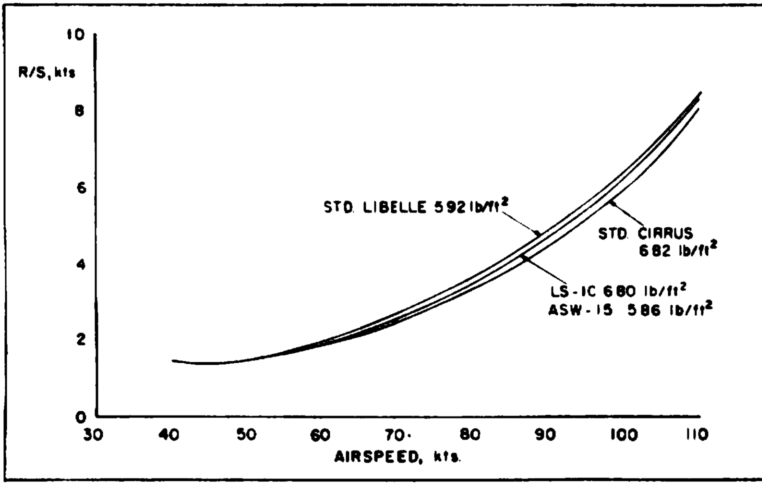
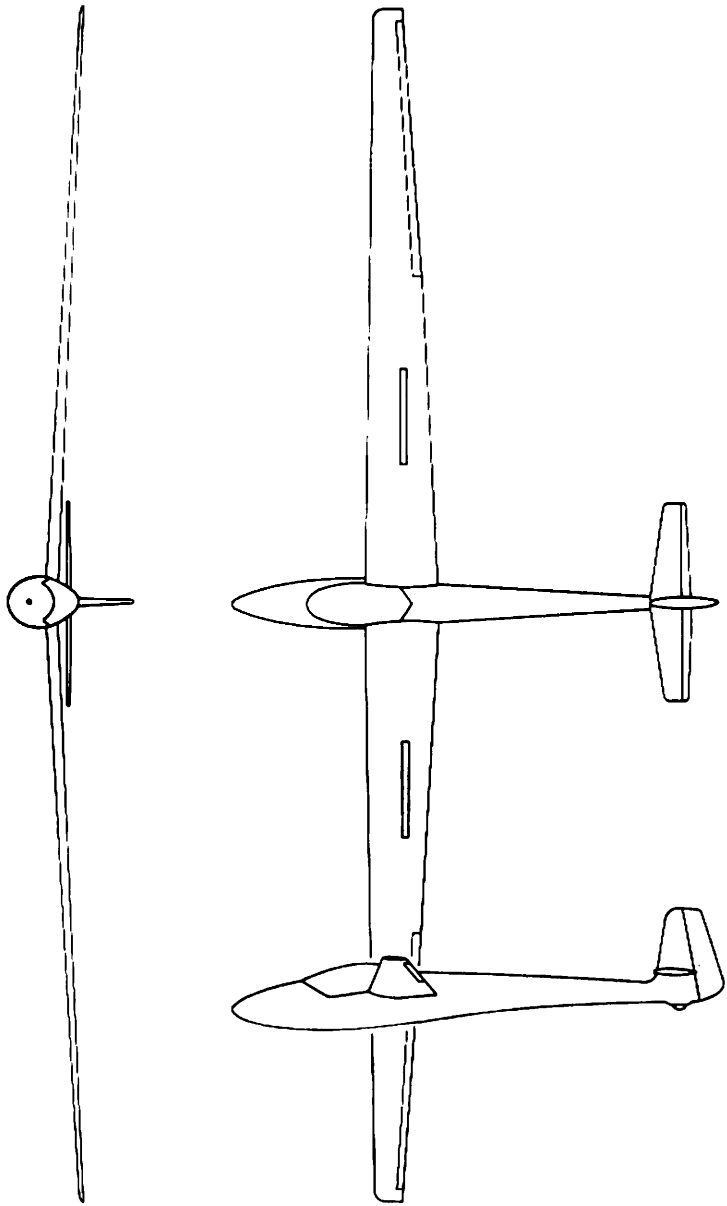


Fig. 1. Standard Class sailplanes from "Polars of Eight," Bikle

The most significant factor in gliding performance is wing loading. Here we are comparing ships with wing loadings ranging from 5.86 lbs./sq. ft. for the AS-W 15 to 6.82 lbs./sq. ft. for the Standard *Cirrus*. It would certainly seem more logical to compare these ships at identical wing loadings. This is indeed possible and realistic for the Standard *Cirrus*, *Libelle*, and LS-1, but not for the AS-W 15. If you look closely at the criteria used in designing these ships you see that two design concepts are evident. The *Cirrus*, *Libelle*, and LS-1 rely on a wing planform with a low wing area, high aspect ratio, and therefore a high wing loading. They compensate for the wing loading by using a thick, high-lift airfoil. The AS-W 15 incorporates a wing with more area, a lower aspect ratio and therefore a lower wing loading. This permits the use of a thinner airfoil with a somewhat lower minimum drag, but with a more narrow drag bucket. What



Standard Libelle

this means is that the AS-W 15 may fly with a lower wing loading and still be competitive on the glide. If the ship is ballasted to comparative wing loadings with the other three ships, say near 7.0 lbs./sq. ft., the climb will surely suffer. On these grounds it would not be realistic to correct the AS-W 15 wing loading of 5.86 lbs./sq. ft. up to the 6.82 lbs./sq. ft. of the Standard *Cirrus* and expect it to be competitive in the climb. More on the climbing ability of the AS-W 15 later in the article.

Wing loading corrections

Before correcting performance of the three remaining ships for identical wing loadings, one additional correction must be noted. Bikle figures the wing loading of the *Libelle* based on the manufacturer's quoted wing area of 102.3 sq. ft. If you take the time to measure the wing area, you find the manufacturer neglected the fuselage contribution, the true wing area is 107 sq. ft. *(A letter from Glasflugel to the author written subsequent to this article states: "There is one point that needs clarification: Paul Bikle seems to have taken the Libelle wing area from the H-301 Libelle, which has a smaller wing than the Standard Libelle. Our Standard Libelle*

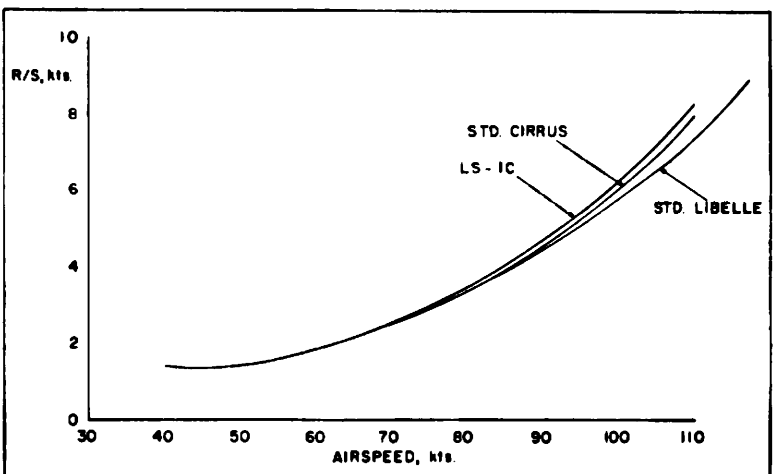
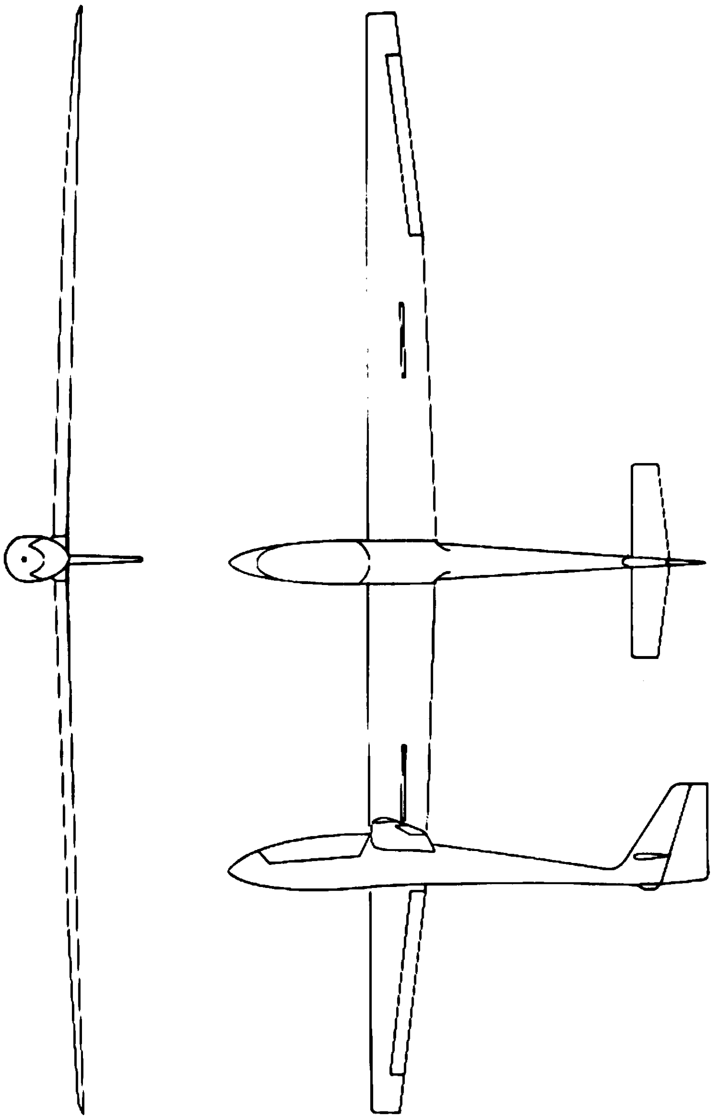


Fig. 2. Standard Class sailplanes from "Polars of Eight," (Bikle), corrected to equivalent wing loadings, 6.80 lbs./sq. ft.



AS-W 15

brochure gives the wing area as 105.5 sq. ft." -Ed.) This changes the wing loading at testing from 6.18 lbs./sq. ft. to 5.92 lbs./sq. ft.

Performance of the Standard *Cirrus, Libelle,* and LS-1 corrected to identical wing loadings of 6.8 lbs./sq. ft. are presented in Figure 2. All the ships appear to be equal up to 70 kts. At this point the Standard *Cirrus* and *Libelle* become slightly better than the LS-1. At speeds above 85 kts. the Standard *Libelle* becomes superior to both the LS-1 and Standard *Cirrus.* The myth of the Standard *Libelle* being inferior at higher speeds is truly that -a myth!

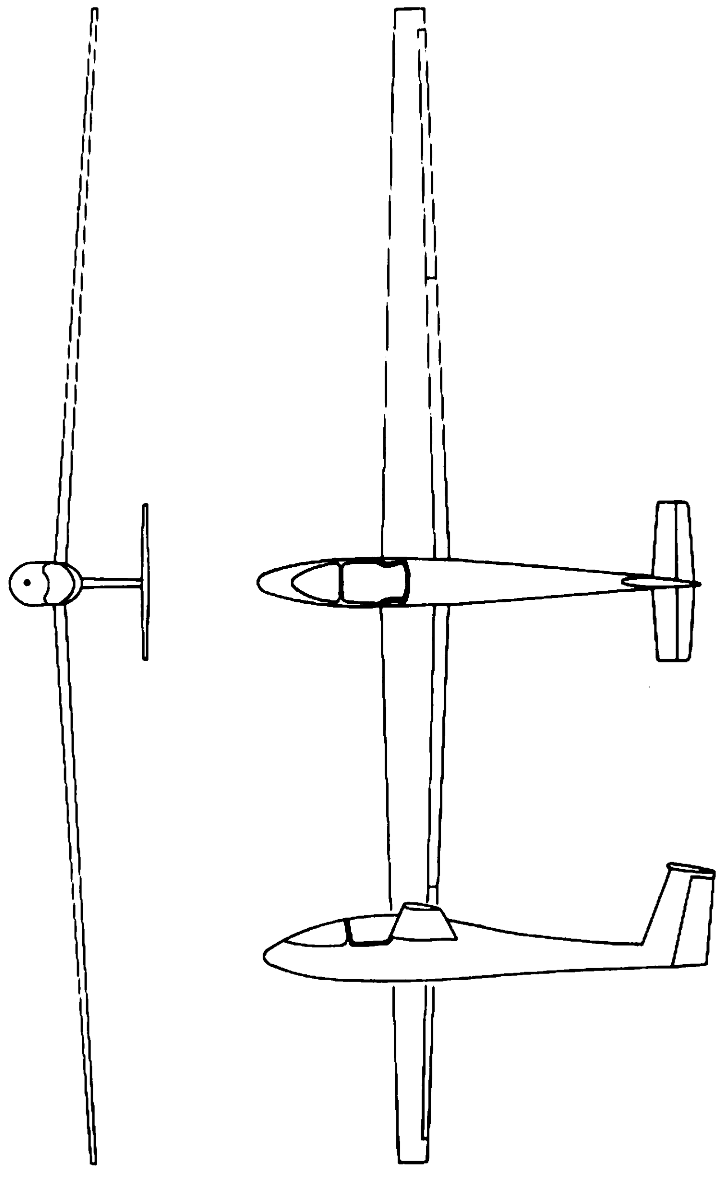
A sealing program

A program was initiated approximately one year ago to determine what performance gains might be achieved by extensive sealing of a sailplane. Since performance gain was our only concern, it seemed logical to measure relative performance between two ships both before and after the sealing. The two ships used were Standard *Libelles* owned by David Andrews and myself. Both ships were essentially as received from the factory. Numerous comparison runs of seven to ten minutes made in still air revealed identical performance at airspeeds of 55 and 75 kts. An extensive sealing program was then conducted on my ship. After many still-air runs following the sealing it was evident that a three percent increase in performance had been achieved at 75 kts. with no gain at 55 kts. At this point we could say that my ship is at most three percent better than a factory ship at the higher speeds.

In May of this year an opportunity existed for making comparison runs with a new LS-1 built for competition in the '72 Internationals. Initial runs were conducted with the LS-1 as received from the factory. The wing loadings of both ships were matched at 6.3 lbs./sq. ft. Initial runs made at 55 and 75 kts. in still air showed my *Libelle* to be five percent better at both speeds.

LS-1 comparison

The following day the LS-1 was sealed (canopy, wing root, gear, etc.). A fuselage vent hole was also cut for exhausting



1-35

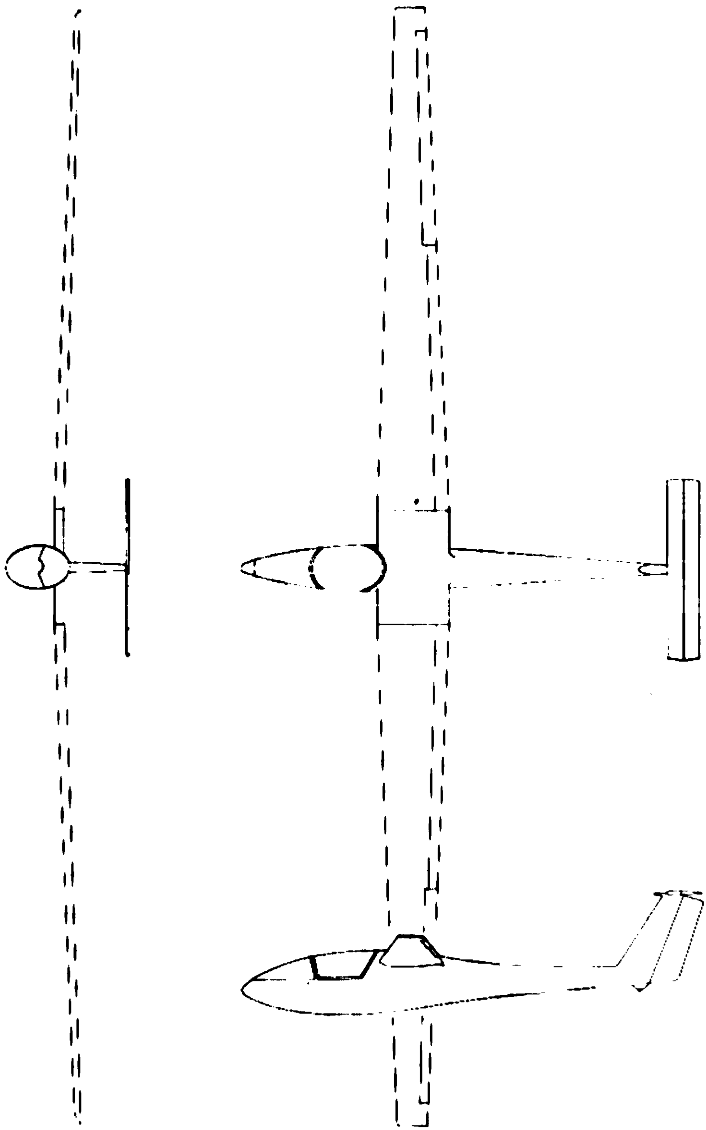
air in the rear. Comparison runs again showed a five percent differential at both speeds; this time with both ships ballasted to a wing loading of 7.0 lbs./sq. ft. The LS-1 had been so beautifully finished at the factory (ailerons sealed, close canopy and gear door fit, small gaps between control surfaces, etc.) it was decided the sealing work we did had a minimal effect.

This measured. differential is supported by Bikle's data from Figure 2, at 75 kts. The Standard *Libelle* is seen to be 3.3 percent better than the LS-1. Also evaluated was climbing of the ships. The climb appeared equal at both wing loadings until rain was encountered under an over-developing sky. The LS-1 rate-of-sink was drastically affected with the *Libelle* markedly outclimbing the ship. Runs made between thermals in the rain also revealed larger differentials in gliding performance not observed before.

AS-W 15 comparison

In June of this year another opportunity presented itself for comparison runs between my *Libelle* and an AS-W 15 which had been flown by the German team in the 1970 Internationals. The ship was in excellent condition with the most optically perfect set of wings I have seen. As mentioned before, no logical approach existed for adjusting wing loadings so both ships were run without water ballast.

The AS-W 15 wing loading was at 5.8 lbs./sq. ft. and the *Libelle* at 6.0 lbs./sq. ft. At speeds of 55 and 75 kts. the *Libelle* was six percent and eight percent better, respectively. Even if you take the time to correct the AS-W 15 wing loading up to 6.0 lbs./sq. ft. you still fall short of the *Libelle* performance. The climbing ability of the AS-W 15 seems good at the lower wing loadings (dry). Numerous comparisons with a dry AS-W 15 stationed at Eagleville (gliderport in Tennessee) have shown it to climb as well as the *Libelle*. The wet AS-W 15 is another question. Flying with an AS-W 15B model in a recent regional contest proved it unable to match the *Libelle's* climbing performance with both carrying identical amounts of water. Also, the pilot of the AS-W 15 with whom I made the performance runs earlier,



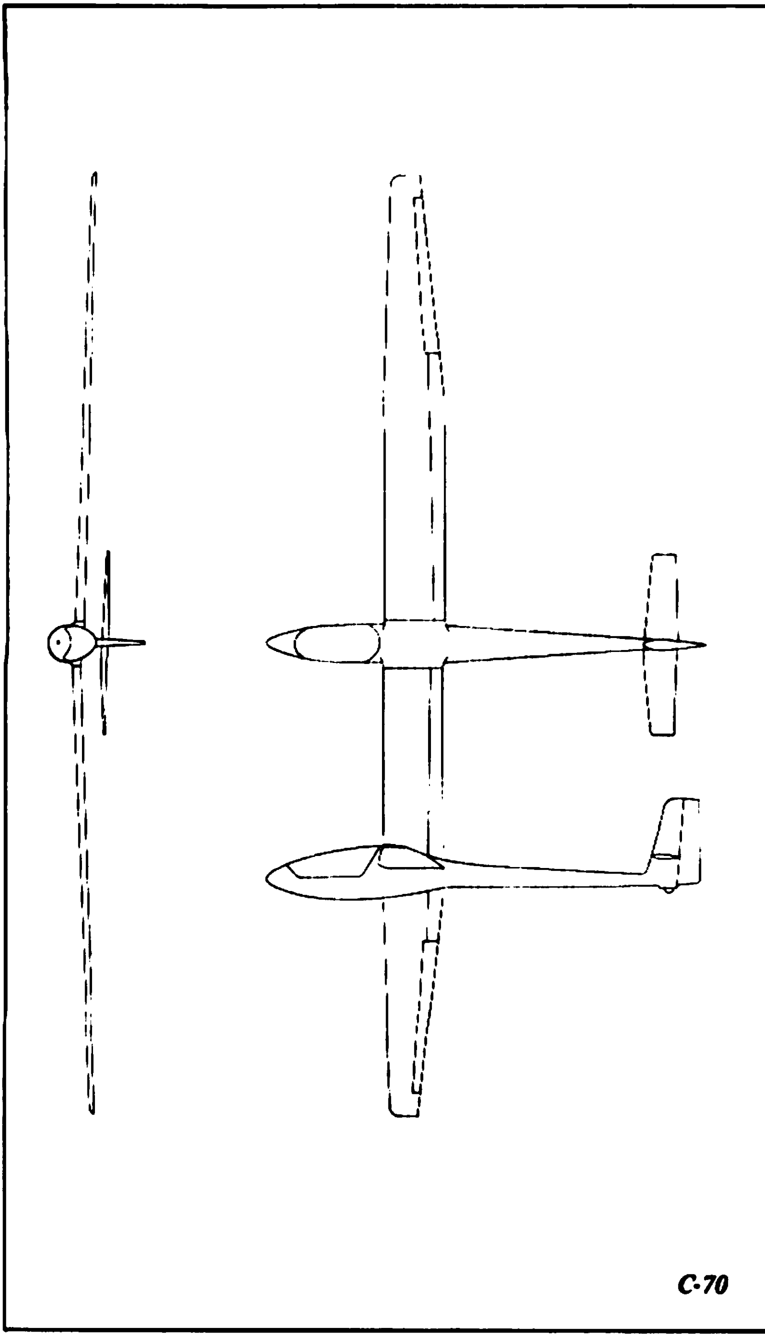
Nugget

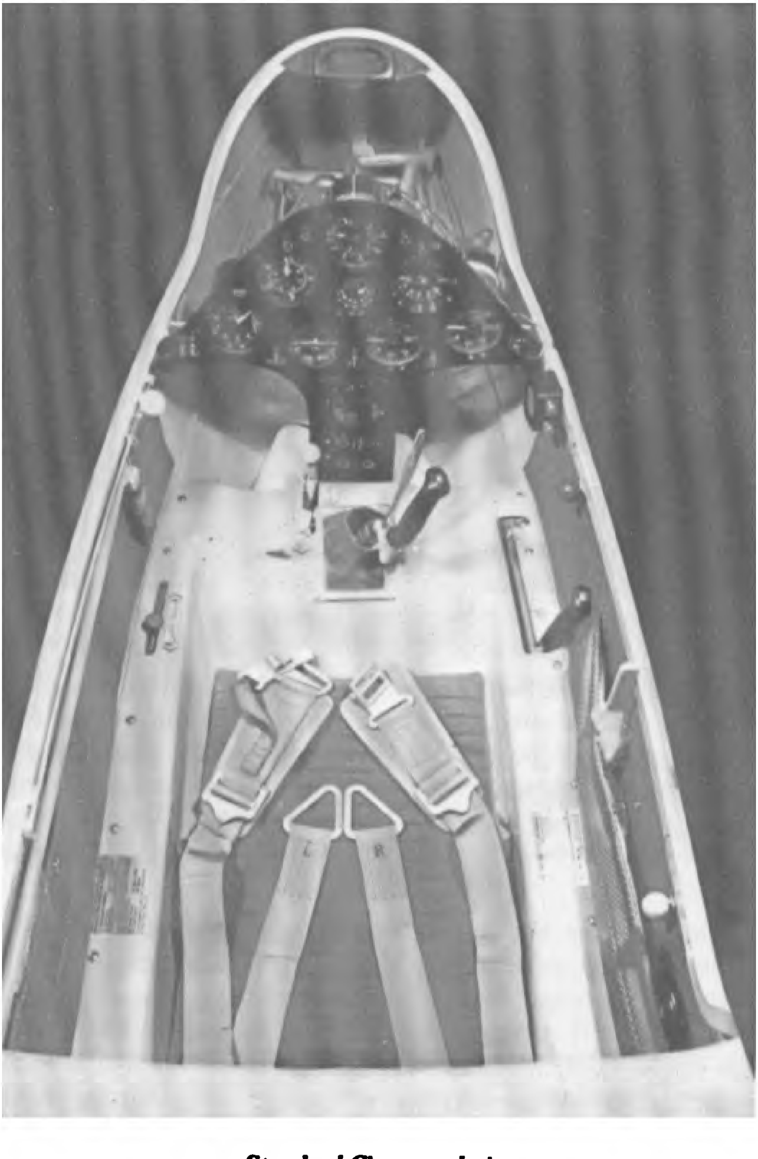
feels the *Libelle* is superior in the climb with both ships loaded.

No Cirrus comparison

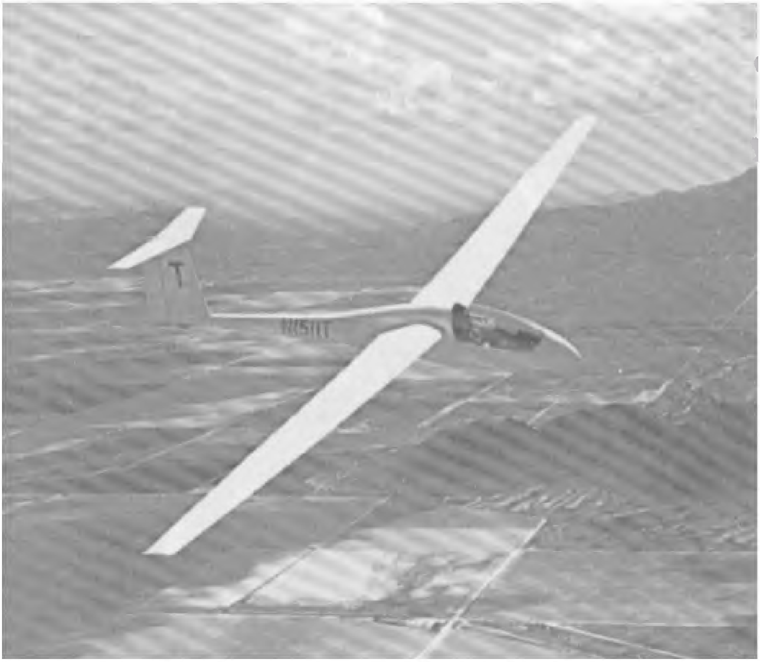
No still-air comparison runs have been made with the Standard *Cirrus*. Since the *Cirrus* is considerably heavier than the *Libelle*, ballasting of the latter would be necessary before making runs. At two separate regionals I had an opportunity to compete against this ship. On one occasion a run approaching 100 miles was made with Tommy Beltz in his Standard *Cirrus*. Both ships were loaded with water but the Standard *Cirrus* had a slightly greater wing loading due to its heavier initial weight. On all runs the *Libelle* was superior or equal to the *Cirrus* under these turbulent conditions. The climb of the ships appeared equal. Based on the previous correlation between the measured differential of the LS-1 and Standard *Libelle* and the differential shown in Figure 2, we can also expect the Standard *Libelle* to be slightly better than the Standard *Cirrus* at high speeds, as seen in Figure 2.

I think it would be difficult, if not impossible, to label a single characteristic which gives the Standard *Libelle* its edge. A few of the more important things can be recognized with the untrained eye and ear. The next time you are at a contest, listen to the ships as they cross the finish line at high speeds. It is very obvious the *Libelle* is the quietest of the ships. This may be recognized in the data extracted from Figure 2. Above 85 kts. both the LS-1 and Standard *Cirrus* suffer from an abrupt performance degradation most likely caused from the lower wing surface becoming turbulent or from flow separation, both which are very noisy. Also, observe the percent thickness of the ships' vertical and horizontal stabilizers as compared to the *Libelle*. For some unknown reason the AS-W 15 has a vertical stabilizer with a percent thickness near that of the wing. The wheel of the *Libelle* is completely enclosed internally such that no air leakage can exhaust from the fuselage out the gear doors; without this it becomes impossible to achieve a gear door seal–no other Standard ship has this asset. Observe the fuselage frontal area of the *Libelle* as compared to the other ships. I think the designers have gone overboard with


C-70



Standard Cirrus cockpit



Standard Cirrus

providing the pilot with room and they try to compensate by reducing wetted area aft of the wing at the tail boom. This could very well be the point at which flow separation is occurring at high speeds. One of the most important *Libelle* assets is its wide range of wing loadings. The Glasflugel people have done an incredible job on saving weight in this ship.

This chapter was included to give badge and competition pilots a better insight into the relative performance of the Standard Class sailplanes. Three views of the Schweizer 1-35, Laister Nugget and Concept 70 have been included among the illustrations to give you an idea of what the newest, flapped Standard Class sailplanes are like. Let me again reiterate that the small performance differences shown here may be far overshadowed by relatively minute pilot decisions during competition flying.

10 KESTREL

A pilot's notebook

by DEREK PIGGOTT

Many private owners are 'changing up' to 19 metres from Standard Class machines. There is no lack of advice in club bars about how to fly with flaps but from what we hear much of it is contradictory. Derek Piggott test flew the Kestrel and competed in one. His notes may well later save new owners from some big repair bills.

The Kestrel is a very straightforward and docile machine to fly in spite of the initial impression of the complicated cockpit. This consists of a mass of knobs and fittings, and the most likely cause of trouble in flight is operating the wrong one.

When you have sat in the machine a few times, try blindfolding yourself and then identifying all the controls by feel. This may prevent you pulling the rudder adjustment by mistake for the tail parachute.

Flaps

The flap operating lever allows the flaps to be raised and lowered for cruising flight. At the same time this repositions the ailerons to keep them in line with the flap. However, when the flaps are lowered the consequent drooping of the ailerons restricts the range of aileron movement, thus slightly reducing their effectiveness and increasing aileron drag. This does not happen when they are raised.

In light winds, all the available control may be needed during take-off and landing, and this means that the cruising flap lever should be in the *neutral* (0°) position.

Landing flaps

Pulling the landing flap toggle, which is a separate control, lowers the flap 30° or so without moving the ailerons. This results in a further increase in lift and a marked increase in drag so that the attitude must be changed considerably to maintain the same airspeed. The approach attitude is, therefore, much more nose-down than normal flight, even without using any airbrake. The Kestrel will not bounce after landing if it is fully held off so that it touches down wheel and tail together; alternatively, the glider must be landed tail high until it loses speed.

A useful and approved modification is an extra slot to provide a 'half-flaps' position for the landing flap. This can be used for take-off and in turbulent conditions, when a good, low speed landing is required. It avoids the need for position change of the cruising flap during take-off or launch. The maximum speed with half landing flap is 70 kts. The flap should be raised if the launching speed exceeds this.

Water ballast

Make sure the two plastic nuts are dead tight at the wing roots or you will fill the cockpit and wing root with water. Keep the wings level when filling and try to avoid parking the glider wing down before take-off or you will get one wing very heavy.

Water ballast makes very little difference to the handling but requires approximately 3-4 kts. extra speed for thermaling. The water must be jettisoned before landing and takes some time to drain. Turn the tap on at 500-600 ft. on final glide. Before take-off be sure that the tap can be reached when you are strapped in. A loop of string etc. may be necessary.

Take-off: aerotow

Because of the concealed position of the release toggle it is vital to start the take-off with the left hand on the release. Otherwise, if a wing drops, you will not be able to release in time.

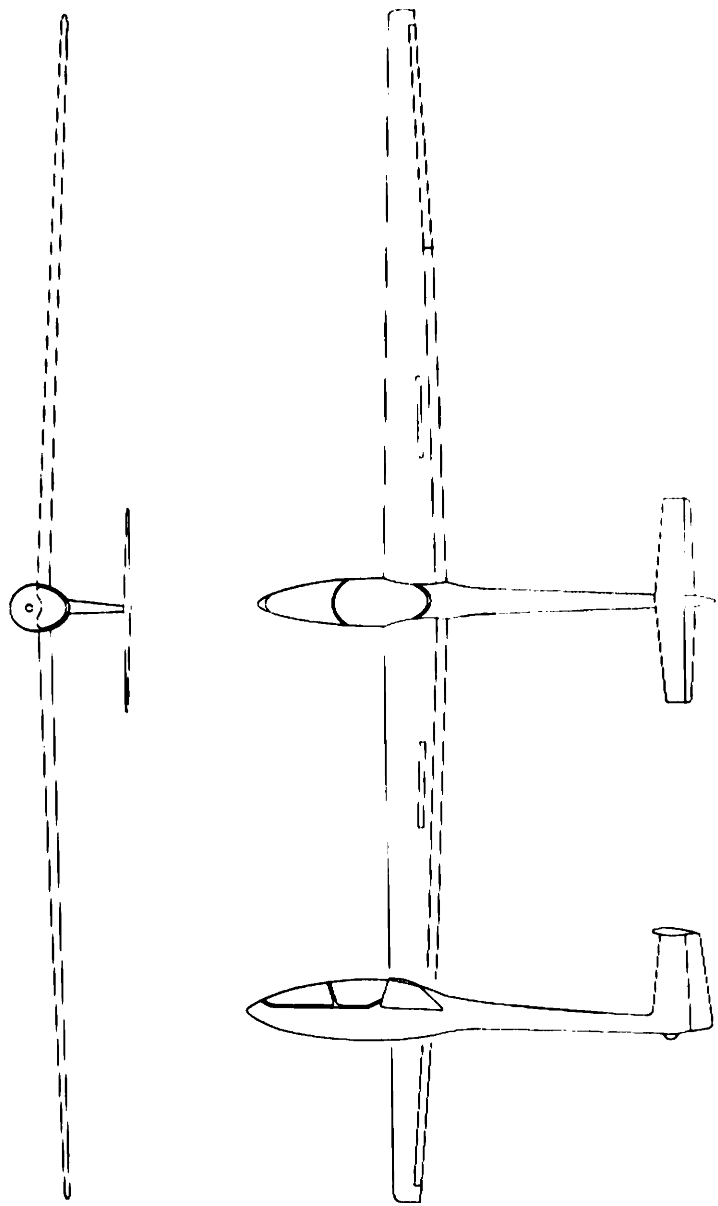
The cruising flap lever should be in the 0° position, *not* the +1 or +2, which would reduce the aileron effectiveness at low speeds. The landing flap should be set to the 'half-flap' position, as this avoids any need to adjust the cruising flap during the launch. The tail should be raised to prevent the glider from bouncing during take-off. If the landing flaps cannot be set to half flap, they should be in the up position, and the cruising flaps should be lowered to +1 or +2 during the take-off, after adequate control has been gained. This will help the sailplane off the ground.

Unless flap is lowered, the forward view is poor because of the nose-high attitude. The unstick speed is also very high and it is difficult to stay out of the slipstream. Always ask for extra speed compared with a training glider, 60 kts. is ideal.

Wire launching

The Kestrel can be launched in several configurations. The use of each configuration depends upon natural conditions. The easiest way is to set the cruising flaps to 0, and select half landing flap. This gives a good launch with full aileron control in the event of a cable break. In windy conditions, the cruising flaps may be set at +1 or +2, with the landing flap in. This gives a better launch, but less aileron control (the flaps will not have to be re-adjusted unless the wind is very light). If the 'half flap' position is not available and the wind is light, set the cruising flap to 0 and the landing flap up for take-off. Keep the left hand on the release toggle until there is good control and the glider is moving on the main wheel with the tail up. Then, lower the flap to +2. This will assist the take-off and give higher lift for the climb.

Normally start the take-off with the flaps at 0° and with the left hand on the release toggle. Lift the tail and get the glider running on the main wheel, by which time there will be good aileron control. Lowering the flaps to +2 will then assist the take-off and give higher lift for the climb.



Kestrel

PIGGOT

Kestrel cockpit

In practice, lowering the cruise flap during take-off presents no real problem as it can be done leisurely at any stage in the take-off once the glider is stabilized. Similar to aerotowing, always raise the tail on take-off to prevent bouncing and leaving the ground prematurely at low speed.

Cruising

According to the manufacturers the optimum flap settings are: 50-55 kts. 0° flap, below 50 kts. +1, +2, this means that the flaps should be raised progressively to increase the speed above about 55 kts.

The necessary change of attitude is almost automatic if the flaps are raised slowly. When slowing down, the flaps should be lowered back to the zero position as the speed is reduced to about 55 kts., and kept in that position until the initial centering moves have been made. In rough air this enables the glider to be flown more accurately because of the better aileron control. The flaps can then be lowered to +1 or +2 as desired to allow a tighter turn to be maintained for the climb. In very turbulent conditions it may be easier to use zero flap and take advantage of the better handling.

In normal flight the left hand should be on the flap lever if the time and changes of speed are initiated by moving the flaps. This avoids the possibility of overspeeding with the flaps down.

Flaps 0°, –1, –2, Vne 135 kts.
+1 the maximum speed is 108 kts.
+2 the maximum speed is 80 kts.

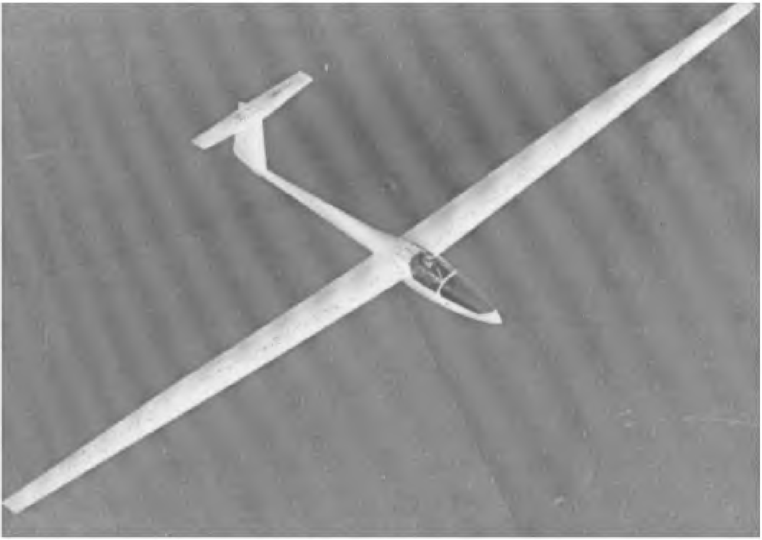
With *landing* flap down the *maximum* speed is *65 kts.* and this is very easy to exceed and will result in serious *structural damage*. (One case in the U.K. in 1972.)

Stalling and spinning

The stall is docile in all configurations and the glider will only spin fully with 'in-spin' aileron (spinning to the left with the stick to the left). Otherwise it develops into a spiral after about one turn. Being very clean, the speed increases rapidly in a dive and recovery must be made promptly. Do not attempt spinning unless the flaps are in the 0° or up positions as the maximum speeds may be exceeded during recovery. The stalling speed with landing flap but no airbrake is approximately 35 kts.

Sideslipping

The Kestrel can be sideslipped very effectively for a steep approach. However, it is suggested that every pilot should explore the sideslipping at height before using slipping on an approach. The angle of yaw with full rudder is surprisingly large, and the ASI becomes totally unusable during the slip. With large amounts of rudder, the rudder loads reverse, so that a definite force is needed to re-centralize it.



Kestrel

Try at least one sideslip using *full* rudder to see exactly what it is like. Even with full rudder, the angle of bank is small and the sideslip is very flat.

Airbrakes

Because of the spring-loaded airbrake caps, the forces required to lock and unlock the brakes are high. They cannot be closed or locked above about 80 kts. because of high 'suck-out' force.

Tail parachute

Tail parachutes are only reliable if they are repacked each day before flying. They fail if they are packed badly or if the fairing jams. On pulling the deployment toggle it is best to joggle the rudder to ensure that the fairing does not jam. At the end of each day's flying, the tail 'chute should be taken out so that it has to be repacked on the next day.

Always repack the tail chute before the day's flying. If the deployment toggle has been pulled since the last flight and the fairing is not properly locked, the 'chute may come out during take-off. There is no way of detecting this fault from the cockpit and on aerotow the combination will almost certainly end up in the woods (one case in an SHK in 1972).

Between flights, it is a wise precaution to check that the fairing is securely locked by taking hold of the fairing and pulling it downwards firmly.

If *at any time* you suspect a serious increase in drag, pull the parachute *jettison* toggle. If the chute is deployed, it will save the glider, and if this is not the trouble, it will only mean reattaching the chute inside the fairing after the flight.

If the parachute has become damp, it may become frozen in flight and fail to open. If the pilot or an onlooker pulls the jettison toggle on the ground, the fairing and parachute may drop away altogether when an attempt is made to deploy the toggle. A small piece of sticky tape across the release rings will prevent such a hazard. Then, the rings cannot drop out of the release without a positive load on them.

When the 'chute is deployed there is no appreciable effect for a few seconds; then a deceptively gentle deceleration can be felt. The drag of the 'chute is *much* greater than with any airbrakes, it can therefore only be used when there is *already excess speed* or when there is time and height to lower the nose enough to maintain the approach speed. If it is deployed at a normal approach during the final stages of the approach, you will end up too slow and will make a very heavy landing and may well break the glider. (Two cases in 1972). It will probably require 60 kts. or so if the chute is deployed at about 50 ft. since during the time that elapses before the round out a significant amount of speed can be lost. Lower down, less speed will be acceptable and if the 'chute is deployed during the float, no extra speed is needed.

The tail parachute, unlike airbrakes, does not affect the stalling speed of the sailplane, but just increases the drag.

Extreme caution is needed to make sure that the speed is maintained after the 'chute has been deployed. This can only be done by pointing the nose well down. If at any time the speed is falling to 50 kts. and there is no chance of lowering the nose enough to keep above this speed, the chute must be jettisoned and the airbrakes used normally for the landing.

Fundamentally there is no reason not to use the airbrakes and the tail 'chute together, but in practice the 'chute is so effective that there is seldom need to do so, and it will increase the chance of ending up too slow for a normal round out.

For normal flying, there is no reason to use the tail 'chute as the combination of landing flap and airbrakes is very effective. If it is intended to use the tail 'chute deliberately, the best system is to open the 'chute at about 400-500 ft. going downwind rather close to the field. The approach can then be made in a steep descending turn maintaining at least 55 kts. Excess height can be dived off as the drag of the 'chute increases rapidly with speed.

If the 'chute fails to open, the downwind leg can then be extended for a normal longer approach and landing. In this case the 'chute should be jettisoned so that it cannot become deployed at a later moment and cause an undershoot. This way of using the tail parachute requires constant practice. In a crosswind landing the parachute should be jettisoned after touchdown to prevent a bad swing.

Rain and ice

The Kestrel, like many other modern gliders, is seriously affected by even light rain or icing. A distinct, continuous vibration will be felt at all speeds in rain and the performance drops to about that of a K-8.

Aerobatics

The Kestrel is not recommended for aerobatics as it is very easy to exceed the Vne because of the clean design and limited elevator range.

Landing

First, lower the main wheel—this spoils the performance considerably. Adjust the flap to zero position (for best aileron control) and slow down to 50-55 kts. before lowering the landing flap.

After the initial slight gain of height, the nose must be lowered to maintain 50-55 kts. If you find it difficult to lower the landing flap you are flying *too* fast! The actual glide path is not so steep as it appears, since with the landing flap down the flying attitude is very nosedown. The airbrakes can then be used normally keeping 50 kts. or a little more in rough conditions.

Even in no wind, the ailerons are adequate to prevent a wingtip touching during the landing run, provided that the pilot is alert and the *cruising flap is at 0°*.

Because of the forward position of the main wheel, a drift landing or any swing will tend to result in a violent ground loop.

In very light winds, you are advised to give yourself extra room whenever possible. It is unwise to try to be clever and to steer the glider anywhere near to any obstructions after landing.

As a type, the Kestrel is simple to fly but you need to know the various approach configurations before taking it across country.

NOTE: Since the above notes were written the CAA and BGA Technical Committee have approved the following modifications:

1. The landing weight of *all* Kestrel 19s has been increased from 960 lbs. to 990 lbs.

2. Applicable only to Kestrel 19s fitted with elevator anti-balance tab (mod. 9). This modification extend the aft CG limit to 15.83 in. aft of datum subject to the following changes in Vne (This is not a structural limitation, and with more forward C of G positions the reduction in speeds is not necessary):

Flap setting 0° and +1 reduced from 108 knots to 100 knots. Flap setting +2 reduced from 81 knots to 70 knots.

All Kestrel 19s without mod 9 retain the origional CG limits and speeds.

11
AS-W 12
Is it for everyone?

by GEORGE D. WORTHINGTON

It may seem presumptuous for a relatively inexperienced soaring pilot to write about his impressions in the AS-W 12. The last pilot to do so, in the August 1969 issue of Soaring, *was Wally Scott, who has held numerous World Soaring records, who led the American team's showing in the 1965 Internationls, and who has been a recipient of the Barringer Trophy every year for the past five years. However, it might be argued that therein lies the weakness of his report. He is a proved champion, and therefore he must fail to tell us how the average sailplane pilot might fare in the awesome AS-W 12.*

The AS-W 12 still holds both the world's distance and goal records, and was the sailplane, which, when guided by A. J. Smith, won the 1971 Nationals. Newer sailplanes are in production, but the AS-W 12 is still of great interest to anyone contemplating a move upward to a higher performance machine. As the champions accept delivery on their AS-W 17s, Nimbus IIs, and Glasflugel 604s, it is quite likely that some of the AS-W 12s will be offered for sale. Should the average pilot allow himself to be tempted into buying one of these superships?

The decision

I bought 7R in September 1970. I had spent the previous three months trying to make up my mind whether, in the long run, it would be worth spending approximately $14,000 for the ship and all of its associated equipment. During this time, I at first thought that flying any ultra-high-performance sailplane without spoilers or flaps for use in glide path control would be unthinkable for me. However, as I learned more and more about the exciting performance of the AS-W 12, the temptation began to weaken my judgment. Finally, I found myself thinking "If those other fellows can handle the problem, so can I." Surely proper slipping technique on final can be appropriately applied as a substitute for spoilers. After all, didn't I successfully land a Prue Standard in a 30-mph 90-degree crosswind with surprising ease? And don't I have 8000 hours of power time with absolutely no accidents, unless you want to count the two times I forgot to lower my landing gear? Isn't it true that I've made over 10,000 airplane landings and only forgot the gear twice? Converted to a percentage figure, that's 99.998 percent perfect. And don't I have 250 hours of soaring experience plus a Diamond Badge? So what is there to worry about?

When I paid for the ship and took possession of it in Michigan in September 1970, it had been raining heavily for two days and the weather analysts gave no hope for clear weather for at least several more. Therefore, there was no chance to test fly the ship before purchase as planned. I was in such deep mental shock at seeing my very own hands fork over such a large chunk of my wordly wealth that I decided the only cure for my twitching and sweating was to return immediately to California and the security of my home and loved ones.

After returning to California, 7R remained parked for ten days beside my house. Only 12 miles away there is a small gliderport where 2-22s and 1-26s cavort on weekends. On the eleventh day I drove to the gliderport and measured its length and scouted its ground squirrel holes and tiny gulleys. It seemed more than large enough. In order to give myself every advantage, I made arrangements to fly on a Monday when the gliderport was normally closed, so that no other ships of any description would distract me while landing.

First flight

On the great day of my intended first flight I was mightily impressed with the ease of the AS-W 12 assembly. Only two wing pins are required and they slip in with incredible ease compared to other ships of my acquaintance. There was no denying the psychological lift which this fact imparted to my overall mood. Of course, it wasn't all roses. There were problems and decisions to make. For instance, my newly-ordered chute had not yet arrived, so I had to add twenty pounds of lead from my scuba diving belt in order to meet the weight and balance parameters outlined in the pilot's handbook. But all in all, everything looked good. There was a 10-mph wind directly down the runway which would have the vital effect of lengthening the runway, by reducing the touchdown speed and the rollout distance.

I had decided days earlier, after hours of careful meditation on the subject, that I would make all my landings without using the tail chute. Ben Greene had told me in July that the tail chute could be expected to fail about five percent of the time. To me that was like Russian Roulette. Every 20th time I'd have an exciting emergency on my hands. And there was no way to tell on which landing this would occur. Logic suggested that there was only one answer to the 'chute problem.' Rather than wait for the chute failure, and then hope that I could recognize it in time and cope with it successfully, I would learn to do without a chute. Judicious slipping, I decided, was the answer.

On my first tow I released at the relatively low altitude of 1000 feet in order to save money. I left the gear down and performed several turns. The ship flew just like one would expect of a high performance sailplane, which was quite comforting. At 400 feet I set up a pattern and flew a downwind and base leg. At perhaps 200 feet high and 400 yards from the threshold, I turned final with confidence. I set up a slip with the rudder pressed full right and the stick full left. Naturally I put the nose down a bit to be sure of staying well above stall speed. This procedure had always worked very well in the 2-22 when the instructor said I couldn't use the spoilers. The AS-W 12 lost altitude rather well in the slip, but when I straightened the ship for a wings-level glide over the threshold, I had 75 mph and was still 75 feet in the air and gaining altitude! This was a case for the use of a little experienced airmanship.

I decided to make a 360-degree turn to lose a little more altitude before trying to land. The first 150 degrees of the turn were uneventful. But suddenly thereafter I could sense that I really might not have enough altitude to make a complete 360-degree turn. I was in sort of a trap. It occurred to me that I wanted desperately to pull the nose up to stop the sickening sinking toward the ground, but that I'd better not or the ship would surely stall and spin. So I kept the nose down and airspeed needle exactly on 55 mph and sweated it out. I knew the left wing was getting close to the ground and I thought of reducing the bank, but the ship was headed for a hill. By then I had completed 300 degrees of the turn. After 330 degrees of turn, I was headed for my car, the trailer, and the towplane. It was quite urgent that I remain in the turn. But a little farther around the turn the left wing began dragging on the ground.

As soon as this fact was communicated to the brain, which may have taken quite a while, I tried to raise the wing. However, by then the dragging wingtip turned the ship to the left, which completed the 360-degree turn but caused me to lose control of what otherwise would have been a perfect landing. I'm not really sure of what happened next except that the ship lit on the right wingtip and then pancaked onto the ground with fearful force. I've never had a shorter ground roll, which was less than 15 feet, mostly sideways, with the left wingtip now digging into the ground. When the motion stopped, I was confident that the ship was broken in at least two parts if not three or four. I was sick with anger. I released the canopy locks, lifted up the canopy and flung it hard to the ground nearby.

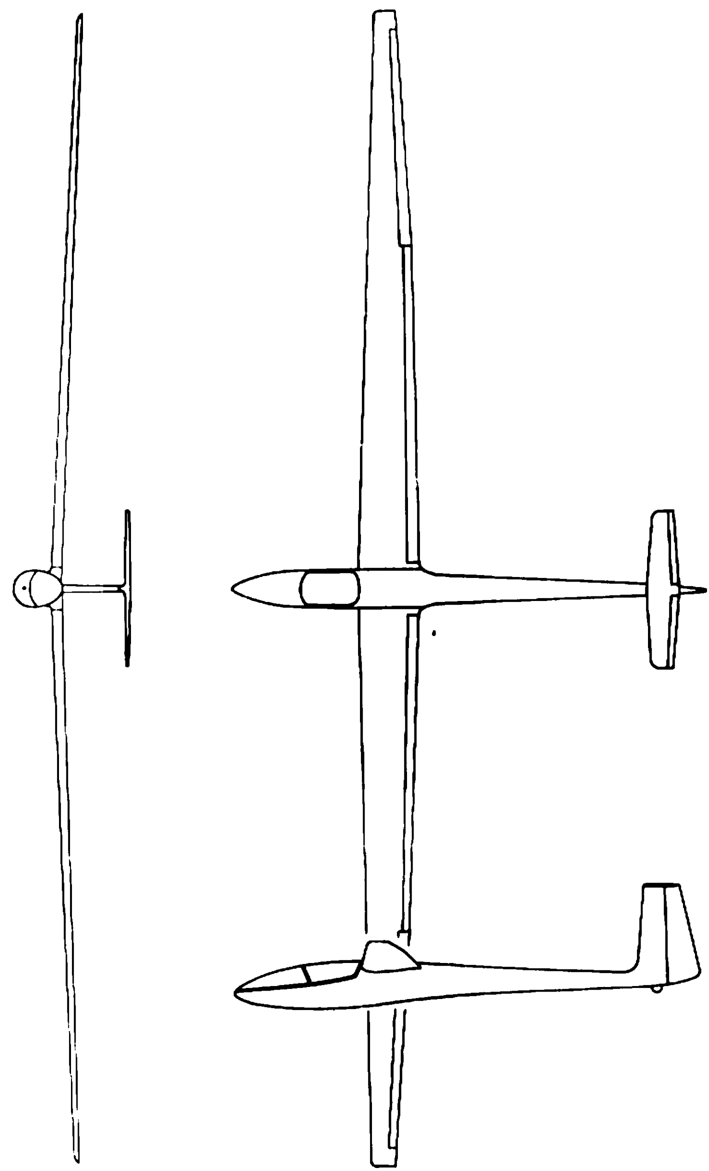
Surprisingly, the ship was relatively undamaged. The wingtips were a bit scratched underneath and the canopy had a hole in it about the size of a cantaloupe exactly above where my head had been. However, when we pushed the ship to the takeoff area, the landing wheel rolled normally. There was only one thing to do—make another takeoff as soon as possible, so that all three of us (my wife, myself, and the tow pilot) could forget the last landing and remember the next one. I knew instinctively that I should check over the ship carefully for other signs of damage. However, anger, emotion, humiliation, and fear stood in the way.

A second try

The second takeoff was more eventful than the first one had been. Just after getting airborne, I suddenly found myself turned 40 degrees to the left of the takeoff direction, with the wings still level. I decided that the towrope may have broken and that in any event, I had better pull the tow release and land while there was still time. I pulled the tail chute and landed straight ahead beyond the end of the runway. The round was so rough that I lost control of the ship after touchdown and a wingtip dug in. A jolting ground loop ensued. I realized that the ship's structure had already taken a terrific beating on the first landing, and I wondered if it could stand much more in this second bit of tortuous wrenching and jouncing. I was already learning, and this time I sensibly refrained from throwing the canopy to the ground nearby. I set it down rather gently and scrambled out.

Out of the corner of my eye I could discern that the ship seemed to still be in one piece. I couldn't bear to actually look squarely at the noble thing, which I was so severely mistreating. We got the car and towed 7R back toward the takeoff area. It was then while walking the wing down the runway, that I noticed that there were 20 to 30 tires on each side of the runway to mark its outline on the ground. One of the tires had been displaced about 40 feet. Also the left wingtip had a huge black scuff mark on its leading edge. It didn't take a mastermind to figure out what had happened. I told my wife to stop the car, and I hurled every tire on the south side of the runway an additional 40 feet to the south. Also, I remembered that it was extremely dusty on takeoff–so much so that I was practically on instruments. I therefore consoled myself with the thought that there really were extenuating circumstances which could be used to explain my unprofessional showing.

On my next landing, 15 minutes later, I again set up a landing pattern, slipped with controls thrown full over, straightened out, realized again that I was too high, deployed the drag chute, and made a greased-on landing. I made three more landings, trying each time to refrain from using the chute, but it was no use. I used it and luckily it worked.



AS-W 12

Five landings–an analysis

Having carried out my plan of spending only 15 dollars to make five practice landings, it came time to put the ship back in the trailer. I tried to retract the wheel, which is necessary for the fuselage to squeeze into the limited trailer dimensions, but it wouldn't budge. The struts were compressed and bent. I couldn't just leave the fuselage on the runway at the gliderport, so I allowed the tow pilot to get a sledge hammer and pound the struts into their folded position. Each blow of the sledge bashed against my sensibilities with the mounting knowledge of the damage I had done to 7R.

I brooded and lay awake every night for six weeks before I finally could face the issue of getting the lovely, fragile, graceful 7R repaired. The bill for repairs by an expert was $350, but she was like new again.

The difficulties I had encountered could probably have been avoided if I had, (1) practiced no-spoiler landings in any high-performance sailplane before flying the AS-W 12, (2) selected a larger, longer runway with a hard surface.

I learned in those first five landings that the ship bumps and jerks alarmingly on any unpaved ground surface. The wheel axle is mounted rigidly and unyieldingly to the fuselage, and one wonders if just possibly some sort of spring action couldn't have been incorporated into the undercarriage design.

I performed landings number six through 10 at El Mirage, which has about 3800 feet of old and cracked but level asphalt runway. My log book entries are as follows:

Landing 6: 15-mph wind down runway. Slipped, but still high at threshold. Needed chute. Used chute. Used only first 200 feet of runway.

Landing 7: 15-mph wind down runway. Crossed threshold low enough not to need or use chute. Used 2000 feet of runway.

Landing 8: 15-mph wind down runway. Slipped, but too high. Needed chute. Used chute. Used 500 feet of runway.

Chute failure

The next morning, landing number nine was made in absolutely calm air. I tried hard to extend the downwind leg so that the final would be low enough to require only a small amount of slipping. I therefore didn't turn base until I became fearful that I would not have enough glide to return back to the runway at all. However, when I turned onto final, it was obvious that I was still too high. I slipped as hard as possible and crossed the threshold with 30 feet of altitude. Fearing I would run off the far end of the runway, I pulled the chute. Nothing happened. I tried fishtailing, then set the ship down fast and dumped the flaps from positive position seven to negative position one. I immediately applied the brakes. But while braking as hard as I could, the great white ship rolled on and on. It rolled through the takeoff area where my wingtips passed within 20 feet of other fiberglass sailplanes on both sides of the runway. Somehow these prescient people had prudently kept a lane open for me. Inexplicably but gratifyingly 7R remained on the exact center line of the runway and stopped 100 feet from the end, and so there was no damage.

The chute failure was probably caused by the coldness of the night. The ship had been tied down outdoors assembled, and the fuselage apparently had contracted more than the chute cable. Full throw of the cockpit chute lever was insufficient to withdraw the pin which would have deployed the chute. However, not knowing this, I mistakenly thought that I had somehow incorrectly installed the chute housing after repacking the chute on the previous landing. I dropped the chute with the outside tail lever, fiddled with the mechanism a bit, and tried the cockpit lever four or five times. The chute dropped the last three of those times. I took off, determined to extend my downwind leg evern further. However, in spite of these efforts, fear again made me turn onto base early. Again the slip was ineffective and this time I was 35 feet over the threshold, five feet higher than the last landing. The chute again failed. I repeated my futile fish-tailing and flap-raising and maximum braking. I even tried taking my right hand off the stick at about 20 mph so that I could tug on the brake with both hands. However, a wing began dropping and threatened to throw the ship out of control. Again I glided on the ground majestically past the sailplanes at the takeoff area (thank God they were watching the fabulous AS-W 12 and by now were counting on my ineptitude). This time I failed to stop at the runway's end, and used an additional 50 feet of level unobstructed dirt. My humiliation was complete. I decided to pack up and drive home as quickly as possible.

Breakthrough

At home I brooded for six more weeks before venturing forth once more with the potent but hairy AS-W 12. On landing number 13 I finally achieved a breakthrough. With a 10-mph wind down the runway at El Mirage, I crossed the threshold with eight feet of altitude, did not use the chute, and stopped after using 700 feet of runway. On the next landing I did even better, crossing the threshold at two feet and stopping after using only 500 feet of runway—again with a 10-mph wind.

By the 20th landing I had bettered the best figures above, and made four landings in a row without chute, touching down each time in the first 100 feet and using a total of only 450 feet of runway in a six mph wind. This performance was rapidly allowing a return to my normal, healthy, piloting confidence.

In February, I shifted my soaring activities to Lake Elsinore which was only 75 miles from home compared to the 150 miles of El Mirage. For six straight landings (23-29) my performance retrogressed and I was forced to use the chute each time to avoid the risk of running off the end of the 3000-foot runway.

During February, March, and April, I was getting some exhilarating and, for me, fantastic flights in the Twelve. However, I knew that until I could master the short landing technique without the chute, I would be very limited in my ultimate goal of cross-country soaring. My progress in shortfield landing was sporadic. I needed the chute 30 percent of the time. Noteworthy was the fact that my first landing at a strange airport was particularly bad. I was invariably very high and was often forced to make violent S turns on final approach in an effort to lose altitude. Sometimes even these unprofessional procedures would be inadequate and I would be forced to use the chute. It was obvious that my main enemy was fear itself—the fear of landing short. The fear was useful though, because it takes only one bad mistake to cause many thousands of dollars worth of damage to an AS-W 12. This was particularly important because I had elected to fly uninsured except for liability coverage.

Crosswind landings

In June, I made 20 flights and did not require the chute even once. I now had 61 flights and 90 hours in 7R. However, a new source of danger in the AS-W 12 appeared. At El Mirage and Elsinore, takeoffs and landings can always be made almost directly into the wind. On July 3rd, on my sixth cross-country flight in the AS-W 12, I was forced down at old Apple Valley Airport. This abandoned runway has no wind sock, but an American flag at a nearby gas station provided the same information. It showed that I had a 70-degree 15-mph crosswind from the left. I had directional control until I had slowed on the landing rollout to about 25 mph. At that point the nose started to swing to the left into the wind and toward a fence. By instinct I lowered the right wing as I started an uncontrollable ground loop to the left. The wind accidently contacted the asphalt and created enough friction to bring the nose back straight down the runway.

I had discovered a new menace, but also a new tool to combat it. It would be wise to trade some deep scratch damage on the bottom of a wingtip for the more drastic damage potential of a severe ground loop, particularly on asphalt, and particularly when a fence or rough terrain lined the side of the runway. Even so, after you've used foam rubber under the wingtips religiously for months to protect their delicate and beautifully contoured surface, it seems like you're messing around with your sanity to deliberately force that wingtip down into pitted, rough, and weather-worn asphalt just to maintain directional control during one landing.

In June, the AS-W 12 wheel brake was redesigned (back to the factory original) and relined and finally became as effective as most supership brakes.

Slipping effectiveness

Somewhere along the way, between September and July, I learned to slip the Twelve with a far greater effectiveness. Success came slowly because of the obvious danger involved. Early in the slip, the airspeed indicator begins to give useless readings. Therefore, you worry about getting slow and stalling and spinning, especially with severely crossed controls, So you find it extremely difficult to want to raise the nose and keep it high. Extensive practice at safe altitudes above 2000 feet is helpful. It teaches you that the ship is very stable in a slip, even with the nose in a very high position. But still you worry about gusts, dust devils, ground effect, and wind shears when you're in your final approach, near the ground, and very vulnerable.

Actually, your worries regarding stalling while slipping never subside completely, but you gradually gain confidence until you find yourself using the nose-high slip, which can give more than 1000 feet-per-minute descent when used properly. This slip is used approximately at the same times and in about the same amounts as spoilers might be used. During all the experimentation high in the air and the 30 landings from July until September in the AS-W 12, never once has there been any suggestion of a stall while slipping. There *have* been stalls while thermaling however.

In 250 hours in the Twelve I've inadvertently stalled about eight times while thermaling. Each stall was caused by carelessness and was due to pilot impatience and rough handling. Seven of these caused the nose to drop suddenly to a point some 50 degrees below the horizon, whereupon the ship immediately picked up speed and was flown quickly back into the thermal. The danger seemed minimal and the occurrences were only mildly annoying. However, after I had flown the Twelve for over 200 hours, the eighth stall, also in a thermal, was much more serious, because I was at only 1300 feet at the time and because I used forces on the controls which were particularly rough and impatient. In trying to recover too quickly from the stall, I encountered a second accelerated stall during which the nose plummeted to a point 90 degrees below the horizon. In order to be certain at that point that the wings were unstalled promptly, I pushed forward on the stick for a heartbeat, before trying to recover from the dive. This placed the AS-W 12 slightly on its back. Final recovery from the dive forced the ship within 300 feet of the ground. Needless to say, great thought is still being given to the possibility of having been at only 900 feet or less when that first stall occurred. However, I don't feel that such stalls are any real problem, once you know they can happen and are willing to take the pains to handle them smoothly and respectfully. By using a little more care, no stalls have inadvertently occurred in the last 50 hours of flying in the Twelve.

If you haven't flown sailplanes with the fully reclined 'seating' position, you're in for a very pleasant surprise. The 1-26s and Prues and Blaniks gave me severe back pains after only 1½ hours, whereas the AS-W 12 has been extremely comfortable for periods exceeding nine hours. For me, the main drawback of the recline design is mainly the extreme difficulty of map unfolding and reading (you have no 'lap' to set things on), and I am still uncomfortable while thermaling at 300 feet—I keep wanting to sit up straight for a better perspective. Nevertheless, I still find myself occasionally thermaling at 300 feet in the Twelve.

Ground loops

Ground looping on takeoff and landing is a constant hazard in an AS-W 12. Aside from the two which occurred on my first two flights, I've had three others during 95 flights and 250 hours. They were very mild but they had a pronounced effect on my confidence and anxiety level. Two of these were caused by wing runners who held back or pushed forward on the wing on takeoff. The third was caused by a 90-degree change in wind direction in the time interval between downwind leg and touchdown. This one could have been avoided, I think, if I had jettisoned the chute a few seconds after touchdown.

In a crosswind condition after touchdowns the wind catches the chute, pulling it out to the side and greatly increases the forces already tending to push the tail downwind. Luckily, four out of five of my ground loops were on ground/sand which is much more forgiving than most asphalt or concrete surfaces. All of the ground loops were the result of pilot error and need not have happened. However, the average pilot must reconcile the fact that he will probably have a few ground loops while transitioning in the AS-W 12. Also, it must be said that I have never ground looped any other sailplane or any airplane. These facts suggest perhaps that the AS-W 12 is maybe a bit more difficult to control while traveling on the ground. When you consider that the weight on the tail skid with pilot aboard is 95 pounds, the vertical fin is exceptionally large, and the considerable moment arm of those long wings which weigh 200 pounds apiece, the ground looping possibilities are not surprising.

Raising the landing gear in the air requires considerable force. I'm six feet with better than average strength, however, it often takes every bit of muscle that I can summon to raise the gear. Ben Greene told me he gets help in this task by applying negative *g* loads.

Originally, I had planned that while on cross-country flights all landings would be made at airports. Gradually I began to realize that this plan would greatly limit cross-country capability. One day while trying to reach an airport I had to land one mile short of the runway in a cotton field in Texas because of sudden strong headwind. The 15-mph wind was 90 degrees to the direction of the furrows, and although the ship turned into the wind at 20 mph, it didn't receive a scratch. Several landings in dry lakes were also very successful. Other AS-W 12 pilots discussing their off-airport landings, helped to convince me that although airports still offered the greatest safety, the Twelve was by no means limited only to airports. This is extremely important to serious cross-country flying in the Twelve.

One immensely valuable aid during landings off airports has been the use of a smoke bomb released through the cockpit window over the intended point of landing. Knowing the wind direction and general intensity can make all the difference.

Summary

In summation, I feel that the AS-W 12 is probably not for everyone. However, I feel that the average soaring pilot can safely transition to this ship providing he is willing to observe some general precautions as follows: before flying the Twelve, learn to make satisfactory landings in any high-performance sailplane (preferably fiberglass) without the use of spoilers. For the first 50 or so takeoffs and landings in the AS-W 12 use a large multi-directional type gliderport to avoid all but the smallest crosswinds and to allow plenty of runway length. Also, for the first 50 landings, try to make all landings without use of the tail chute. Learn the extremely effective nose-high slip for use as glide path control. Be prepared to drag a wingtip for use in directional control in crosswinds on a narrow landing lane in order to avoid severe ground loops or obstacles near the edge of the runway. Plan to fly your AS-W 12 a minimum of 150 hours per year to develop and maintain a high degree of proficiency. Remember that success in avoiding accidents in sailplanes probably correlates more with how much you fly than with your innate pilot ability or the total hours you've flown in the distant past.

If you do decide to purchase one of the fabulous AS-W 12s, even though, like me, you know you are a soaring pilot of only average ability and experience, you might have the same feeling Wally Scott had when he first flew the ship: "The most fantastic machine I have ever flown."

12
AS-W 17
Living with a new ship

by DICK JOHNSON

My first meeting with the AS-W 17 occurred in March of 1972, and I was frankly apprehensive. The big beauty had just arrived in Houston the day before, and Rudy Mozer had quickly plucked it from its container and brought it to Grand Prairie, Texas, where a number of interested pilots were gathered to evaluate the elegant machine.

Assembly

New paint made a tight fit of the parts, and the combination of new insufficiently cleaned fittings and unfamiliarity with assembly procedures resulted in some frustration. The inner wing panels weigh about 220 pounds each. This by itself is manageable, but with no wing support stands and the long delay in completing the main pin insertions, the first impressions were not favorable.

Finally, the assembly was completed and the new sailplane looked immensely proud and beautiful. Its vertical tail appeared disproportionately large, but by experience I knew it was necessary if good flying qualities were to be achieved with the large span 20-meter wing. The wings, though only four and one-half inches deep at the spar root, showed surprisingly little droop while the sailplane was at rest on the ground. This, I understand, is due to the wing spar design in which the spar's glass fibers are spread in a wide monocoque form comprising the exterior skins of the wing inner panels. This stressed-skin spar construction also apparently avoids the wave-at-the-spar shrinkage problem common with conventional concentrated spar glass wings.

The slender aft fuselage tail boom is graceful, but at first glance it does not appear strong enough to support the large rudder. Again, the first impression did not prove to be accurate, and the slender aft fuselage showed a surprising amount of stiffness. This is derived from the two-skin sandwich fuselage construction used where the inner and outer skins are separated by .25 inches of a unique plastic Hexcell-type sandwich material.

Next to the slender fuselage boom and generous vertical tail, I was most impressed by the remarkably sensible horizontal tail design. It has a 2.9-meter span, which I knew would provide good longitudinal stability. In addition, the fixed stabilizer comprised by far the major portion of the surface, and this, by design, would provide the comfortable and safe highspeed handling qualities which some recent designs lack.

The fuselage has a distinctly pointed nose designed by Gerhard Waibel to maximize low-drag laminar flow. When I later suggested to Gerhard the possibility of cutting a hole in the tip of this elegant nose to install a rain-and-ice-resistant pitot, he was concerned that a significant amount of laminar flow would be lost. The shoulder-high wing location is aerodynamically efficient, and reduces fuselage interference effects such that no noticeable wing root airflow separation occurs while thermaling.

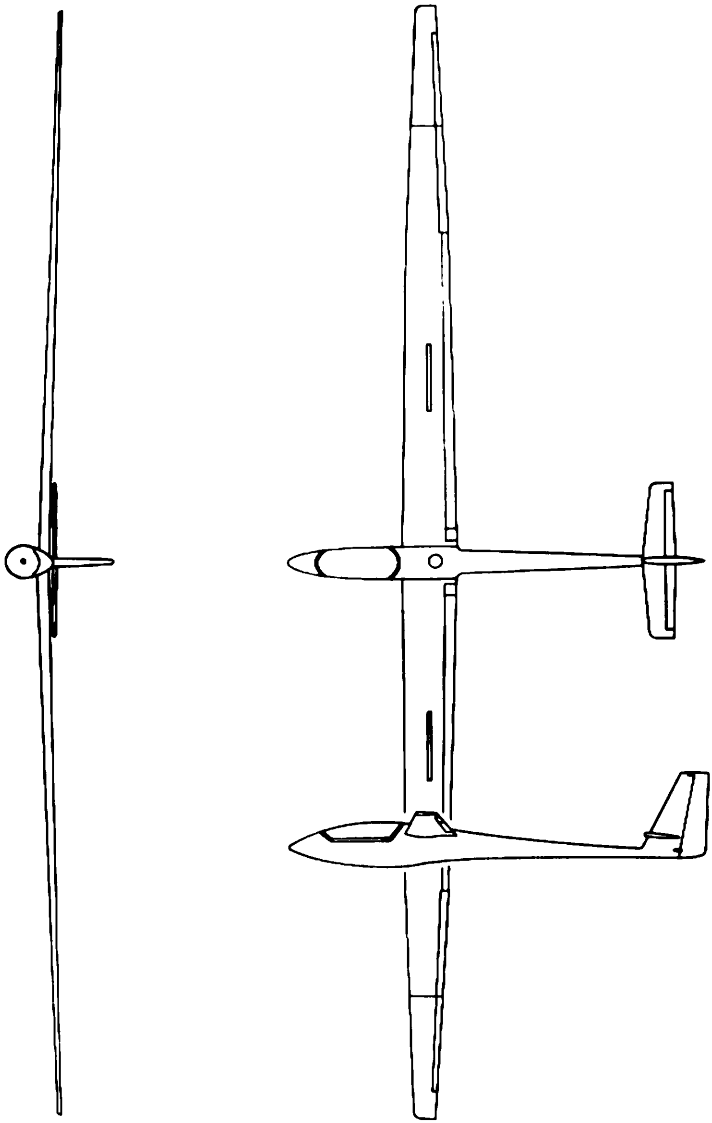
Cockpit

I have always considered the Slingsby *Skylark 4* to have the best cockpit of any sailplane I have ever flown, and the AS-W 17's is almost that good. It has a comfortable 24-inch width, adequate length for all but the tallest pilots, and a well-shaped seat contoured to fit the pilot's important posterior surface. The pilot is semi-reclined to about the same degree as the *Skylark*, and the visibility from the pilot's seat is quite good. The landing-gear handle is located on the left side of the cockpit, as it should be, but unfortunately a pilot with even average arm length will hit his elbow against an aft cockpit fairing protuberance just before the wheel is fully retracted. After I learned to compensate by leaning to the right and holding my elbow close to my side, I had no further trouble with this. I understand that newer models will have the gear handle placed about two inches farther forward, which will correct this problem. The other somewhat minor cockpit problem was the location of the wheel-brake actuation tee handle, which was on the right side of the cockpit. This necessitated changing hands on the control stick to actuate the brake when completing a landing. This also, I understand, is being re-mounted on the left side of the cockpit.

Takeoff

The control stick is comfortably located and remarkably free to move, considering that the stick not only provides the normal aileron motions but also differential movement to the wing flaps. Compared to other long-span machines this flaps-plus-aileron movement provides superior lateral control during the critical takeoff roll. The wings on the 20-meter machines are unmistakably heavier and more difficult to control than those of the 15 and 18-meter variety, and all possible help is needed here. The most common error of a pilot inexperienced with long-span sailplane flaps is that of making the initial takeoff ground roll with the flaps in other than the full-up position. Flaps should remain in full-up position until good lateral control is reached at about 30 knots airspeed, and only then be placed to takeoff position. Reversing the procedure during crosswind landings also works well.

The first takeoff went better than I expected. As anticipated, the inertia of the long, heavy wings was much more significant than any sailplane I had previously flown. A good sense of anticipation for lateral control requirements is needed if one is to avoid wingtip dragging during takeoff and landings. Lift-off was made at about 42-knots airspeed and the airplane tow was accomplished with unexpected ease. The big tail, combined with the well-balanced lateral control system, no doubt contributed greatly to the good tow characteristics.



AS-W 17

Trim

After release, wings-level flight was investigated. Longitudinal stability was excellent, and the trim airspeed appeared to be about 54 knots. Sink rate was remarkably low at that airspeed, and the glide ratio obviously very high. Increasing the airspeed to 80 knots did not increase the sink rate to a large degree, and the apparent flatness of the glide angle gave credence to the advertised outstanding high-speed performance.

Next, the low-speed range was tried. At 40 knots both the sink rate and cockpit noise levels were very low, and the control systems responded quite adequately. This airspeed is near the advertised minimum rate of 97 fpm. Reducing the airspeed still further necessitated a definite back pressure on the control stick to accomplish—additional evidence of fine longitudinal stability. Minimum speed in the unballasted condition I was flying was about 35 knots. Light buffet was present near minimum airspeed. The stall was remarkably gentle for this class of sailplane and was similar to that of the excellent *Skylark 4*.

Roll rate

In subsequent tests of rolling manoeuvers it was apparent again that the wings were long and carrying a stout spar. It takes close to eight seconds to perform a roll from a 45-degree bank to a 45-degree bank in the opposite direction when flying at about 45 knots airspeed. This relatively low roll rate will probably disturb those used to shorter and lighter wings, but in time one gets used to it. Adverse yaw during rolls is comparatively light, and keeping the yaw string centered was considerably easier than with my HP-13. Again, the big rudder seems to be the key.

It was still well before noon, but weak early spring thermals were rising to about 2000 feet AGL, so naturally I banked the big bird and circled to regain lost altitude. Though banked for normal thermaling, the AS-W 17 maintained its low sink rate, and it climbed beautifully despite its comparatively heavy 6.1 lbs./sq. ft. wing loading. Before long other sailplanes were joining me in the thermals, and I was able to determine that its excellent thermal ability was a reality in fact and not just my imagination. A reversal of turn direction while thermaling is somewhat difficult and time consuming because of the inertia of the big wings, and I found it best to avoid that manoeuver if at all possible.

Landing

After having flown the ship 2.5 hours on this, my initial flight in the '17, and knowing others were waiting to also try the machine, I reluctantly returned to the TSA airstrip for a landing. The gear came down easily, and the flaps were set to their plus 9° landing position. Being unfamiliar with the ship, I kept the airspeed at about 55 knots during the approach. There is no tail parachute on the AS-W 17, but large airbrakes extend from both the upper and lower surfaces of the wing and provide moderately good glide-path control. A high, steep approach into a short field is not possible because weight and cleanliness of the big super ship carries its airspeed to too-high levels to permit reasonable ground roll distances. Instead, a moderately shallow approach must be performed so that the airbrakes can keep the airspeed at the desired approach value. The forward visibility is excellent during approach and landing, but once on the ground it does take more braking to get stopped in a short distance than with a smaller, lighter sailplane.

Flying the AS-W 17 was an experience, but not love at first sight for me. Its flying characteristics took time to get used to, and its trailer and our assembly procedure needed improvements. A month later I called Rudy to ask if it would be possible to fly the '17 some more during our South Region 10 Contest in May; I was scheduled to fly an AS-W 17 during the coming World Championships in Yugoslavia, and I needed more practice. Rudy's '17 was in Wichita being fitted with a new trailer. Rudy generously consented to my using his magnificent bird, provided Roy LeCrone could get the new trailer completed in time. Roy just did and Curt McNay kindly towed it down to Dallas the evening before the contest started.

The weather was good and my AS-W 17 flights, numbers two through six, were all good for 1000 points each during our five-day contest. The machine was clearly superior, and I knew it was not really a good comparison of piloting abilities. During the area distance task, for instance, a 32-mile final glide in a light crosswind to an airport goal with only 3500 feet of altitude loss really impressed me. I was also impressed when my two-man crew was able to assemble the '17 unassisted while I was attending the pilots' meeting. Their only support equipment consisted of the new LeCrone trailer and one sawhorse.

Practice for Vrsac

After the contest Rudy kindly allowed me to keep his machine for an additional two weekends of practice before leaving for Yugoslavia. The club gliderport where I divide my time between instructing and practice flying is at Heath, Texas, 20 miles east of Dallas. We have no towplanes and our only means of launching is by auto tow. This gave me a chance to evaluate the '17 under new conditions.

On all three days I flew the '17 there, the weather was hot and the winds near calm. This, combined with the moderately far-forward towhook location on Rudy's '17, did not allow me to climb more than 600 to 700 feet before the towcar reached our field's end. Each day I found I could quite easily climb away from these relatively low tow heights, thanks to the flat glide angle and marvelous climb characteristics of the '17. On the last day I did not find lift after tow until I was down to 250 feet and about to turn into a landing. The relative ease with which I could get the big machine to climb at this altitude amazed even me. Gerhard Waibel later told me that Rudy's '17 had the forward towhook position intended for aero tow, and that he was surprised that I did at all well auto towing with it. Ignorance was bliss here. The German '17 I flew in Yugoslavia did have the towhook installed farther aft on the bulkhead just behind the pilot's seat, which is the normal combination auto/winch/aero towhook location. I did not get a chance to fly this machine on any but aero tows while in Europe, but it did aero tow almost as well as Rudy's.

By now I had logged nine flights and 46 hours in Rudy's serial #2 machine, and I felt moderately well prepared to start the formal practice period for the World Championships in Yugoslavia. The AS-W 17 the factory had arranged for me to fly was a real beauty. It was serial #7, and bore contest letters AS, for the firm's founder, Alexander Schleicher. It was impeccably equipped with radio, artificial horizon, Althaus, electric vario, and oxygen by its gracious owner Edgar Kremer, test pilot and Director of Development at Schleicher.

Flying in Germany

Two flights from the Wasserkuppe, followed by six more at Hahnweide and Solgau in Germany, preceded our team's journey to Vrsac, Yugoslavia. The flights in Germany put the machine to an unusual test. The thermals contained relatively large numbers of small insects that we would call gnats here, but which are called mosquitoes in Germany. They would deposit themselves on the leading edges of all the glider surfaces at such a constant rate during flight that one could almost log his flight time by counting the number of splattered insects per unit span on the wing leading edges. These affected everyone's performance, but appeared to degrade the thin AS-W 17 airfoil less than the thicker winged machines. According to Waibel, there are two reasons for this. One is that these airfoils are basically less affected by surface roughness, and the second is that the thin airfoil will naturally impact fewer insects in a given time because of its sharper nose and thinner profile. Insects generally are not so populous in our U.S. thermals, and do not present much threat to our laminar wing performance. However, raindrops affect the airflows in much the same way, so the performance of the '17 is likely better than with most other machines in that environment.

During subsequent flying in Yugoslavia, I had many occasions to fly in cloud and rain, but never had a good chance for observing comparative performance with the wings wet. The '17 flew well in cloud, principally because of its good stability and docile stall characteristics. Because of these characteristics, Gerhard Waibel calls the '17 his "grandfather's ship"! I pretty much agree with Gerhard's evaluation, but I think the grandfather should be *current* and *proficient* with his Ka-6 or *Skylark* before he flies the '17.

Summary

In summary, after flying the AS-W 17 for 145 hours, I feel it is a safe and superb machine, and well worth the 40,000 DM price. The more I fly it, the better I like it.

Dick Schreder's view

Near the end of the Standard Class Nationals in 1972, the opportunity arose to fly Rudy Mozer's AS-W 17 in the National Soaring Championships at Minden, Nevada. My preliminary flight in this ship convinced me that it should be able to win at Minden. Two days later we were on our way with the AS-W 17 in its trailer hooked behind our Ford.

On the very first flight in Nevada, a small problem arose. Specifically, the five-foot-long canopy lifted from the fuselage and disappeared into thin air above the mountains five miles east of Douglas County Airport. There I sat at 15,500 feet, minus canopy, hat, charts, papers, and everything else that wasn't strapped down. Except for the draft, the ship flew very well and an uneventful landing was made back at the airport. This incident pointed out the need for a positive visual indication of the fully engaged release pin; hot Nevada temperatures had expanded the canopy enough so that a hard push on the locking knob before take-off (and several times in flight) just didn't shove the pin all the way in. Fast work by Rudy Mozer and good cooperation from the Schleicher factory in Poppenhausen, Germany, had another canopy in San Francisco twenty-four hours later.

Back in the air once again with enough time to check the ship out, I found it to be a beautiful thing to fly. Control forces were light and response was good even into the stall. Coupling the flaps and ailerons together makes lateral control surprisingly good for such a large ship.

Landings were something else. Although the dive brakes are adequate, the ship lands fast and, being heavy, it really rolls on the ground. The brake handle located on the right side was very awkward. The left hand must remain on the flap handle to control glide path until touchdown. At that instant the left hand must be shifted to the stick and the right grabs for the brake handle which is dangling on the end of a cable on the right side. This switch couldn't come at a worse time. I'm certain that every pilot who has flown the ship will write to Schleicher, as I did, to suggest putting the brake on the left side.

I was never able to get the wheel brake to work properly because of cable stretch, poor linkage, and insufficient adjustment capability. Consequently, every landing was terminated with a nighmarish 1500-ft. rollout that practically insured washing out the ship if an off-airport landing had to be made in the difficult Reno terrain. This was undoubtedly a factor in making me work harder to stay up.

Another problem encountered was the tendency of a wingtip going down on takeoff or landing. The thin wings bend enough to allow about ten feet of the lower wing surface to scrape the runway so that a mass of scratches can mar the beautiful finish. I solved this problem in the same manner that Dick Johnson did—by keeping the flaps in the full up positon (minus 12°) until 30 mph is reached on takeoff and immediately after touchdown upon landing. (The ailerons go up and down with the flaps. The four-setting flap-aileron system is very effective for improving performance at high speeds; flap settings are marked on the airspeed dial.

The water ballast system installed in the U.S. was inadequate (160 pounds) and unreliable; only one side would dump after most flights.

Cockpit ventilating air is taken in through flush inlets on each side of the fuselage under the wing. Air is directed through ducts to exhaust into the front end of the canopy. Ventiliation was excellent but the noise level is unusually high and the lack of any flow control made the cockpit uncomfortably cold at high altitudes.

The results of the Minden Nationals may mistakenly convince those who weren't there that the Open Class ships aren't any better than the Standard Class machines that won and placed better. This is not true. It so happened that all of the big ships had at least one bad day, while the top Standards didn't. I lost the contest on the second day when I dropped more points than I needed to win by going down at Carson City on a 70-mile final glide when I got into the Sierra downwash and went east of Carson City instead of west. I did place ninth although there wasn't a single day when everything went right. The great potential of the ship was evident on the 24th of July when the AS-W 17 was first with a speed of 80.5 mph compared to Jack Bamberg's 2nd place in his Libelle *at 70.3 mph, in spite of the fact that I passed by the best thermal of the day to sit for twenty minutes at 200 feet in Montgomery pass.*

The AS-W 17 won the Region 6 Contest for me in weather that was very weak and difficult on all but one day. Although I expected to have a larger advantage on weaker days, there just wasn't any noticeable difference in performance over the Libelles *and* Cirruses *when the going got tough.*

To sum up my impressions of the AS-W 17, I feel that there is no better ship flying in the U.S. today. The problems that I encountered can be solved by making some relatively simple equipment and operational technique changes. When this is done, it will be very difficult to make a better ship of similar size.

13
NIMBUS II
Getting to know you . . .

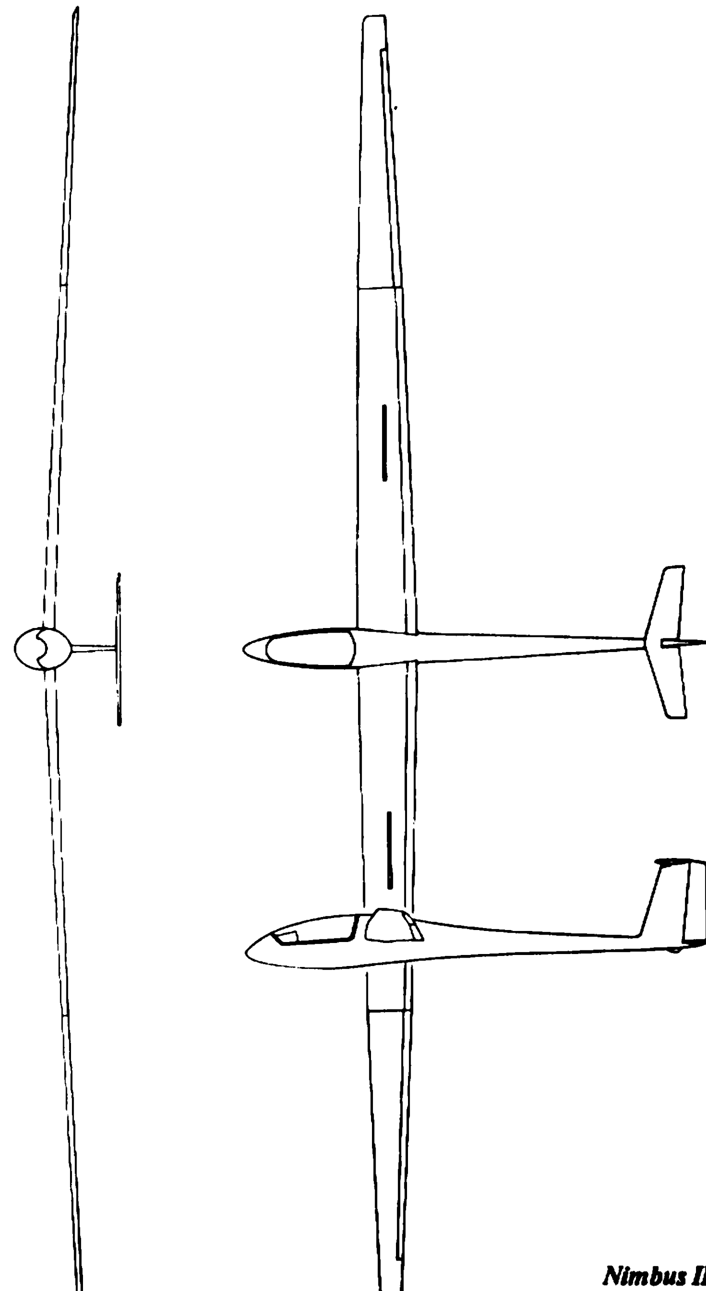
by A. J. SMITH

Don't misunderstand. The Schempp-Hirth Nimbus II *is a superior production sailplane. You could infer from parts of this report that it's something less. Don't. Read on. Generally, pilot reports on aircraft are poor and getting worse in the flood of new and revived aviation magazines. The old-standards attempts to compete produce some shoddy stuff, too. Everybody's looking for sensationalism, and facts are ignored. Errors occur in quantity. They're outnumbered only by cliches and attempts at funny analogies. Reader beware. This report could prove the point.*

Delivery problems

In January, 1972, John Ryan, the U.S. distributor, provided his new *Nimbus II* for a shakedown. It had been partially sorted out, but we really went to work blueprinting it. Interesting. There was a pronounced difference in the flap positions; the flaps were twisted; and the attachment of the wings to the fuselage was less than dead on. In addition to the other usual minor bugs, there was a strange, loud foghorn drone in the tail at high speeds. To work!

It was easy to adjust the well-designed push-rod system to eliminate flap twist and get the positions correct. This adjustment seemed to correct the minor lateral out-of-trim flight we had experienced. There was nothing we could do to correct the misalignment of the wings on the fuselage. Sad! Examination of the intersection of the horizontal and vertical



Nimbus II

tails revealed a cantilever cover over a wide gap, which probably was vibrating at high speed. Later filling of this gap apparently eliminated the foghorn.

Weight!

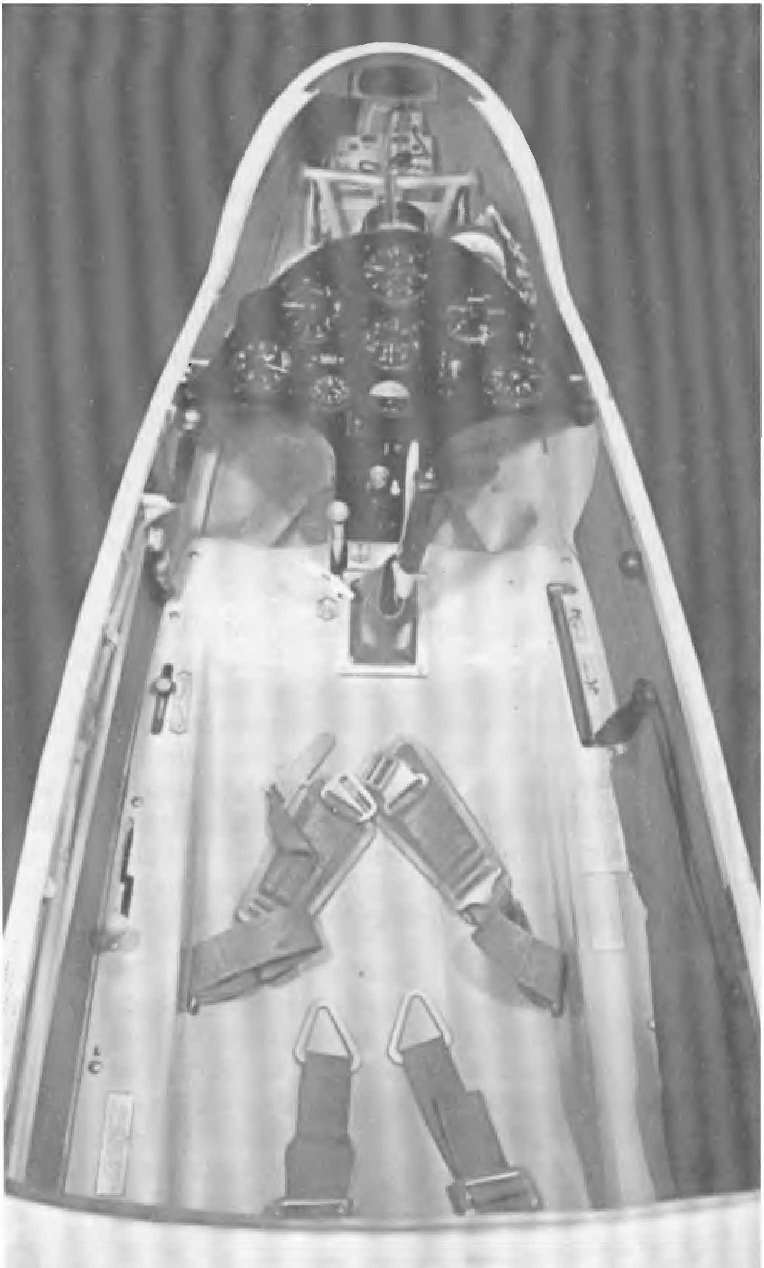
There wasn't time or equipment to weigh and check the general dimensions of the 20-meter machine, but it's interesting to note that the wings of my own machine were only slightly heavier than predicted by the builder. However, they were 186 lbs. for each inner wing panel, as opposed to the 165 mentioned in the recent article about the ships at Vrsac. The outer panels weighed 64 lbs., as opposed to the 50 lbs. mentioned in that same story. All is not lightness and light! The empty weight of my machine was 760 lbs. with minimum instruments. Its lightest weight, ready for competition was 1038 lbs. or 6.74 lbs. per sq. ft. With a full load of water, the wing loading was on the order of 8.7-plus lbs. per sq. ft. Heavy!

Flights over several days were satisfying. However, it was difficult to get good comparisons, because there were not other big Open Class machines available. The *Nimbus II*, at its low wing loading, seemed little better than the Open *Libelle* in glide, but spectacularly better in the climb. With the realization that the wing loading could be increased with water ballast by more than 2 lbs. per sq. ft. in strong weather, the outlook was promising. Klaus Holighaus, the designer-builder, was most helpful through this trial period with super-fast (one week/cycle) correspondence.

Generally the *Nimbus* systems work well. They're not particularly ingenious, perhaps not so sophisticated as Glasflügel's but they have a straightforward design that's appreciated. Things are simple and they work. The controls are where they should be, and the systems loads and control pressures are reasonable and balanced. You might not conclude the ship is light and sprightly, again perhaps like a Glasflügel, but it has a good, easy, solid character.

Handling

The big *Nimbus* has good, simple handling. After a short time in flight, not more than an hour, it seemed not much



Nimbus II cockpit

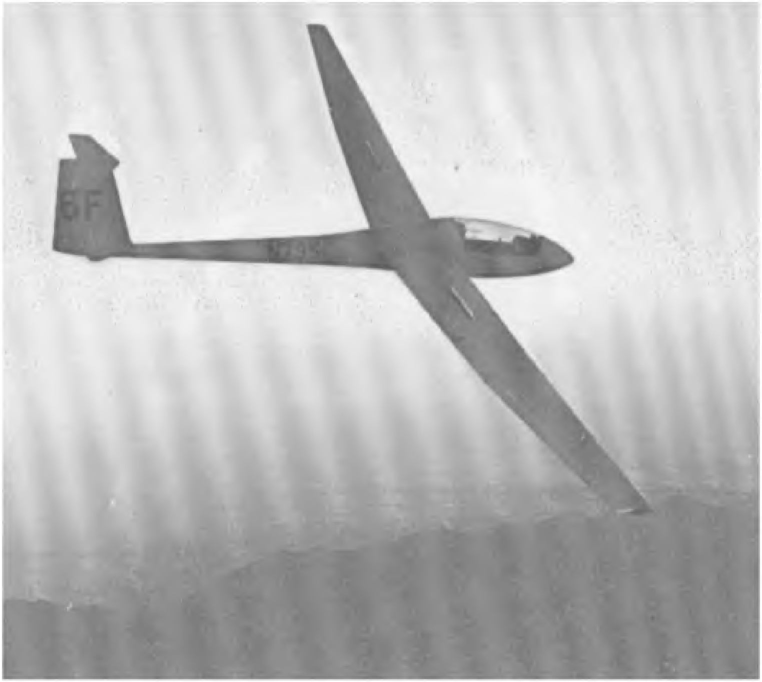
different in sensations and responses than the small Standard Class machines. Occasionally in some rolling turns it was apparent the large-span inertial effects and adverse yaw were slowing the response. But this wasn't often apparent. The *Nimbus* handled its full load of more than 300 lbs. of water well, and some interesting experiments with partial loads were begun.

With a half load of water–about 160 lbs–it seemed that after a short time in a slight skidding turn the overbanking tendency of the sailplane was diminished and that an extremely smooth, steady high rate of turn was achieved with minimal control deflections. It's difficult to describe how delightful this turning state was. And, most important, the rate of climb seemed improved.

Slip in turns

The results of the asymmetric lateral loading seemed to confirm the work done earlier in the year by NASA's Phillips and Blanchard. The technique contrasts with Holighaus's recommended slight slipping turn in thermaling. Holighaus's slip makes sense in that it increases the angle of attack of the inboard wing relative to the outboard. This could be particularly effective in a ship with the almost excessive dihedral of the *Nimbus*. However, two things should be noted: First, this slipping turn would dump a half load of water ballast down to the inside ends of the tanks and further increase the overbanking tendency of the machine. Secondly, in some flights in which I was able to outclimb Klaus in his *Nimbus* (once 1000 feet in a couple of thermals) I could notice as I went up over his back that he was using the rudder in those small rough thermals just like all the rest of us do! Additional work by NASA is certainly going to improve our knowledge in this mode. Meantime, you'll have to sort out the different techniques to your own satisfaction.

I made the decision to fly a *II* in the Internationals. Joe Lincoln made it possible to get one in time. We've lost count of the number of times Joe has done monumental things like this to make soaring easier and more enjoyable for all of us. He made a considerable sacrifice in this instance by trading delivery positions with me. His generosity assured



Nimbus II

that we would have competitive sailplanes for the Internationals in Yugoslavia. He's a good man!

Practice in Germany

Two weeks of practice in Germany before departure to Yugoslavia proved the *Nimbus* a super ship. But with problems. The practice sessions before the Internationals are always fascinating. The pace at the factories is frantic. New teams and old friends arrive every day. There's lots of man-to-man trying-out of machines, and this, together with the hectic activity of fitting out a ship for competition, makes a highly stimulated situation. Doing all this in the beautiful country around Kirchheim Teck makes for the best of life. You've got to try it.

My *Nimbus* was just off the assembly line, beautifully finished, and ready for the instrument panel and equipment we had built up here at home. We were flying it within one day and there were no really apparent problems. The sealing and clean-up campaign was started on the sailplane. The wing, the most important part, seemed to have the normal amount of production waviness. Klaus assured me this was not at all detrimental. All my experience told me otherwise, but I was slow to honor my own judgment. We learn.

There were frustrating problems with the individual dump valves in each of the water ballast tanks. One would leak and soon that tank would be empty. The tank in the other wing would still have its 150-plus lbs. of water. It created an overturning moment on the order of 1000 ft./lbs.. Trim drag was increased. Even after we got the valves repaired, we were never certain that they would reseal after dumping a partial load of water and that leaking might not quickly empty one tank. A more dependable system is necessary.

The first week in Germany went well and happily. The Schempp-Hirth workers were superb. The second week, however, started with discouraging comparison flights with the just-arrived AS-W 17. It immediately was apparent that the '17 was clearly better than the *Nimbus* in thermaling. Dick Johnson was able to put the big landing wheel of the '17 out and still climb up through the *Nimbus II*. He did this often and reported each incident to numerous people. The wheel doesn't degrade the performance all that much at low speed, but having it out as you climb through an opponent can be impressive to the uninitiated. The implication is unmistakable.

Wing loadings . . .

As a result of these flights, I desperately tried to sort out the wing loadings of the ships. Characteristically, though, no one seemed to know his wing loading. The '17 calculated at about 7.2 lbs. per sq. ft. according to the various weights quoted by Johnson (he later wrote 6.1 lbs. per sq. ft. in *Soaring*–February 1973). And so it was difficult, or perhaps impossible, to make valid conclusions about the relative performance of the ships. Particularly since the *Nimbus II* was always better than the '17 at higher speeds. Ah, but the plot thickens!

Holighaus agreed to make a comparison flight using my *Nimbus* against the '17. He arrived at the field late in the afternoon when the thermals had nearly died. The '17 and I, at what I hoped was the same wing loading, had been aloft for about four hours in an extremely heavy concentration of insects. Heavier than I'd ever seen before. Certainly heavier than any ever experienced here in the United States. Absolutely unbelievable. I landed to permit Klaus to make his comparison with the '17. While I was arranging for a towplane, he proceeded, against my most convincing speech and manner, to remove the bugs from the wing of the *Nimbus*. Remember, Johnson was still aloft with his full load of bugs. While I was away for a few minutes longer, Klaus even convinced one of our own team members to help him clean the wing. He sure has a winning way.

Finally Klaus was towed aloft and soon my crew chief was pointing out that he was dumping water ballast. Ah, the intrigue! The frustration! He then proceeded to do some inconclusive thermaling at very low altitude with the '17. If anything, the '17 was better.

Of course, you see the problem in all of the above. The '17 had a tremendous load of insects on the leading edge of the wing. The *Nimbus* had none. Probably the *Nimbus* was one-half to one pound per square foot lighter than the '17 according to which of Johnson's figures you believe. (I'm not convinced any of his figures are correct.) A fair comparison? Hardly.

The above incident is the same one reported in the January 1973 *Soaring* (without the above discrepancies) and the conclusion there would imply the difference was minimal. You would hardly draw the same conclusion. The difference, particularly taking into account the leading-edge disturbances and the different wing loadings, was clearly significant. Time to go to work again!

Leading edge roughness

The clues were apparent in the incident above. Clearly the *Nimbus* is more sensitive to leading-edge roughness and by implication probably to waviness also. We started to contour the wing and put more intense effort into the completion of other sealing and clean-up detailing. This work was carried on into the practice week in Yugoslavia. As soon as the contouring was started, it was obvious that the wing leading edge indeed could be improved. In addition to a rather large hump on the upper surface near the leading edge where the two wing shells are joined, there were other numerous closely-spaced waves in the first three or four inches of the upper surface. All of this was relatively easy to contour out. Intersections of wing components were reconciled and faired in. The butt end of the flap was sealed against the fuselage. A fillet was contemplated where none exists between the wing root and the fuselage. However, that job appeared monumental and was not attempted in the short time we had. It needs to be done. A taping technique was developed to produce a uniform minimal fillet in the 90-degree root intersection.

Perhaps the most effective modification seemed to be an ingenious but simple sealing of the horizontal tail. Stick and trim travel in pitch were immediately reduced. To a surprising degree. It's difficult to understand why the improvement was so pronounced. I'd like to go back now and take the seals off to see if the larger stick and trim movements return. Fascinating.

With all this work done and the practice session nearly complete, we were able to fly again against the '17.

Performance!

The *Nimbus* had responded well to the quick soup-up. Now it climbed through the '17. Now it was possible to put the *Nimbus* wheel down above the '17 and generally maintain the difference. However, the *Nimbus'* advantage was not as great as had been the '17's at the outset, and sometimes it was necessary to pull the wheel back in again quickly as the '17 came on up. These flights were done with a half load of water aboard the *Nimbus*, which seemed to assure a wing loading at least as great as the '17's if it had its maximum load aboard.

Conclusive results? Hardly. There are still too many things unknown. However, the improvement in the *Nimbus* was significant. It climbed as well or better than the '17 in smooth clean air and still maintained its advantage over the '17 at the highest speeds. In addition there was evidence of much further improvement possible with simple wing modifications. Further, remember, we had not contoured the bottom surface. And that's often the most important side.

Through all this, the '17 being compared was a factory ship, beautifully finished, immaculately prepared and, according to Johnson, 80 lbs. lighter than a production '17. If you think a factory ship or any carefully prepared competition machine is the same as a production model off the line, you are wrong. At the same time you can observe that my particular *Nimbus* came off the line in pretty good shape for a production job, responded to souping-up quickly without too much work, and was able to compare with a highly finished, ready-for-competition item. And at the end of all of this, as at the start, the *Nimbus* maintained its high-speed superiority.

The point of all of this? Perhaps the above results can be reversed and reversed again. It depends on the particular '17 and *Nimbus*, on the particular environment and wing loadings. Even more importantly, in thermals, on the pilots. Clearly the *Nimbus* is a superior machine. So is the '17! The *Nimbus* handling and wide range of wing loadings (considerably wider than the '17s) make it a great competition machine. It has a good competition record, and this is the ultimate measure of a machine.

Though various rules and regulations may make it less important in the future, it's interesting that the big *Nimbus* is a good instrument platform. It handled the heavy rain, icing, turbulence, and all the features of the violent Yugoslavian storms with ease. It's steady in the roughest stuff and, even with a loss of airspeed indication in that last contest flight, the ship was relatively easy to control up through the second big storm and on a straight run through the third and most turbulent storm of the flight.

Problems

The loss of instrumentation revealed detail problems. Some of the plumbing is nearly inaccessible. It's not easy to fix the location of water in the static systems. Even after removing the seat pan, access panels, and all that, it's still difficult to be certain the tubing is clear of water. The plumbing needs to be rearranged for better accessibility and to be provided with bypasses or alternate sources (owners' responsibility?).

The loss of airspeed indication certainly contributed to the last bad landing of the contest. It has been said before that the *Nimbus* is sensitive to leading-edge roughness. But that's true of all machines when you're talking about flight in rain. The light rain in our landing zone was sufficient to leave droplets standing on the wing and certainly increased the sinking speed. It's good to remember this and to check sinking and stalling conditions of such a burdened machine before the final approach. The high sinking speed resulting from this condition can destroy your approach plan and cause nasty landings.

That last landing had interesting results. First, the *Nimbus* fuselage structure failed in good sequence. This was a cartwheeling landing (probably in approximatley a 45-degree plane), and the fuselage failed progressively from rear to forward. The last major fracture was through the cockpit rails at about the pilot's shoulder position. The rear of the fuselage was destroyed. The forward undamaged. A lot of energy was absorbed by the fuselage. The wing was only slightly damaged. It's a large, heavy, strong structure that transfers overwhelming energy to the weaker parts of the ship. A good thing to remember. If you're really in trouble, a straight-ahead landing into a barrier might not be the best.

Second, small cockpit details were revealed in safety terms. The instrument panel, the instruments themselves, and battery packs need to be padded and isolated. These things do considerable damage to the pilot. Interesting, too, a good-looking padded headrest may conceal dangerous details. On this landing the pilot's head, on first impact, quartering to the front, went through the canopy with little damage because the mounting rails and quarter-inch steel canopy retaining rods bent at extreme angles (and the plastic broke) to absorb most of the energy. However, on the second impact, traveling backwards, the pilot's head was driven back into the headrest. Fortunately, dead on center. The leather cover and padding were driven back into the headrest and two steel mounting brackets, 1 x 1/8-inch plate and 5 or 6 inches long came slicing out through the front of the headrest. They made significant bruises on either side of the pilot's head and could have penetrated had the head been slightly turned. These detail revelations were quickly recognized and analyzed by the builders. Corrections are underway. We learn and benefit.

Future needs

Any other points? Yes. There's so much more we need to know about the performance of sailplanes. We won't know much more until we get information on them under controlled conditions and with accurate observations. Some good work has been started in that direction, and better work is coming. All of us will benefit. The designers will be able to do a more effective job of compromising all of the pertinent factors to arrive at the best competition machine. The pilots will be able to better utilize the machine in actual competition conditions. But until we have this better and more accurate information, we're likely to live with more and more unscientific pilot reports. Like this one, I suppose.

I'd rather have a complete set of accurate polars plotted for all the conditions of soaring flight.

Whatever your preference, whatever your machine, you should find a few items in this report to apply to your own efforts. Luck.

Best of luck,

14
COMPETITION FACE-OFF
AS-W 17 vs. Nimbus II

by GEORGE MOFFAT

In 1972 two new designs appeared that dominated the Open Class at Vrsac. If their success at Waikerie in 1974 is any example, they seem likely to continue their supremacy for some time to come. The two designs were produced by Klaus Holighaus and Gerhardt Waibel, two of the three students who ten years ago revolutionized soaring with the fabulous D-36. Having won the 1973 U.S. Nationals in the '17 and the 1974 Internationals in the Nimbus II, I now have considerable competition experience in both types and feel that a comparison might be interesting. These comments go beyond my rather superficial Vrsac impressions.

In general, in 1972, most pilots seemed to feel that the '17 had a slight performance edge over the less exotic looking Nimbus. This opinion was based in part on tests between Dick Johnson in the '17 and A. J. Smith in the Nimbus II, as well as a good deal of contest experience in Yugoslavia. Few realized at the time that Dick's borrowed ship was some seventy pounds lighter than the later production models. Then too, flying in Yugoslavia, with a high incidence of rain, tended to favor the '17 with its less critical wing section. In 1973 in Liberal, three of the four '17s entered finished 1-2-3 against a field of some ten Nimbuses—but none of the latter were flown by serious contenders. In Australia the better Nimbi seemed to have a noticable edge on all but one of the '17s. What had happened? What factors in the design and flight characteristics accounted for these performances?

ASW-17

First, let's consider the AS-W 17. Immediately one is struck by the sleek contours, beautiful lines and immaculate workmanship. In the air the remarkable maneuverability for so large a ship immediately becomes apparent. The older, 1962-design Wortman wing section does not suffer as much performance loss due to bugs or rain as does the 1967 section used on the Nimbus. However, to offset these strengths are a number of weaknesses that become apparent during a contest.

Certainly the first (or first-noticed) problem is the ship's great weight and difficult rigging. At 905 lbs. empty it is 150 lbs. heavier than the Nimbus, mostly in the inner wing panels. This weight, combined with the too-close fit of wing to fuselage, made rigging a near impossibility in hot weather until considerable fiberglass had been filed away. Unfortunately the heavy weight also interferes with the flexibility of performance. With a 200 lbs. load of water, the minimum wing loading is 7.1 lbs., compared to 6.1 for the Nimbus, giving the latter an edge in weak thermals. Conversely, the '17 carries only 240 lbs. of water for a maximum loading of 8.6. The Nimbus can be supplied with extra tanks to bring the loading to 9.3 for strong conditions, although these tanks created a bit of a rhubarb at Waikerie.

Another difficulty with the '17 results from the low and drooping wings. I found that even a stubble field was likely to produce ground loops due to a tip hitting the ground during a bump. The tendency is increased by lower surface dive brakes that hang some eight inches below the already low wing (the Nimbus has only upper-surface brakes and a much stiffer wing). Adding to landing difficulties is a wheel brake of hopelessly inadequate design. None of the brakes on the four '17s at Liberal ever really worked. Landing roll on a smooth surface is 1500, as half a ton of kinetic energy slowly dissipates and spectators scatter.

In the air, by far the most aggravating characteristic of the ship is its poor forward visibility. This is particularly frustrating in weak weather, when one wants to keep an eye on sailplanes out ahead. In the '17 they are in a blind spot—one that does not exist on the Nimbus. Poor downward visibility in the '17 can cost many seconds at turnpoints. I watched Hans-Werner Grosse take several tries at positioning himself over one turn in Australia, each attempt taking a twenty-degree bank with resulting loss of altitude due to slipping. I figured that I gained at least a minute on that one turn due to the excellent downward visibility of the Nimbus.

The last weak point of the '17 lies in cockpit design. Gerhardt Waibel designs strikingly beautiful ships of very high performance, but he seems uninterested in the ergonomic comfort of the occupant. Landing the '17 requires that one fly with the right hand and do the following things with the left: 1. Lower gear. 2. Select landing flap. 3. Operate the dive brake normally. On touchdown one (a) promptly releases the dive brake and (b) reaches for the flap lever to select full negative flap position to increase aileron effectiveness and ward off the threatened group loop, (c) drops flap lever and lunges for the wheel brake handle, which lives on the end of eight inches of springy wire. One then heaves mightily while nothing much happens. Small wonder that in Australia Hans-Werner got mixed up during roll-out and retracted the gear instead of applying the brake. While bouncing around on a rough off-field landing, actually connecting with all these operations is rather unlikely! On the Nimbus only dive brakes need operation by the left hand. The highly effective wheel brake is on the stick, all handy-like. Because of the stiffer wings and better aileron response, the ground loop propensities of the Nimbus II are mild, and the landing position of the flap need not be altered under most landing conditions.

In short, the '17 is a ship of superb performance but one in which the pilot is likely to lose contest points because of inadequacies in detail design. Herr Waibel claims these details are not of great significance, but the majority of the '17 pilots in Australia were planning on converting to the Nimbus at the earliest opportunity.

Nimbus II

Why has the Nimbus II, seemingly of slightly inferior performance—especially in climb—finally done so well more than two years after the design first appeared? Part of the secret lies in the fact that the ship is well built but relatively crude as it comes from the factory. The surfaces are good, but the wing- and flap-to-fuselage juncture is poor, no provision is made for exhausting vent air, and many other details of sealing need attention—more so than on the '17. Much of the reason for the difference probably results from the much higher labor rates at the Schempp-Hirth works and the realistic need to minimize man hours to produce a ship at a competitive price. In short, the Nimbus is an easy ship to clean up significantly, but very few people other than A. J. Smith did anything about it until 1974, and he did not have the time to undertake the more ambitious items. Another important factor, only learned in the Fall of 1973, was that the factory-recommended flap settings proved wrong by a large margin (see below in the Waikerie report). The handbook recommends six degrees for climb but ten degrees works far better. In run, the book recommends going to –4 at about 80 mph and –7 at 95. Actual tests showed 60-104 mph to be the proper range for –4 position. These discoveries, together with wing-root fairings worked out with the aid of Dr. 'Put' Putnam of Princeton's Forrestal Laboratory of Low Speed Aerodynamic Research, made significant differences. In Australia I found I could climb away from Dick Johnson's ASW-17 with ease, especially in weak weather, although Dick had always outclimbed the Nimbuses at Liberal in 1973. Even Hans-Werner's extended-wing '17 was not quite a match for my cleaned-up Nimbus. Interestingly, Ragot's '17—apparently fresh out of the factory crate—was the only one I had trouble out-climbing. Despite the performance, Ragot was looking forward to taking delivery of a Nimbus after the contest.

Since I could have flown either ship in Australia, what led me to choose the Nimbus over the '17? Highest on the list was the performance flexibility offered by the Nimbus's much wider range of wing loading. In fact we were never able to use the extremely heavy maximum loadings due to Committee prohibition on flying at significantly over normal gross weight. Tests at the heavier weights during practice showed the Nimbus to have superlative performance at gross weights of up to 1140 lbs. Secondly, I liked the practicality of the Nimbus, long a feature of Schempp-Hirth ships. Everything worked, the cockpit layout was good and the visibility outstanding. A third factor in my thinking was a long and close friendship with Klaus Holighaus, the designer, who offered much helpful data and advice during the preparation stages despite the fact that he was himself flying against me in Australia for the German team. Designers are all stubborn as mules–they couldn't be designers if they were not able to have an almost pathological belief in themselves–but Klaus has a considerably more creative and less defensive reaction to criticism that Gerhardt.

What next? I think that both ships badly need to be produced in Mark II versions. One imagines a ship with the maneuverability and basic climbing ability of the '17 combined with the practicality and flexibility of wing loading enjoyed by the Nimbus. There is no evidence at present that ships of significantly greater span will outperform the '17 and Nimbus II in contest conditions. I certainly feel that either of these ships would outperform the original, developmental Nimbus I with its 72-foot wings in all but the most extreme weather conditions, either weak or strong. Both the '17 and Nimbus II offer a glide ratio that has been measured at 48/1, combined with excellent handling and maneuverability. Each is the product of enormous thought on the part of what certainly must be not only the two most brilliant living designers, but designers who have been outstanding enough as pilots so that each has represented his country in World Championship competition.

The Open Class seems to be bumping into the farthest reaches of technological possibility with the AS-W 17 and Nimbus II. Although these two great sailplanes represent the current limits, the fact that either has shortcomings–possibilities for improvement, however slight–indicates the direction of continued progress and the assurance that even these ships will ultimately bow to the refinements of the future.

SAFETY

21. **Type Conversions**

The "flight test" approach

H. A. Torode

22. **Fiberglass Repair**

Some 'dos' and 'don'ts' for pilots

Fred Jiran

15
THEM THAT HAS
And them that's going to

by CARL HEROLD

My motivation for assembling the following accident and damage-survey article is to alert clubs, private owners, and rental pilots to the fact that there are two classes of pilots–those who have damaged a glider and those who are going to.

During seventeen years association with soaring, I have looked at the wreckage of at least 100 sailplanes and have damaged a sailplane three times myself. During the same period in the U.S. there were 20 fatalities, 20 to 40 injuries, and many near misses. I would like to offer my quantitative guesstimates of the damage ratio being experienced by various categories of pilots.

Soaring is safe

My purpose is not to show soaring is dangerous, but that as you mature in the sport you will want to do more with your glider–one direct result being that you are more likely to damage it. I would like to dispel the fantasy that you will never land off field, whether local soaring or on cross-country, or that you will never damage a glider. The chances are very low that you will get hurt or injure others, but quite good that you will damage a glider if you continue to participate. I believe your risk won't diminish until you have accumulated over 500 solo hours and 25 cross-country flights. One positive way in which you can, however, minimize the risk to the ship you are flying is to be conscious of the risk. Be conscious of–recognize and avoid–those tempting situations which have been demonstrated time and again to be unforgiving if you subject yourself to them often enough. Some examples might be poor pattern discipline, lack of respect for the hazards of ridge soaring, lack of staying current in type, excessive concentration on instruments, no preflight inspection or flight planning–and the conviction that you can occasionally defy the laws of gravity.

This chapter is organized into three sections. In the first I review my own flight history. I have then summarized both Pete Newgard's *(Herold's longtime soaring companion.–Ed.)* history and mine, particularly our cross-country and off-field landing experience. Finally, I have tabulated a list with my estimated damage ratio for several categories of pilots.

TABLE I: PERSONAL FLIGHT HISTORY (SOLO) OF CARL HEROLD

Year	Total Tows	Total Hrs.	X-C Tows	X-C Miles	Hrs./ Flight	Mi./ X-C	Glider
59	1	.3	–	–	.3	–	2-22
60	15	4	–	–	.27	–	TG-3
61	46	20	–	–	.44	–	1-26
62	61	30	–	–	.50	–	1-26
63	29	27	–	–	.94	–	1-26
64	104	171	18*	1525	1.66	85	Ka-6CR
65	122	232	39**	3202	1.90	82	Ka-6CR
66	115	237	32	3041	2.07	95	Ka-6CR
67	114	295	33	4165	2.58	127	Dart 17
68	76	233	35***	3220	3.07	92	HP-14
69	63	228	37	5208	3.62	141	HP-14
70	61	228	42	8163	3.75	192	AS-W 12†
71	52	171	33	4925	3.28	149	AS-W 12†
72	55	224	41	8135	4.05	194	AS-W 12†
73	41	154	34	5174	3.75	152	AS-W 12†
74*	34	128	28	5576	3.76	199	AS-W 12†
Totals → 16 yrs.	984	2382	372	52,334	2.42	140	

*x-c flt. #2, non contest–cut power lines, bent axle, blown tire, $50 materials, 10 hours work.

**x-c flt. #23, contest–busted gear and belly, $100 materials, 150 hours work.

***x-c flt. #130, non contest–bent wing, $700 materials, 400 hours work.

†Accident free flying.

TABLE II: PILOTS' FLIGHT HISTORY SUMMARY	PILOT C. Herold	P. Newgard
Years	1959-1970	1964-1970
Total Tows	792	487
Total Solo Hours	1705	930
Total Cross-Country Flights	236	134
Total Off-Field Landings	48	35
Ten Longest Flights Average (miles)	391.4	355.0
Total Cross-Country Miles	28,524	16,082
Off-Field Landings/Contest Tows	30/99	24/50
Off-Field Landings/Non-Contest Tows	18/137	11/84
Damage Ratio*		
Local Soaring	0/556	1/353
Non-Contest Cross-Country	2/137	0/84
Contest Cross-Country	1/99	1/50
Off-Field Damage Ratio	3/48**	1/35

*Neither Pilot has incurred injury.
**No damage for last 106 Cross-Country Flights, 16 were off-field.

TABLE III: MEAN DAMAGE RATIO SAMPLED AND/OR ESTIMATED DAMAGE PER TOWS

Category	Data	Mean	
I. Commercial Soaring Site			
A. Sky Sailing (Aggregate Local Soaring)	6/24,000	1/4,000	(S)
Rental Pilot (Including Dual)		1/10,000	(S)
Club Pilot (Including Dual)	3/750	1/250	(S)
Private Owner	2/2000	1/1,000	(S)
B. Truckee (P.O. & Club, Local Soaring)	3/300	1/100	(E)
II. Cross-Country			
A. Rental Pilot		1/25	(E)
B. Club		1/10	(E)
C. Private Owner			
1st 25 Cross-Country		1/15	(S)
26 plus Cross-Country		1/100	(S)
D. PaSCo Wave Camp			
Local Soaring	6/1500	1/250	(S)
Cross-Country	0/100	1/200	(S)
E. Regionals		1/50	(E)
F. U.S. Nationals	32/3061	1/96	(S)

(S)—Sample Data
(E)—Estimated Data

Table I is a tabulation of my logged solo flight history. You will note that I have had three glider landings (all off field) resulting in damage. For the purposes of this article, I have arbitrarily defined damage as being sufficient that the glider (or pilot) is unsafe for an immediate tow without repairs. This could include a blown tire, extensive fabric damage, bent axle, broken canopy or suspicion of structural damage. If the pilot decided that the damage was minor so that an immediate tow could be made, then I have excluded this as a damage statistic.

Table II gives a summary flight history for Pete Newgard and myself, including local soaring, contest and non-contest cross-country experience. The reader can analyze Table I and II and draw his own conclusions. Further analysis of my first year of cross-country flying shows that one-third of my flights ended as off-field landings. In 1970 only one-seventh non-contest cross-country flights were off-field and I still experienced 1:3 ratio for contest off-field landings. Each year my non-contest, cross-country, off-field landing ratio has constantly reduced. In Pete's case his off-field landing ratio started out at 1:2 and now his non-contest ratio is 1:10 while his contest ratio runs 1:7. For whatever reasons, our logged flight history shows we are risking our gliders in off-field landings less and less.

The reader may feel his own personal flight history is better than the foregoing, but they represent more time and miles than most pilots will accumulate in a lifetime of soaring, and though the sampling is small, I feel it has some basis for statistical significance. Other pilot flight histories I had solicited were not forthcoming, and I felt the sooner I got started the better.

Insurance

In my case, my three damages cost me a total of $900 and 700 hours of personal repair work. I estimate the cost would have been over $5000 if I had a professional shop do the work. (Pete's repair work amounted to about $600 and 100 hours.) Thus, averaged over the eight years of owning a sailplane, I have spent an average of S115 and 100 hours of labor per year. This does not include maintenance and drag reduction work which cost me on the average at least the same hours. I did pay hull insurance during my first two years of cross-country flying and did not make a claim. For my AS-W 12 my premium for hull insurance would be nominally $440 per year with $500 deductible. At this premium rate, I still prefer to insure myself. I do strongly recommend carrying hull insurance for the first several years of contest and non-contest flying, however. I think any partnership must include hull insurance and that all club gliders must be insured to protect the investment of the members, particularly in view of the poor damage ratio that clubs experience.

Table III represents my estimate of damage per number of tows for the several categories I have arbitrarily selected. For the Sky Sailing data I made estimates after a short review with the owner and operator. For Truckee I have just made an educated guess of 300 tows in the last year for local soaring. I suspect my estimate is not off by a factor of two. For the club pilot and private owner this is again just my estimate which I also feel is not off by more than a factor of two. If I have erred in my estimates, I have done so in the direction of a lower damage rate.

Referring to part two of Table III, I have made estimates of the damage ratio for cross-country flying. For the rental pilot, the club pilot, and the Regional contests I have just estimated. For the other categories I have based the estimates on actual flight data.

Based on the foregoing data and estimates, I would like to summarize several points:

1) The rental pilot has the best damage ratio for several reasons. He is under more direct supervision and control than the club pilot or the private owner. He is generally flying gliders and in conditions he is more qualified to fly. He is more likely flying at training sites which have more favorable weather, terrain, and density altitude. Even though this pilot will usually be of low proficiency and will experience a large number of near misses, the forgiving nature of the sailplane he is restricted to fly will frequently save the pilot and glider from damage. Furthermore, he will more consistently follow the rules than do his own thing, creating problems he is not able to solve. He is still more likely to fly a proper pattern,

leave the ridge with sufficient altitude margin, and still be waiting for his self confidence to improve.

2) The clubs have a different problem. They generally exercise less control over their pilots. Let's face it, the pilots (who are part owners) influence the rules. This class of pilot is generally further removed from his flight training, flies less hours per year, and has more opportunities to fly higher performance equipment on the days he wants to fly—not when the instructor says he had the ability for the ship and conditions.

3) The local-soaring private owner experiences a higher damage rate mainly because it is at the training sites that he introduces himself into less-forgiving sailplanes requiring skill and proficiency he has yet to develop. In addition, the private owner is under less supervision than the club pilot, but he will build his proficiency more rapidly, finishing transition sooner, both in elapsed time and number of tows.

4) To date, in Northern California, the towplanes and tow pilots have an excellent safety record. I know of no sailplane damage due to tow pilot and towplane failure in the last nine years. I would guess this represents over 150,000 tows. Towplanes have been damaged but they have not damaged gliders.

5) In this same nine-year period, we northern Californians have had three fatalities, two on a ridge and one unexplained. In addition we have had, to my knowledge, eight persons injured in local soaring accidents and one injured while on cross-country. Four of these were ridge soaring.

6) I estimate chances of damage are four to ten times higher for the first 25 cross-country flights. In my opinion, club and rental pilots will always stay in this category for numerous reasons. I wonder if non-cross-country members should be underwriting the insurance premiums and low utilization achieved from the club cross-country glider. This, of course, depends upon the objectives and interest of club members.

7) For the U.S. Nationals over the past seven years I obtained a damage ratio of 1:96. However, if you remove the names of pilots flying their first Nationals, this ratio drops to

somewhere around 1:250. I would suspect this 1:250 ratio would also exist for cross-country pilots with more than 25 cross-country flights in a Regional also. The damage ratio could be expected to be higher for a Regional with the reduced entry requirements–including a higher percentage of pilots of low cross-country proficiency, some quite willing to defy the laws of gravity. These pilots get the message by the time they reach the Nationals, but not always. Analysis of contest data shows one clear result: pilots who take many risks don't win, place, or show; they just keep repairing their gliders until they either get discouraged and drop out of contest flying or get the message.

Are you a statistic?

I don't doubt there will be readers with much logged glider flight time who have yet to ding a ship, but for each of them I am sure there are many more who have. You might not be average and therefore can lie (no pun intended) on either side of my estimates. But remember it will only take one accident to move you over to the other side. I have attempted to present the damage ratio data as tentative actuarial data.

There are many related questions I would like to be able to answer in addition to firming up the numbers I have provided. For instance, what is the average dollar value of the damage for the various categories I have shown in Table III? It would be insteresting to see how the varying utilization per year for each of the categories affects the annual damage rate. Recall that hull insurance premiums are not based on a per-flight exposure rate, but only on sailplane cost and minimum pilot requirements for private owner, club, and commercial uses. Just because the damage rate is higher for club cross-country flights, their considerable lower number of annual exposures might mean that the club glider still gets clobbered more times per year in local soaring. I have not broken the data down into flight hour increments, but my guess is that a 200-hour local soaring pilot is a poorer risk than a 500-hour pilot with 25 cross-country flights logged. In my book, previous experience as a power pilot, whether private SEL or ATR, is a handicap to your damage ratio. I am a 700-hour power pilot and I still believe it.

It would also be interesting to total the other types of damage sources such as hangar rash, rig/derig damage, trailering damage, midair collision damage, etc.

16
SWINGS AND ROUNDABOUTS
Safer crosswind takeoffs and landings

by DEREK PIGGOTT

An accident at Lasham has emphasized the personal responsibility which rests on every pilot of a glider just prior to being launched.

On the day in question a Nimbus 2 was starting on a car launch when it swung off and groundlooped into a K-8 about 150 yards ahead of the launch point and a short distance to the side of the runway edge. The Nimbus pilot, realizing that the take-off would involve an element of risk, had in fact asked for the K-8 to be moved. When this had been done for a short distance, the situation was accepted rather than cause further delay by still refusing to be launched. The Nimbus was undamaged, but the K-8 had one wing amputated at about half-span as well as other serious damage.

Later that day an identical situation arose at the aerotow point, when a Kestrel pilot was preparing to be launched with an obstruction about 100 yards ahead and not far to one side. In both cases the wind strength was about 5 to 10 kts. and almost at right angles to the take-off direction. The accident caused considerable consternation, and many pilots obviously did not understand the factors involved that influence gliders during takeoff and landing. They do not all behave as well as most training gliders and it is vital to understand the differences.

The most important point is that, regardless of who may be at the launch point, and however inexperienced the pilot may be, it is *he* who bears the responsibility for accepting or rejecting the launch in the light of the situation as he sees it from the cockpit. If he has the slightest doubt about his ability to launch safely, bearing in mind such hazards as a positively sideways swing or a cable break at any stage, then he must refuse the launch. He must not be influenced against his judgement to go ahead in a doubtful situation and must never be criticized for playing safe by refusing the launch.

If a cable break could result in part of the cable landing on or close to a glider in mid-field, then it is not safe to launch. Sooner or later, if such a risk is accepted, the cable will break at the wrong moment and an accident will occur. The pilot who takes a chance is always to blame if he creates a hazard that was unnecessary.

Furthermore, if anyone at the launch point sees any reason to think that the pilot has not seen or understood a potential danger, then it is his or her *duty* to stop the launch. This particular accident, although the ultimate responsibility of the Nimbus pilot, would never have happened if only one of the dozen or more competent pilots at the launch point had cared enough to shout STOP! To say that it was not their business to stop the launch is not good enough. Safety is everybody's business.

Crosswind effects

The main effects of a crosswind on the ground run are well known. The wind tends to lift the upwind wing and the glider always tends to swing, or weathercock, into the wind. Inexperienced pilots often find it difficult to remember, or to work out quickly, the control movements required to keep going straight. But once the wind direction is known it is easy–it is always the into-wind wing which must be held down (by moving the stick slightly into wind), and it is always necessary to rudder *out* of wind. This applies during any crosswind takeoff, it applies equally for crosswind landings whether the into-wind wing down or crabbing method is used.

Light crosswinds, in particular those with a slight downwind component, provide by far the most treacherous conditions for take-offs and landings. Due to the crosswind there is the tendency for the glider to start a swing, while due to the down-wind component there is a delay before the controls can become effective, during which the ground speed has increased and accentuated the effects of inertia. So *prevention* is far better than *cure*, and the wingtip holder should always be on the *downwind* side so that any pull he may exert is anti-swing into wind. This is contrary to usual practice. He should also hold his wing tip a little above the horizontal and be prepared to *run* with it, not just balance it and let go. The pilot himself can help by anticipating a swing into wind and by applying opposite rudder before he starts to roll, also by holding the stick back to increase the tail load. As the controls begin to become effective the opposite rudder can be reduced and the tail raised long before full flying speed has been reached.

Strong crosswinds

Unless the wind is more than about 60° to the direction of take-off a strong crosswind seldom creates problems. This is because good control is reached at a much lower ground speed, and inertia effects are relatively minor. However, with stronger winds the tendency to wing into wind is far more pronounced, and at low speed cannot always be controlled by opposite rudder. In this case, again, the wingtip holder should be on the *downwind* side and should hold his wingtip well above the horizontal to prevent the wind getting under the upwind wingtip. Provided that there is normal acceleration on take-off, the pilot should have good aileron control, and be able to hold off any windward swing by means of the rudder, shortly after the wingtip holder has let go.

Of course there is a definite limit to the strength of crosswind component that can be accepted with some of the modern gliders. The main preventive measure is to leave plenty of room on *both* sides of the takeoff path to allow for a possible swing. Room must be left into wind, particularly for the case of a cable break, but there must also be room on the downwind side for a swing that might occur if the turning tip should touch the ground. If the ground is rough or the grass long, a violent swing will occur and the launch will almost certainly have to be abandoned.

Stabilizing effect

On take-off, the pull of the tow rope exerts a stabilizing effect and helps to prevent swinging, but how much effect this can have is dependent on the position of the tow release. A nose hook for aerotowing can be a very useful asset in crosswind conditions. In strong crosswinds, it is often an advantage to start the take-off run a little on the upwind side of the tug aircraft so that the load in the rope is already helping to prevent a swing into the wind.

If the cable breaks during the take-off run there is a real risk that the pilot will be unable to prevent the glider from weathercocking into the wind and running into any obstruction on the upwind side of the take-off path. Always consider the possibility of a break during the ground run, as well as what should be done in the case of a break later during the launch.

Weathercocking

In flight the directional, or weathercock, stability is assured by the existence of the fin and rudder which provide more side area behind the C of G than ahead of it. Thus, with aileron and rudder held central, the glider will always weathercock into line with the relative airflow, just as a (church) wind vane will always swing directly into wind. When rudder is applied, the nose of the glider yaws until the force produced by the rudder is balanced by the tendency of the aircraft to swing back into line with the airflow.

If the aircraft is very stable because of a large fin, the rudder will not be able to produce a large angle of yaw before this balance occurs. With a smaller fin the directional stability will be less, the rudder will be more effective and the angle of yaw far greater. Now when the glider is on the ground it moves not about its C of G, as in flight, but about its point of contact with the ground. If the wheel is well ahead of the C of G the glider will have a greater tendency to weathercock and rudder power will be less. Conversely, if the wheel is behind the C of G directional control will be much better.

All modern gliders fitted with retractable wheels, also many others including the K-6 and Olympia 463 series, have their landing wheel well ahead of the C of G, and when stationary or at low speeds the tail skid or tail wheel is resting firmly on the ground. Another key factor is that the position of the wheel also affects the behavior of the glider once a swing has begun. The swing will be increased by the inertia of the glider. Any tendency to swing will therefore be increased by the mass of the glider behind the C of G trying to move on in a steady direction, thus accentuating the swing and making it even worse.

Sliding sideways

A swing can only occur if the tail is sliding sideways over the ground, and a tail wheel with a rubber tyre will resist skidding sideways over tarmac, though it will not be so good if it is bouncing over rough grass. On the other hand, a metal tail skid, or a metal or nylon tail wheel, will easily slip sideways on tarmac, but is better on grass or earth.

Any extra load on the tail will help to increase its resistance to moving sideways and so help to prevent a serious swing. On the other hand, the friction of a tail skid will make intentional steering more difficult unless the tail load is reduced. It is, therefore, helpful to hold the stick back on these gliders during the early part of the ground run until sufficient speed has been reached to ensure good rudder control. Similarly, after landing the stick should be held right back to increase the tail load if there seems any risk of a swing developing.

Wheel brake

Many violent swings and ground loops during landings occur because of the use of the wheel brake after touch down. If the brake is powerful, the effect is to reduce the load on the tail and it can then slip sideways more easily. The effect of rapid deceleration is even more significant. Unless the glider is running absolutely straight, the deceleration increases the effect of the mass behind the C of G and so accelerates the swing. Violent braking in modern gliders should always be avoided, especially if they start to swing.

Swings often start after a touchdown with drift, and it is useful to remember that a slight over-correction for drift in crosswind, will produce a small swing contrary to the main weathercocking action. Therefore it is better to overdo the correction.

The possibility of an uncontrollable swing depends on the type of glider and the wind conditions. Special care is essential with gliders that have the main wheel ahead of the C of G, since they will be unstable once a swing has been started. If the surface offers low resistance to the tail wheel or tail skid slipping sideways, it will help to prevent a swing by keeping the tail firmly on the ground at low speeds.

Anticipation

Crosswind takeoffs should be started with full rudder applied in anticipation of the tendency to swing into wind. The glider should be held by the *downwind* wingtip with the into-wind wing below the horizontal position. This will help to prevent any swing into wind and ensures that if the wingtip man does drag the wing, the aircraft is always swung out of wind.

Leave ample room for swinging into wind and always bear in mind that the cable may break during the take-off roll so that the glider may swing into any obstruction on the upwind side, even though it is several hundred yards ahead of the launch point. In light winds, leave ample room for the possibility of a ground loop in either direction. Avoid fierce braking after landing, particularly if the glider is turning at the time.

Above all, remember that it is the very light wind conditions that are the most critical. Do not be tempted to take off or land near obstructions or other gliders in these seemingly easy conditions.

Finally, if you ever do ground loop, make sure that it is only your own machine that can be damaged. Inspect the glider very carefully. With the modern types the loads on the rear fuselage can be very high. Almost invisible hair line cracks in glass-fibre machines may look very much like minor cracks in the paint finish. They could result in a complete fuselage failure on a subsequent flight. Judging from some of this kind of damage brought to light on C of A inspections, there may be a number of pilots flying dangerously unserviceable machines all over the world.

17 APPROACH CONTROL

Devices for terminal energy management

by RAY STAFFORD ALLEN

In the beginning, gliders were slow, had fairly steep gliding angles, and could be side-slipped by the pilots (usually intentionally). Consequently, getting the thing down on to a given spot was not very difficult.

However, gliders began to get more and more efficient and the gliding angles became shallower and shallower, so that a very small error in speed or height could completely muck up an approach. In addition, as they became cleaner, they became more and more difficult to side-slip, owing to the strong directional stability which made the machine turn into the slip. Pilots began to demand some sort of control to make the last bit of the approach simpler and safer.

The first device to appear was the spoiler. (There was a story that Mungo Buxton in fact made a split rudder on one design so that when the pilot pressed hard with both feet, the rudder opened up into a sort of Vee shape. Mechanically simple, but apparently the drag produced was disappointing.)

Spoilers

Most pilots must be familiar with the spoiler, from their training days in two seaters. The device consists of plates in each wing which can be raised so as to stand 'normal' to the top surface of the wing. They are usually fixed so that the forward edge, where the hinge lies, is at about the thickest part of the wing. When the pilot operates the control, the plates stand up normal to the surface of the wing, and the effect is to detach the airflow from the top surface of the wing over that part of the wing which is downstream of the plate. Since the total lift of the wing must still equal the total weight, disregarding any contributions made by the other bits of the glider, the rest of the wing has to make up the difference.

In effect, therefore, you have reduced the aspect ratio of the wing, and have increased the induced drag. Since the induced drag of the wing is small at high speeds, the spoiler is not very effective at high speeds, as most of us have found out, but it is a jolly good control for steepening the glide at low speeds.

A further point in favor of spoilers is that when operated, they usually produce a 'nose down' change of trim and this is a positive advantage in a training glider, because pulling out the spoilers tends to make the speed increase rather than decrease. The effectiveness of a spoiler depends to a large extent on how far forward on the wing the thing is fixed. The further forward, the more effective.

For many years, spoilers were the standard form of glide control but, shortly before the war (the Hitler fracas, not the Kaiser punch up), pilots started to go into large clouds, and climb in them to great heights. Several people had some rather hair-raising experiences in these clouds when they found the speeds getting out of hand. Pulling out the spoilers did not do much good in holding the speed down, and folk began to ask for something a bit better.

Brakes

The answer was brakes. The basic idea of these devices is that they produce enough drag at high speeds as well as at low, to hold the speed of the glider down to below its V_{NE}, whatever its attitude, even in a vertical dive. Equipped with these things, pilots felt that they could safely venture into large clouds with the knowledge that, if things got a bit hairy, they could open the brakes, sit back and watch the instruments go haywire, knowing that the speed could not exceed the V_{NE}. This was all very nice, except that one or two people came back with stories that they found that ice had made it impossible to open the brakes just when they needed them! However, in spite of these horror stories, brakes have been with us now for many years, and most people seem to have been pretty satisfied with them.

There are three basic types of brake. The most popular type seems to be the scissor brakes as fitted on many types. They are very effective, but like everything else in this world, you do not get something for nothing. The main snag is that there is a very strong opening force on the brakes, and this requires an over-center lock to keep the brakes in when they are not required. The pilot finds when he unlocks the brakes there is a strong force to be opposed on the lever, tending to open the brakes. This is just the opposite from what he has been used to in his training glider fitted with spoilers. In that machine he had to hold the spoilers open; now he has to oppose the tendency of the brakes to fly open as soon as he has unlocked them.

The second type of brake is the type where the brake paddles are hinged in the wing and swing up forward and down backward, on the top and bottom surfaces of the wing respectively. By careful arrangement of the hinge points, the two surfaces can be made, more or less, to balance each other though the accent should perhaps be on the more or less. The paddles when open stand off the wing, unlike spoilers, and they produce a great deal of drag at high speeds as well as at low. They are mechanically more complex than the scissor type of brake. It is virtually impossible to arrange the leverage so that they do not produce the same sucking out tendency as the scissor brakes, though it is true that the forces can be made rather smaller. However, this type has never become really popular, perhaps because of the complicated machinery required.

The third type of brake, which is not very often seen, is the 'dragon's teeth' type of brake as fitted on the M-100s. In this type the brake is formed by a series of small elements which hinge out of the top and bottom surface of the wing. In fact when opened they stand out of the wing like a row of teeth. They can of course be made as large as you like, so they can produce as much drag as you like, and the operating forces can be kept reasonably low, but the mechanical arrangement of this system is undoubtedly rather complicated and they never seem to have caught on to any degree.

However, brakes made the business of getting into a small field very simple, the problem became exactly the same as that facing the power pilot making a precautionary landing. The latter had always been trained to approach into his field, keeping the speed steady with the elevator, and to control his rate of descent by the amount of throttle. The glider pilot now had the same ability except that instead of using the throttle he used the brake lever. The problem is in fact simplified for the glider pilot because the response to changes in brake setting are more or less instantaneous while the power pilot has a definite lag to the throttle change.

It may well be argued that this same technique of 'speed steady with the stick and rate of descent on the brake' can equally well be employed when using spoilers. There is some truth in this, but the big difference lies in the fact that if the speed is inadvertently allowed to rise during the approach, the spoilers lose a lot of the effectiveness. Brakes do not suffer from this loss of effectiveness, and the approach is therefore much simplified.

Like spoilers, brakes are more effective the nearer they are to the leading edge of the wing. If you fit them way back on the wing, they seem to operate in the wake of the wing rather than in undisturbed air up near the leading edge. This of course leads to problems on the hotter types of gliders, since this is exactly where you do not want the wing surface to be messed about with gaps, slots and ill-fitting bits of brakery. In addition, air tries to leak through from the bottom surface to the top, and if it manages to do so, it produces a lot of drag by spoiling the laminar flow just at the very point where you do not want it to be spoilt. Brakes, therefore, are not an unmitigated blessing and much midnight oil has been burnt trying to think up better ways of doing the same thing.

Flaps

One solution to this is to fit braking flaps. All the things that we have considered so far, spoilers and brakes, reduce the lift over the portion of the wing across which they act, and this means that the stalling speed increases. In fact the increase is not very large, but it can be enough to make a very heavy landing, if they are operated carelessly.

Flaps on the other hand increase the lift, and therefore they reduce the stalling speed, and this is an added bonus. Unlike powered aircraft, gliders do not need flaps to reduce the stalling speed for landing; the stalling speed is normally quite acceptably low. However, a reduction is welcome provided that there are no control difficulties. The usual type of flap that is employed is the plain flap, in which a piece of the trailing edge of the wing can be hinged downwards. The first bit of the downward travel produces a sharp increase in the lift of the wing, but beyond a certain point, probably around the 30° mark, the lift increase with further flap movement is small, but the drag increase becomes larger and larger. Many gliders have been fitted with flaps which come down to slightly more than 90° in the full down position and the drag increase at this setting is very large. The approach is very steep and pleasantly slow. However, the round out at the bottom is rather sharp and, in view of the high drag, there is virtually no float. Thus, the round out has got to be rather nicely timed or the arrival is a bit sudden. Coming in with excess speed does not really help since it makes the approach steeper still and makes the 'corner' to be negotiated at the bottom even sharper. The flaps cannot be used in the same way as brakes–that is, adjusting the amount required all the way down to control the rate of descent–because they do not simply affect the drag of the glider but affect the lift as well. Putting the flaps in to stretch the glide is liable to result in a pronounced sink before the glider flattens out its glide. This may be enough to defeat the object of taking off flap. Another snag is that flaps do need a large force to operate them, particularly at high speed, and if they are to be relied upon as speed limiting devices, the designer usually has some headaches to provide a suitable means of operating them at high speed. A top surface 'aerodynamic balance' can help here.

They have got some considerable advantages though. First, you do not have to cut holes in the wings to get brakes into them, and this has great advantages, both aerodynamically and structurally. The flaps are also useful not only for the approach but to enable the pilot to alter the characteristics of the wing for slow flight. This means that he can use a small amount of flap for thermal circling at low speed and then raise the flaps to give a low-drag wing for high speed flight. Many of the really hot gliders these days use flaps in any case to give them advantages of being able to set the wing to the optimum configuration for every speed.

Tail parachutes

The latest device to appear for controlling the glider approach is the tail parachute. This is normally stowed in the bottom of the rudder, or in the bottom of the fuselage below the rudder, and can be deployed by a control from the cockpit. There is a second control which jettisons the parachute. Of course the arrangement does mean that you can have a clean wing with no holes for brakes, and you do not even need to fit hinges for flaps, so the wing can be as clean as you like. However, the system is not without its snags. Parachutes in the tail are not yet 100% reliable, though they are pretty good and are getting better. If they get wet, and particularly get wet and then frozen, they are not to be relied on at all.

If they are to be used as a speed limiting device in the event of loss of control in cloud then they clearly have severe limitations. If the thing is deployed in cloud to hold the speed down, then either it has to be jettisoned after emergence from cloud, in which case there are obvious landing difficulties, or else, if the parachute is not jettisoned, the pilot will have to land at once. In any case there is no means of controlling the amount of drag that the thing produces; it is all or nothing, and this does mean that it demands a rather higher standard of pilotage than usual. It is this 'all or nothing' aspect that has caused the Technical Committee to have reservations about giving a cloud flying category to gliders which rely upon one tail parachute*

---

*See "Dunderhead's Thunderhead" (Chapter 19) though it has said that it would review this attitude if the glider were equipped with two separate parachutes, and that it could be sure that if one parachute were used and jettisoned, there would still be a perfectly good parachute for the approach and landing.

Summary

To recap—what have we got? Brakes are excellent, but have certain performance snags on very hot ships. Spoilers do not limit the speed so are not good enough for today's gliders. Braking flaps have many advantages, but they demand a higher standard of piloting and there are difficulties in getting then down at high speeds. Parachutes in the tail have a lot to recommend them, but they must be made 100% reliable and, preferably, there should be at least two separate parachutes.

18
H.E.L.P.
High energy landing problems

by JOHN WILLIAMSON

By the end of 1972 there were 112 modern fiberglass sailplanes registered with the BGA. Common characteristics of all these sailplanes are their German origin, and, stemming from the German airworthiness requirements, air-brakes considerably less effective than those enjoyed by British and Polish aircraft. And of course, they are exceedingly slippery.

First of the proud owners of these new expensive ships were the competition crowd. Bright-eyed and bushy-tailed, they leapt into the air secure in the knowledge of hundreds of safe flying hours in the log book. But soon the problems associated with the high energy potential of the new generation ships began to show.

In 1971-72 there were 20 reported accidents to fiberglass birds in the UK. Ten of them can be attributed primarily to the HELP! factor. In all ten the pilot was very experienced and (except one) previously accident-free. The sorry tale is told in greater detail in the Appendix to this paper.

Ten HELP! prangs in two years, given upwards of 100 glass sailplanes flown by perhaps 500 pilots, may not sound much but it could become a serious and expensive problem very quickly. The normal trend of sailplane ownership is for the latest and greatest of yesterday to become the commonplace of tomorrow and to be discarded down the pilot-ability scale and soon indeed to be bought brand-new as the first aircraft of a new and hopeful syndicate. If ten pilots averaging 875 hours experience can do it, just imagine what the next 50 or so pilots of lesser talent could achieve!

Common Thread

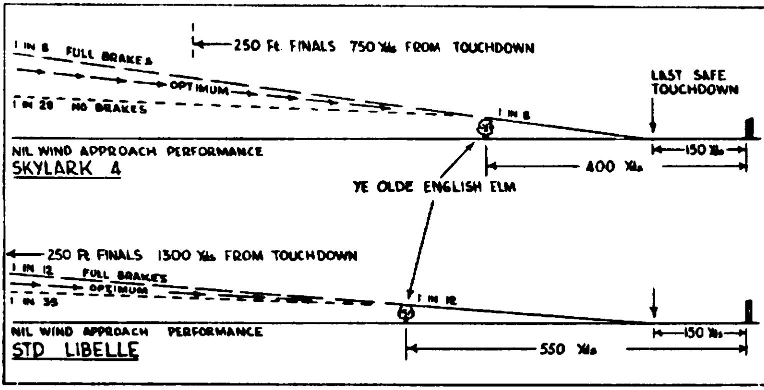
The pattern of the ten subject accidents has a common thread—a badly judged circuit. The aircraft was at the wrong height or speed at the wrong place. Theirs was to do or die—ours is to reason why. Being very experienced, it may be assumed that the ten pilots were trained ten or more years ago and subsequently molded their flying patterns in such aircraft as Olympias, Skylarks and K-6s. In these aircraft they were safe. In fiberglass they slipped. The critical links between the types of aircraft and the cause of the accidents are the types of air-brakes and the high cruising speeds of the fiberglass class.

Air Brakes

Maximum-area laminar flow is the secret of the slippery ship. To enhance his chance of achieving this, the designer has put his airbrakes farther and farther back in slimmer and slimmer wings—or has left them out altogether. So at best one has a pair of small-area paddles above and below the wing; possibly a single paddle, upper surface only; or a pop-it and drop-it drag 'chute.

Guesstimation of the comparative effectiveness of typical fiberglass brakes is illustrated in the diagram on the next page. The Std Libelle, at 50 knots with full brakes in zero wind, achieves a glide ratio of about 12:1. A Skylark 4 similarly placed is 8:1. To approach thus over a typical English elm tree and to arrive safely before the far hedge claims him the Skylark pilot needs about 450 yards of field.

The Libelle man will be hard pushed with less than 600 yards. But the Skylark could be brought in a bit steeper after clearing the tree, thus creating extra drag in useful quantities. The Libelle would also speed up, but the drag increment would be proportionately less and the resultant float in ground-effect would leave her pretty close to the original 600 yard mark. All in all, what was good for the Skylark is not so good for the Libelle and habits die hard.

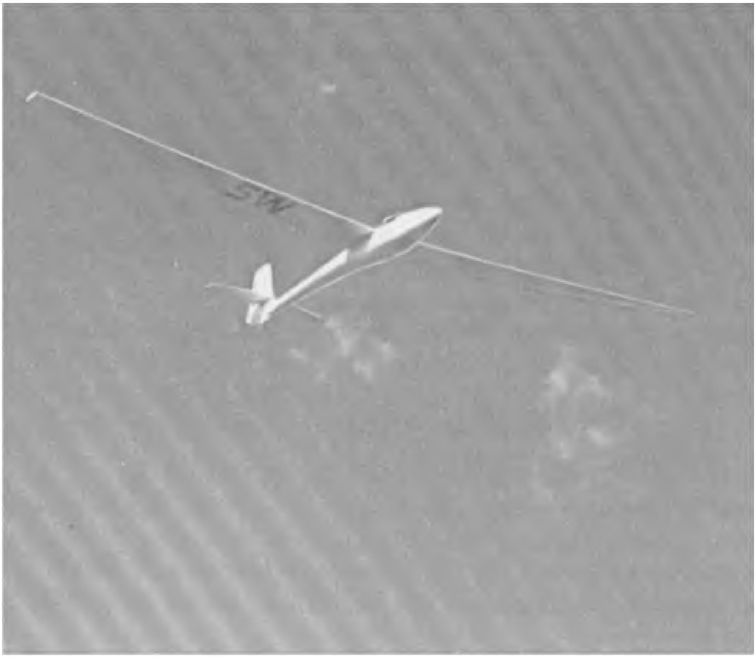


The next problem facing the unconverted is the high cruising speed of the glass-ships. A Skylark in pre-circuit flight is doing about 40 kts. The conscientious (and safe) pilot trims forward, adds five knots or so downwind, another five knots crosswind plus half the windspeed and a bit for Mum and the kids. By now he is doing 55-60 knots, hand on the brakes and preparing to descent into his chosen pasture at a glide ratio of, say, 6:1. Trained assiduously to fly by attitude, his eyes are fixed on the field ahead and NOT (ever) the ASI.

Now put him in the Libelle. His best-glide speed is over 50 knots already and he has become accustomed to this during several hours of soaring flight. He will do the Skylark drill through sheer habit; will change *attitude* rather than speed and will be startled to find himself swinging wide on finals at a previously unobserved speed that can be as much as 80 knots . . . HELP!

Problem . . . remedy

Pinpointing the problem is one thing. Finding a remedy is another, but the remedy must lie in training. Clearly the pilot must first get used to the effect of his new mini-brakes on approach glide paths and therefore on his circuit pattern in a wide range of wind speeds. Starting with the zero-wind case, and assuming half brake, he will have to be nearly one *mile* from touchdown at 300 feet! Try that on an *ab-initio* pilot. His reaction will be one of complete trust and to him it



UVEGES

Fast and slippery . . . HELP!

would easily become the norm. Try it on one of your newly solo pilots and he will be perplexed.

But it is the sort of thing he will have to get used to before he is fit to take a glass ship cross-country and with a bit of extra training he will accept it. Try it on a middle-aged Skylark 4 pilot of around 400 hours and he will probably have a fit. It will take him much longer to get used to the idea; and in a stress situation he is quite likely to revert to his previous circuit habits and finish up in a HELP! situation.

The trouble is that we do not have the two-seaters in which to readily give training which is representative of the fiberglass sailplane situation. The nearest we might achieve at present is a Motor Falke with the throttle cunningly set. Bocians and K-13s are a far cry from the Libelle, and only by deliberate restriction of brake movement may a suitable glide slope be simulated.

Having got used to flat approaches—and in fiberglass you may almost say that if you can see it, you can reach it!—our pilot must be trained to approach at the right speed for the situation. With a near-silent environment and a ship which will move away at high speed with the least provocation, there is only one way—air speed monitoring. For years we have (correctly) emphasized the need to fly the circuit by attitude so as to release the maximum of one's attention to the outside world. Now we must accept the need to monitor the air speed so that we avoid the onset of a HELP! situation.

Barring exotic innovations such as head-up displays and audio air speed presentation, it behooves us to *look* frequently at the ASI at all points of the circuit, and thus keep the energy potential to an acceptable minimum. The minimum must clearly be enough to cope with low-level turbulence but will frequently be *less* than the normal cruising speed.

SUMMARY OF ACCIDENTS TO GRP SAILPLANES IN THE UK—1971/72

In 1971 and 1972, 20 accidents to GRP Sailplanes were reported to the BGA. Ten of these occurred for various reasons not connected with the class of aircraft, but ten could have been caused primarily because the sailplane was of the GRP clan. All the latter pilots were very experienced, but not necessarily so on the sailplane itself. Only one had previously had an accident. The following table is arranged in ascending order of pilot overall experience (hours).

PILOT EXPERIENCE ON TOTAL HOURS	TYPE HOURS	TYPE LAUNCHES	SAILPLANE	BRIEF DESCRIPTION OF ACCIDENT
338	100	—	ASW-15	Too high into small field (sports pitch). Hit far hedge attempting ground loop.
510	20	?	BS-1	Steep approach with drag chute. Did not round out in time. Field landing.
531	88	—	Std Libelle	Field landing. Overshooting so yawed heavily to brake. Stalled and struck ground still yawed. Distracted by mobile obstruction.
650	17	9	Std Cirrus	Undershot home airfield trying to land as short as possible. Hit corn with wing tip and ground looped.
700	8	6	Std Cirrus	Contest flight. Crosswind landing into smallish field. Overshot into hedge.
740	9	14	Kestrel-19	Attempted first 'all-systems' landing in very turbulent conditions. Did not round out sufficiently. Too many knobs and not enough knots?
750	48	28	Std Cirrus	Well organised approach into small field. Hit wire hidden by downwind hedge. With better brakes may have come in steeper and thus with better view?
903	31	22	Std Libelle	Undershot home airfield hitting fence post. Practising short landing technique?
1750	500	—	Diamant-18	Bogged approach into small field (too high). S-turned and then undershot into hedge.
1860	237	—	Phoebus-C	Sideslipping into small field with full brake to "shave" downwind hedge—hit it. Distracted by radio transmission.

It will be easy to teach speed monitoring to new pilots; but less easy as the pilots get more experienced. Instructors should start at once to demand a high accuracy of speed control during post-solo checks and Chief Instructors should devise a series of dual checks for club and private pilots alike, which will include use of limited brakes and close monitor of approach speeds. The latter will not be popular, but in the long term it may be essential for the good name of gliding, and if the insurance premiums for all and sundry are to be kept to a reasonable level.

The time-honored method of boosting the drag of an inadequately spoilered aircraft—Weihe, Minimoa—was to sideslip. This technique has largely disappeared. It may be that the next fiberglass generation will be fitted with adequate brakes—the Poles can do it, perhaps the rest will copy. But meantime the technique should be brushed up by those who mean to fly glass. In many cases this will mean going back to the two-seater and a serious evaluation of the problems involved: airspeed inaccuracies; large yaw movements near the ground; delicate balance between bank angle and rudder effectiveness.

Summary

A problem has arisen because of the high energy potential modern sailplanes. The problem can be overcome in the long term by adding to the syllabus of training such techniques as long approaches with limited brakes, close monitoring of airspeed, and re-introducing the side-slip as a common exercise. The short term solution is to re-educate the solo pilots in the above techniques, if necessary by resort to further dual training, a process which will be resisted. The key man in any such program is the CFI. He has been given the responsibility for everyone who takes off from his site. He must assume, or be given, the power to exercise that responsibility.

19
DUNDERHEAD'S THUNDERHEAD
A cu-nim can be a scary teacher

by GEORGE D. WORTHINGTON

On the next-to-last day of the U.S. National Soaring Championships at Liberal in 1973, I had photographed the final turnpoint and was headed for home in my AS-W 12. A huge cumulonimbus thunderhead with water gushing out of its bottom lay between me and the finish gate. I was 4000 feet above the ground; the storm had seemed to suck all normal lift out of the area for miles around.

From past experience, I decided that my best bet lay in flying directly towards the rain, in the hope of using the updrafts of the storm itself. This strategy had been successful several times on other days of the Kansas contest. Inherent was the danger of being drawn up into the storm cloud, something that could tear a glider apart and endanger its pilot's life (blind flying instruments are outlawed by contest rules in the U.S. and in other countries, although still allowed in Europe).

Antidotes

I had thought about that particular danger many times and had considered what actions I would take: by lowering the wheel, using flap position #3, and flying at the AS-W 12s 125-mph redline, the sailplane would have a descent capability of over 1000 fpm. In the event that the upcurrent exceeded that figure and I found myself being sucked up into the cloudbase, I had a last resort—I could deploy the drag chute. (In order to obtain optimum aerodynamic performance, the AS-W 12 has no spoilers or landing flaps, but has a jettisonable drag chute instead).

I had written to the manufacturers earlier, asking for all available information regarding the deployment of the chute at redline speeds. Their answer was that they were sorry, but that they didn't know and couldn't predict what would happen. I optimistically decided that the chute would withstand the high-speed shock and would do the job. However, I felt that it would never come to that because the danger of involuntary entry into a cloud can nearly always be overcome by flying away from the storm at the correct time. I based this on my more than 20,000 cross-country miles in the AS-W 12 during the preceding three years, with dozens under and through similar storms. I had deep respect for the power and dangers of the storm, but I felt that I could overcome the problem.

Under the cloud

I flew two miles towards the rain under a black cloud shelf whose base lay about 7000 feet above the ground. When I reached the edge of the rain I was down to 3000 feet above the ground. But I found 300-fpm lift.

The cloud's black bulk darkened the area; I caught glimpses of other ships nearby and consequently paid great attention to keeping them in sight as I circled. By the time I had reached 4000 feet AGL, lift had increased to 500 fpm. My mood became excited and hopeful, as it can during such a race. I was expecting to achieve 7000 feet where I would be able to glide out of the storm's lift-killing influence and into the sunshine where normal lift conditions could be expected. At 5000 feet, lift had increased to 700 fpm and my feeling of well-being was increasing. An overdevelopment standing square in the middle of one's path on a cross-country flight is never a welcome sight—I've been stopped by them dozens of times. So it's pleasurable to fly up to them, dip into their power, and get help in circumnavigating them.

About this time my attention was attracted to the ground. I could see large curtains of dust in a furious dance beneath me. This was obviously an area where the storm's churning currents were touching the ground in their circle from downdraft to updraft. I welcomed this sign because it promised strong lift and it was fascinating to watch from my vantage point.

The AS-W 12 was being carried up even faster now, and I suddenly became aware of the cloud mass overhead. Its distance was about right–the base was still high enough above that it shouldn't give me any trouble, and besides, it sloped upwards from my position to the outer edge two miles away. I had gone as high as safely possible so I banked quickly and turned away from the storm at redline speed. It was not enough. The clouds were getting closer. I lowered the landing wheel and set the flaps in position #3. I felt confident that this action would keep me below the clouds.

Into the storm

It did not.

With stunning suddenness I was inside the dark vapors. I reached for the drag chute release handle, then paused. Deployment could rule out any chance of making the finish line and require an off-field landing. If I had to jettison it at altitude there was a strong probability of losing it and having to spend $300 for a replacement. There still remained one thing I hadn't tried.

Many years ago, during instrument flight training in the Navy, I had been taught an emergency cloud-flying procedure using only the compass and airspeed indicator. I had entered the cloud in level flight and the turbulence was only mild. If I could hold a heading I would eventually break out in the clear. However, I had entered the cloud at redline and the compass was dancing and swinging to the degree that it was unusable. Speed was building. I applied careful back pressure on the stick. In spite of this, the speed passed 140 mph and kept slowly rising. I knew the ship was in a turn; I would have to use the drag chute.

No chute

I pulled the release handle. No response. The absence of even a momentary tug convinced me the chute had inadvertently jettisoned. (This was not a surprise. The same thing had happened the day before during a landing. I had called in the best available experts to help me troubleshoot the problem and, on their advice, had shortened the cable between the handle and the chute's deploy/jettison mechanism. Now I knew this shortening had made the situation worse, not better. However, I'm a poor mechanic, there is never enough time at a contest and I am to blame.)

The airspeed continued to build. I knew the ship must be in a nose-down turn. To increase the back pressure on the stick would only aggravate the problem. However, something had to be done because the airspeed needle was now approaching 160 mph. I kept thinking, "How could this possibly have happened? What can I do now to save the ship?"

Disintegration?

A loud chattering noise began. Were the flaps fluttering? It seemed a prelude to the total disintegration of the AS-W 12. I expected a wing to come off at any moment. In desperation I pulled back more firmly on the stick. I began to black out from the *g* forces. That wouldn't do. I eased off on the stick. Nothing to do now but wait . . . the needle crept toward 200 mph . . . the chattering grew still louder. It seemed inevitable that I would at least lose the ship.

A few more seconds had passed when abruptly I caught sight of a patch of ground. The ship was in a right turning dive of perhaps 40 degrees. Just as suddenly the clouds closed in again. I waited. Ten seconds passed. The ground appeared again, but this time the sailplane's flight path had cleared the bottom of the clouds.

Recovery

The controls were rock stiff. It seemed to take a long time to bring the ship to a level attitude. When the speed dropped back through 150 mph the chattering noise ceased. Was the ship damaged? All my senses were critically focused on its responses. These seemed normal and I turned my attention to getting back to homebase. On the way a strong feeling welled up inside me: I had been very lucky. It was overwhelming at the moment; it was to be a mood that would persist for days and weeks.

After the landing, the only visible damages to the ship were a few 'wrinkle lines' on the top and bottom outer skins of the horizontal stabilizer which otherwise appeared quite normal. But further careful examination showed that it had flexed or fluttered to the degree that its structural integrity had been almost destroyed. Repairs of this damage cost $600.

As serious as this incident was, I find that its prevention in the future seems simple. Now that I know more intimately that lift in this area of a thunderhead can exceed 2000 fpm, I can allow more clearance and be more alert for telltale signs. It is obvious that I allowed the prospect of mid-air collision to assume too high a priority to the detriment of my concern for the cloud danger. I also allowed myself to be too distracted by the awe-inspiring dust spectacle below. In effect, I 'went to sleep' near a danger that should have received more attention and respect. The very thing that should have helped–my considerable experience with overdeveloped cu-nim situations–lulled me into a dangerous false sense of security.

Retrospect

It is important to mention in retrospect that the plan to fly in under the cloud shelf toward the rain still seems valid. The mistake occurred as I was nearing cloudbase when I should have been monitoring rate-of-climb and proximity-to-cloudbase more carefully. Had this been done, I would have turned toward the outer edge of the shelf much earlier. I could then have resumed circling upon reaching an area of diminished lift so that the original goal of gaining maximum safe altitude could still have been achieved.

This method would have taken more time, of course, and racers must begrudge this. The lesson I learned is that this particular type of delay is worth the extra safety.

20
POLARS
Using them in the cockpit

by PHILIP N. HESS

Philip Hess has 1000 soaring hours to his credit. His chapter is designed for advanced soaring students and is a singularly lucid exposition on the application of polars and lift-drag ratios to pilotage—the distillate of an experienced instructor's effort to clarify the concepts for his students.

Every student soaring pilot is exposed early in his training to the terms 'best L/D speed' and 'minimum sink speed.' He is taught that the first is the speed that will take him the maximum distance over the ground for a given altitude loss, while the second is the speed that will keep him airborne the longest time. As his training progresses he learns that adjustments in these speeds are necessary to compensate for head or tail winds and for rising or sinking air. Learning to make these adjustments usually takes the form of memorizing rules. 'Add 75% of the head wind to the best L/D speed' is a common example. The conscientious student dutifully files the rules away in his memory, uses them to a greater or lesser degree when they are needed, and rarely understands either where they came from, what the underlying principles are, or what penalty he will pay for not following them.

This approach is moderately satisfactory if the student never leaves the local soaring area. More understanding and the ability to extend the principles to all situations are necessary for efficient and successful cross-country soaring. The following discussion attempts to present the underlying principles and to use them to illustrate how rules to obtain the best speed to fly may be generated for all situations.

Sailplane performance chart

Most production sailplanes include in their flight manual a so-called 'performance chart.' This chart usually takes the form of a 'polar' curve plotted on rectangular coordinates relating sink rate to airspeed. Although the curve may be theoretically derived from the geometry, air foil, weight, etc. of the glider, it is more commonly produced by careful measurement in the sailplane under still-air flying conditions. Note in particular the words 'still air.' The performance chart only predicts sailplane performance characteristics *with respect to the ground* when the sailplane is in *still air*. To say this yet another way, the performance chart predicts glider performance *with respect to the air mass that it occupies*. Only in still air is this also the performance with respect to the ground.

Figure 1 shows a typical performance chart. So that a maximum number of readers may use the following results (at least as examples), the chart of the Schweizer 1-26 is shown.

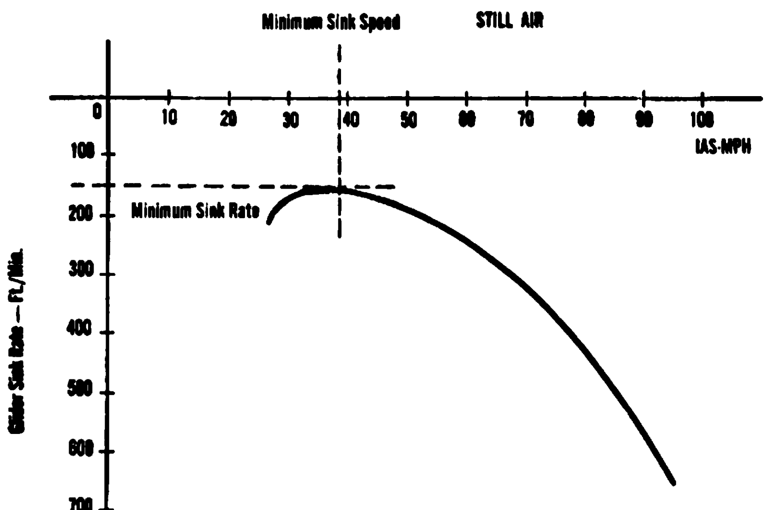


Fig. 1
Performance Chart—Schweizer 1-26

In the form shown in Figure 1 it is not readily apparent that this relationship between sink rate and airspeed is very useful for the information desired. True, it shows both the minimum sink rate of the glider and the speed to achieve it, but that is apparently all.

Terms

To extend the usefulness of the performance chart we must delve a little deeper into the basics of gliding flight. This extra effort will allow us to carefully define some common (though sometimes misunderstood) terms and to see where some common notions concerning gliders originate. Consider the glider shown in Figure 2. It is assumed to be in a constant speed glide. The *lift, L,* acts in a direction perpendicular to the flight path, while the *drag, D,* acts along the flight path. To maintain a constant speed, constant glide angle path, the resultant of *L* and *D* just balances the gravitational force labeled W.

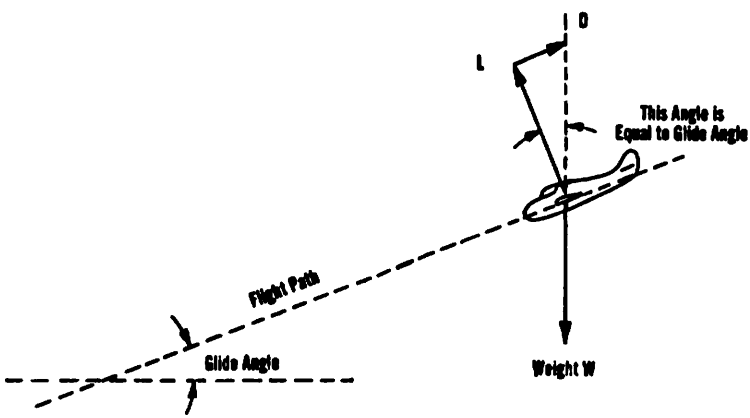


Fig. 2
Lift, Drag, and Glide Angle Relationship

The *glide angle* is the angle between the flight path of the glider and a horizontal plane. Since the lift *L* acts in a direction perpendicular to the flight path, the angle between *L* and the vertical plane is always the same as the glide angle.

The equivalence of these two angles gives rise to the equality of the following quantities:

$$\frac{\text{Life}}{\text{Drag}} = \frac{\text{L}}{\text{D}} = \frac{\text{Distance Traveled}}{\text{Altitude Lost}} = \frac{\text{Speed}}{\text{Sink Rate}}$$

These quantities will, of course, be numerically equal if a common and consistent set of units is used.

It can be seen from Figure 2 that the glide angle will be a minimum (flattest glide) when the L/D is a maximum. From the above equalities, we will also obtain the flattest glide when the forward-speed to sink-rate ratio is a maximum. The performance chart relates these two quantities directly so it must also contain the flattest glide angle information. Simple mathematics show that the flattest glide angle is the angle between the horizontal axis of the performance chart and a *straight line* drawn from the origin of the axes tangent to (just grazing) the performance curve. This straight line and how it is drawn is shown in Figure 3. The horizontal projection of the point of tangency gives the air speed for flattest glide angle. Note that it is somewhat faster than the speed for minimum sink rate. As a point of interest, the flattest glide angle for the 1-26 is about 2.5 degrees.

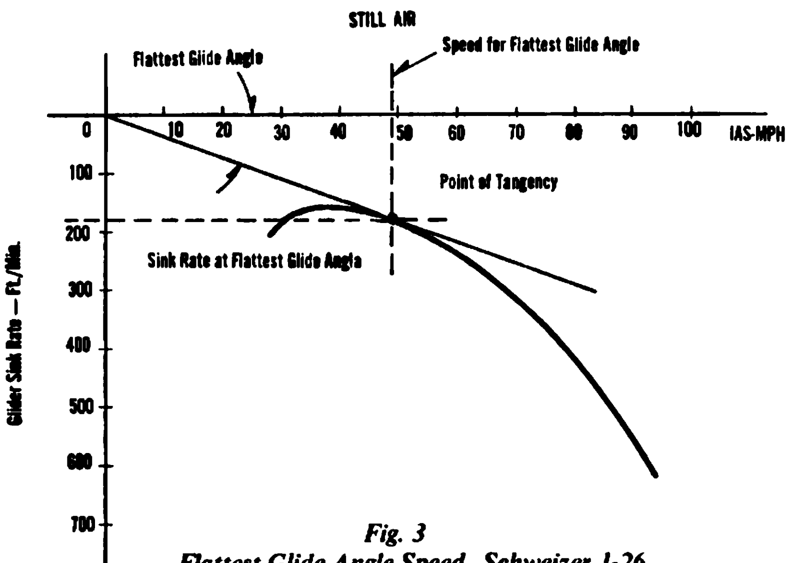


Fig. 3
Flattest Glide Angle Speed–Schweizer 1-26

Headwinds and tailwinds

Keep in mind that the foregoing results refer to the performance of the glider with respect to the air mass that it occupies. Only in still air are these results directly applicable to the glider performance referenced to the ground. This is somewhat like saying that the foregoing discussion is interesting but useless–the glider is seldom in still air and when it is, it will soon land. Fortunately, we can quite easily extend Figure 3 to account for both head and tailwinds and lift or sink. To account for any of these more practical situations one need only move the origin of the straight line which is drawn tangent to the performance curve. Head or tail winds move this point along the horizontal axis while lift or sink move it along the vertical axis. Figure 4 shows several examples of the practical use of the chart. Figure 4(a) shows the flattest glide angle speed for a 20 mph headwind. Figure 4(b) shows it when the air is sinking at the rate of 300 ft./min. Figure 4(c) shows it for both a headwind and sinking air. Finally, Figure 4(d) shows why we fly at minimum sink speed in rising air.

This figure confirms what most soaring pilots know from experience:

(1) Fly faster than normal into a headwind or in sinking air.

(2) Fly at minimum sink speed in rising air or when flying with a strong tailwind.

The point is, one can now readily determine from his sailplane performance chart *how much* faster to fly and what the resulting glider performance will be. A good knowledge of the chart will allow the pilot to maximize glider performance under any and all conditions.

More information from the performance chart

When one is cross-country soaring it is not uncommon to find fairly extensive areas of sinking air between thermals. The examples given in Figure 4 show how one can determine the best speed to fly when such areas are encountered. Since head or tail winds may also be encountered at the same time, it is helpful and convenient to present best speed to fly data in a form that is easier to see at a glance. Figure 5 is one way in which this might be done. Again, for those readers who would like to correlate these ideas with their own experience, the Schweizer 1-26 is used for the example. It is evident from this figure that a wide *range* of flying speeds is necessary to achieve optimum sailplane performance. It is the author's opinion that many pilots do not use the wide speed range indicated and hence obtain less than optimum performance from their sailplane.

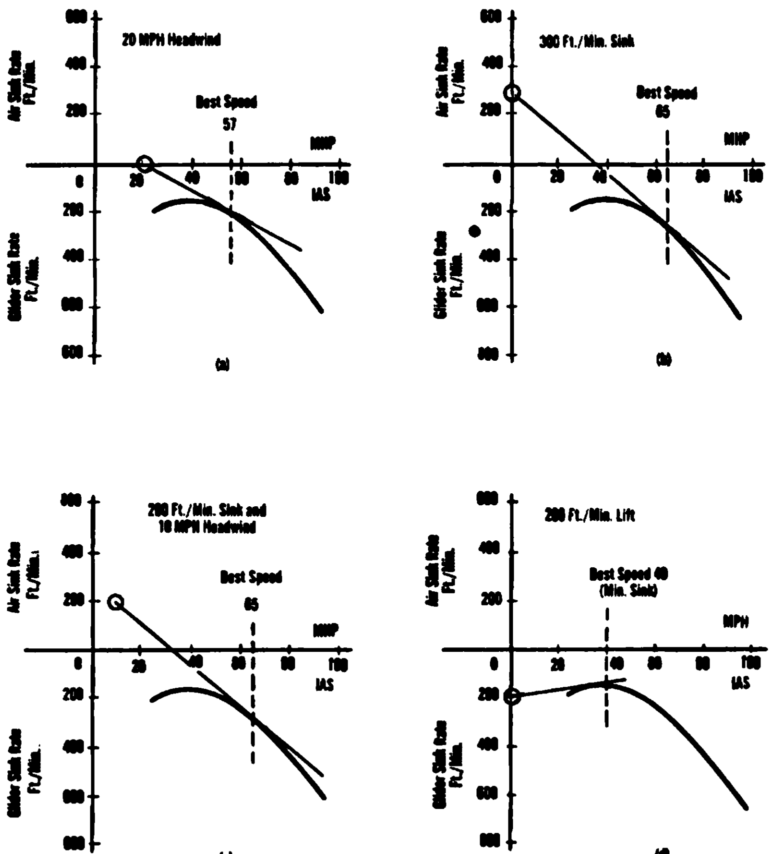


Fig. 4
Flattest Glide Angle Speeds for Sink, Lift, and Headwinds
Schweizer 1-26

Competition soaring pilots are particularly interested in flying at maximum ground speed. The question naturally arises as to how much *additional,* altitude is lost if they fly faster between thermals than the "best" speed given in Figure 5. This can also be simply determined from the performance chart by determining total sink rate (still air sink rate of glider plus air mass sink rate), calculating time elapsed/mile at each value of air speed and from these determining altitude lost/mile as a function of air speed. A typical result is shown in Figure 6. Again, the results are for the 1-26.

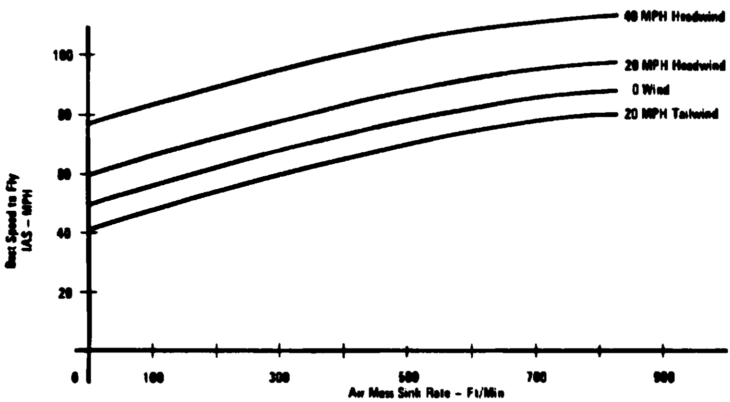


Fig. 5
Best Speed to Fly–Schweizer 1-26

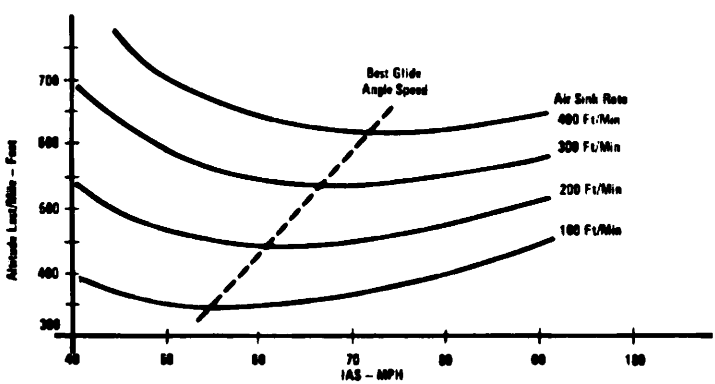


Fig. 6
Altitude Loss/Mile in Sinking Air–Schweizer 1-26

A careful look at Figure 6 reveals two quite amazing results. The first is the very low penalty paid for flying faster than the 'best' speed. For example, in air sinking at the rate of 200 ft./min. one pays a penalty of only 300 feet of extra altitude loss in *10 miles* of flying if he flys 80 mph instead of the 'best' speed of 62 mph. In the next thermal, this penalty altitude can be regained in less than one minute of circling. The increase in ground speed is quite impressive.

The second amazing result is the fact that *exactly the same* penalty will be paid if the pilot flies at the still air best speed of 50 mph. What soaring pilot has not raised the nose and slowed down to conserve a little altitude? It's exactly the wrong thing to do.

The soaring pilot who has a well-calibrated vario can readily determine the air mass sink rate by noting the excess vario down reading at an air speed where he knows the still air sink rate of his glider. Headwind can usually be estimated quite closely from forecasts, ground level wind velocities or drift rates. Thus the best speed to fly and the resultant ground speed can be estimated immediately and maximum glider performance will follow.

Many other ways of presenting 'best speed to fly' data can probably be generated. Whatever the method of presentation, the basic information comes from the simple glider performance chart. The soaring pilot will be well to become familiar with the chart for his own particular bird.

21 TYPE CONVERSIONS

The 'flight test' approach

by H. A. TORODE

Before a new sailplane type is licensed it is subjected to a flight test program to assess its suitability for its proposed role. During this program, an experienced pilot explores the sailplane's handling qualities and flight envelope in order to substantiate that these characteristics are acceptable.

For this task a test pilot must develop an analytical approach to his own flying whilst carrying out tests which are being done for the first time and, on occasions, carrying a certain amount of risk. These circumstances have some parallels in everyday instruction, and practice in this kind of flying is useful to pilots carrying out air tests for certificates and also, in the course of daily instruction, demonstrations where precise control and reaction is required. In particular this situation is related to the circumstance of a pilot of lesser experience approaching a sailplane type that is new to him, and conceivably more advanced than those types to which he has become accustomed.

This particular situation is more problematic at the present time because of the unrepresentative nature of the current generation of two-seaters. If we were blessed with working club two-seaters with the handling qualities of modern high performance sailplanes, then life would be relatively simple.

Safe transition

Further, more inexperienced pilots are now gaining access to highly developed sailplanes and it is the duty of the instructor to see that the transition can be made with all possible ease and safety. In these circumstances it is extremely easy to crowd a system with rules which are unnecessary for the majority of pilots, who are capable of making a rapid and safe transition.

It should be remembered that this situation of rapid advancement is highly desirable and it is up to the instructional system to take up the challenge of seeing that progress is achieved within safety limits. One powerful aid to this end is in the briefing of the inexperienced pilot to adopt what might be referred to as a 'flight test' approach to his exploratory flying.

In any given circumstances the instructor's attitude must be tailored to the mood of his pupil, whether he be under or over confident, and due consideration is also given to his past demonstrated abilities. Discussion with him of his new sailplane and an inquiry into his knowledge of its design features is always worthwhile and gives the instructor the opportunity of gauging the depth of his mental preparation. Clearly, it is highly desirable that the supervisor should have a first hand knowledge of the sailplane, but this is not entirely necessary provided he has an eye for sailplane designs.

Instructor's guidance

What is vital in these stages is that handling and safety aspects should be concentrated upon, rather than performance flying techniques. In this respect the guidance of an instructor is of much more value than that of a competition pilot who is generally all too ready to explain how to fly to his limits, which are unlikely to be the same as those of our student pilot.

The 'eyeball' assessment of a sailplane's qualities is an invaluable aid to the test pilot, particularly when approaching an unflown prototype, when it is the only information to which he can relate his forthcoming flight impressions. This technique is useful to pupil and instructor alike.

As an illustration, consider the fictitious sailplane shown at the end of this chapter. At face value it looks entirely conventional. However, closer inspection shows that we might expect, for instance, poor approach control from the aft location of the airbrakes, awkward ground control because of the low ground angle, and so forth. A full list of design peculiarities (not necessarily defects) are included under the illustration. These sorts of details are always useful talking points during discussions and debriefings.

Cockpit familiarity is also important in the early stages. In a high performance sailplane there are invariably many new controls and the opportunities for pulling the wrong lever are multiplied greatly in a tense situation. Cockpit comfort and a reasonable view of the outside world are also elementary but vital considerations.

Pilot's abilities to cope with an uncomfortable seating position seem to vary widely from person to person, so a dummy run with the sailplane in a representative attitude and the canopy *on* is always a worthwhile exercise. It should go without mention that checks must be made to ensure that the sailplane is within placarded limits. Even so, several new sailplanes, particularly smaller types, can be very marginal, especially with such additions as lavish soaring panels and perhaps oxygen equipment. Initial familiarization flights should be carried out in good weather conditions and a higher tow than usual is recommended.

Several hours needed

However, familiarization with a new type is not a one flight affair, and given a complicated sailplane several hours of flying will be necessary before handling qualities alone will be fully familiar. In the early stages it is of advantage to encourage the pilot to fully investigate his sailplane's characteristics. Many pilots naturally gain much pleasure and useful experience by putting their sailplane through its paces, but it is a constant source of surprise to me to find many pilots, some of eminent soaring and cross-country ability, who have not even explored their sailplanes as far as stalling and stalling off turns.

These pilots must be encouraged to conduct these exercises in a safe and preplanned manner, not only to ensure that he can operate the machine with the maximum of safety margins but also to extract the maximum performance potential from the machine. To this end, discussion of the various attributes of the machine is worthwhile, not necessarily on a pupil/instructor plane but on a more pilot-to-pilot level.

However, experiences in test flying brings one to realize that in these pilot-to-pilot comparisons it is extremely easy to gain false impressions of a sailplane through incorrect analysis or non-representative tests. Thus it is worthwhile considering some pertinent examples concerned with assessing handling qualities, which may be of use to the instructor, as talking points during debrief sessions.

In assessing the rolling power of a sailplane a test pilot executes a rolling maneuver with maximum co-ordinated control movements from a 45° bank in one direction through to a 45° bank in the opposite direction, and measures the time taken to complete the maneuver. This simple test, easily within the scope of the average pilot, is, like many others, open to mis-interpretation if not performed under controlled conditions.

We must first stipulate that the pilot carries out the test accurately with co-ordinated rudder movements as required for full aileron deflection and accept his estimate of the 45° bank angles. Secondly, the test must be done at a constant representative speed (1.4 x level flight stalling speed stipulated in BCAR). Comparisons using other airspeeds are clearly meaningless and cross comparison between different sailplanes are not representative unless compared at a given multiple of that aircraft's stall speed.

Also it is assumed that the sailplane reaches its maximum roll rate instantaneously. This is a reasonable assumption for lengthy rolling maneuvers such as the one mentioned above, but this point leads to another common area of misinterpretation.

Control characteristics

A powerful control is not necessarily a guarantee of adequate controllability. This is because one must also consider the time required for the aircraft to react to this control movement, known as the response time. The power of a control is not necessarily directly related to this initial response speed, and an entirely effective control system must satisfy criteria for both these qualities.

This is again well demonstrated by considering aileron controls. In some sailplanes (notably older types) the power of this control, as exemplified by the roll test, can be found quite satisfactory but the sailplane can remain a handful in rough, turbulent or thermic type air. This is because fast reactions are being used and the aileron and wing response rate is not capable of reacting sufficiently quickly to the inputs of pilot control movement and turbulence.

Assessments of this sort can be further complicated by control-gearing and stick-force peculiarities and the test pilot's task in defining a problem in this area can be quite complex.

To take another example, let us consider pitch control. Modern sailplanes have, in general, lower longitudinal trimming forces than older training sailplanes. This is desirable because they make long flights at constantly changing speeds and the low forces reduce pilot fatigue. These low forces may upset the student pilot and lead to an over-controlling situation. However, this possibility is not dependant solely upon stick force characteristics; the problem is highly complex and still not fully understood, but such parameters as stick gearing, initial response rate, pivot positions on all flying tails, degrees of mass balance and even structural stiffnesses can enter the picture. The problem may also vary from pilot to pilot depending on how he has learned to gather the information he uses to fly a glider. A good instructor should be able to tailor his briefings to suit the known abilities of his pupil.

Most pilots gain a large proportion of their control information for handling a sailplane through control forces rather than positions of controls, and these two quantities are not directly inter-related (and are indeed treated quite separately in flight test circles). Such is the predominance of stick forces as a handling cue that it is possible to mis-read significances into feel impressions. In particular a sailplane that has light longitudinal handling feels racy, which could be interpreted as high performance. An unstable sailplane feels really fast because it wants to increase speed after a given disturbance and this can be very misleading (quote from first hand experience).

Performance flying is a precision business and familiarity with handling qualities at all speeds is a pre-requisite for 'dolphin' type soaring techniques, requiring constant practice in speed control which is usually gained from attitude information. Note, that although a fast sailplane will adopt new attitudes and speeds more quickly and with less effort on light controls, the pitch attitude to speed relationship is much the same on any sailplane. This is also worth remembering on cable break practice and on landing approaches.

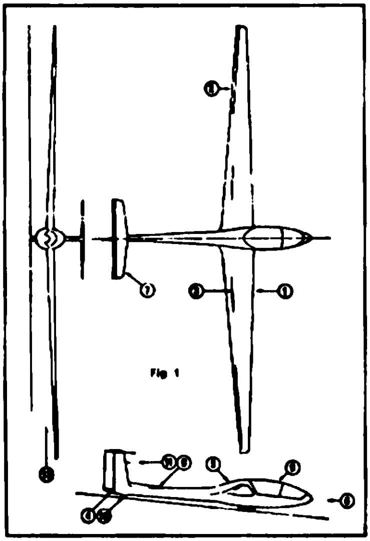
Much has been written already on landing high performance machines with poor brakes and suffice to say here that again familiarity through controlled experiment is the key to success in a tight situation. In particular, one should be familiar with all the approach aids available on the machine, either singly or in combination.

Tail parachutes

Personally I think tail parachutes are an excellent means of producing steep approaches with a minimum of subsidiary airbrake control and could be almost 100% reliable if only more pilots learned the tricks of the parachute trade.

Finally, what about using sideslipping as a last resort? Many modern ships have impressive sideslip performance if only their pilot knows how to use it accurately with good speed control. Try it at altitude before using it on an approach.

With reference to the extension of a flight envelope to its limits, this task falls very much within the compass of the test pilot and certainly there is no sense in the average pilot indulging in high risk maneuvers. This is not to say that one should not be aware of the ranges of loadings, operating speeds



Notes on Fig 1

	Feature	*Effect*
1	Highly tapered wing.	Stall characteristics unpredictable may drop either wing viciously unless wing is also twisted (washout, view in elevation from wing tip).
2	Narrow chord ailerons.	Probably quite effective but lacking in "feel". Could be ineffective at low speed.
3	Airbrakes set well back on wing. (top surface only)	Probably ineffective.
4	Tail parachute.	Assists item (3), learn to use it.
5	Heavily waisted fuselage.	Possible aerodynamic buffet at low speed. Good for stall warning but may be tiresome and cause loss of performance while thermalling.
6	Low ground angle, and forward wheel	Could be problem on the ground in a cross wind. Lack of aerodynamic control at low speed and possible weathercocking.
7	All flying tail with tab and mass balance.	Stick force probably quite "positive" but may be "out of context" with fast response. Good trimmer?
8	Dorsal strake.	Aerodynamicist "fudge" to increase directional stability, thus this is unlikely to be a highly directionally stable sailplane.
9	Wide cockpit with good forward view and big transparency.	Very good for pilot comfort and view. Possible lack of pitch attitude reference, and markedly different reference from previous experience.
10	Big non-castering tail wheel.	Useful for directional stability on ground (provided it is kept on the ground).
11	Tail pitot.	Likely to mis-read at very low speed, in buffet.
12	Low dihedral angle.	Marked lateral divergence when controls released. "Winds up" in turns, requires "hold off bank".

Fig. 1

and load factors of ones' sailplane. In this context aerobatics have long been recognized by instructors as advanced co-ordination and confidence building exercises and there is every reason to employ these techniques with a new sailplane, provided pilot and sailplane are cleared to do so. Spinning also falls into this category and is a must for full familiarity with a sailplane.

The above points have, I hope, highlighted some situations common in test flying that will be helpful to you, as instructors, when approaching a new type or leading others to an understanding of their sailplanes and improvement of their flight techniques. Many people do this sort of thing automatically, even subconsciously, and it is our task as instructors to supervise and, where necessary, encourage the apprehensive to carry out his "test flying" with safety and confidence.

A state of mind

In all, remember that your supervision should be designed to instil a state of mind, and when all is said and done this is identical to the state of mind required for later success in cross-country flying where ability is required to assess a given set of conditions, draw conclusions from that assessment and then act upon them in the manner of careful experimentation. This point of mental approach to the problem is of paramount importance and to show that it is not confined to glider flying, I quote from a recent article on the Empire Test Pilots School of Boscombe Down:

"It is still, naturally, an important aspect of training to develop a student's ability to approach a new type with confidence, but nowadays the necessary attitude of mind is taught rather than assumed."

22 FIBERGLASS REPAIR

Some 'do's and don't's' for pilots

by FRED JIRAN

Most pilots want to know how they can get their ships flying again the next morning, for a competition day or badge flight, and this is what I would like to explain. It is surprising how much can be done if one knows how to approach and assess the different problems. Much more can be done if outward appearance can be sacrificed temporarily and the ultimate precision of a professional job left to be done later at the repair shop. Obviously one must obtain the original structural integrity. So to make a decision on whether it is possible to repair damage overnight, one should understand some basics about materials, about working procedures, how a glider is built, and what sort of loads it is subjected to.

Materials

First of all, let us consider the materials most commonly used in all the German fiberglass sailplanes. All the resins used in these gliders are, of course, epoxies and they are produced by Shell. At the moment, there are no factory authorized equivalents in the United States. All the gliders use various combinations of the same two basic layers of glass cloth and they all use glass rovings. Most manufacturers use various core materials for the sandwich types—for example, in all wings and in some fuselages. Most of them use various ways of increasing resin viscosity for making dry joints, such as in glueing the two halves of the fuselage together.

Reprinted with permission from *Soaring Symposia*.

Glass

There are two basic types of glass cloth, one with almost equal strength along the weave and the warp, the other with almost no strength along one direction and all the strength in the other direction. The latter is commonly called unidirectional cloth. Most pilots have seen rovings. They are just unwoven strands of glass usually rolled up like string and this is also very much how they are used. They are capable of transferring loads only along the grain. Rovings, if saturated with resins (as they always are) can obviously also transfer loads in compression in the opposite direction. Most fittings are attached with rovings that transfer the loads from the fittings to such parts as the skin or other parts of the structure.

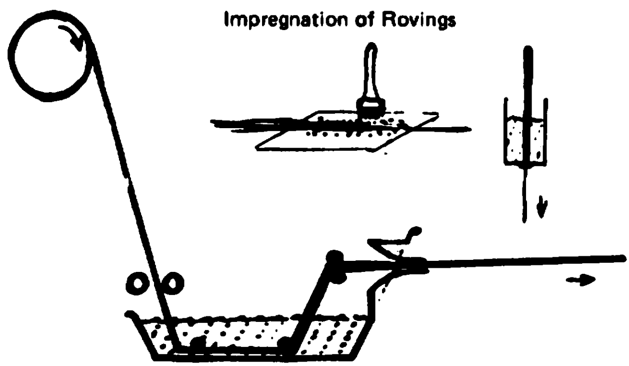


Fig. 1

Resins

The best known, approved resin is an epoxy named Epikote 162, and the hardener is Laromin C260. As mentioned before, there are resins equally as good produced in the United States and probably in England, but they are not authorized by the manufacturers and may not be used. The handling qualities of these particular resins are extremely good. Their low viscosity makes for good penetration of the glass cloth; the exothermic action is very low; you don't get a lot of gas problems as with some of the resins available in the United States.

As an aid in repairs, I also use polyester resins. They are never left in as a permanent structure. They *may* be left in as a backup piece, just to hold the epoxy mixture in place when you first apply it and while it is still soft, but can never be allowed to carry any load since they are just not capable of it. Bonding of polyester resins to glass structures is very, very poor. The time when I might use polyesters is when assembling two halves of a broken fuselage temporarily just to hold them in line; or I might use it to hold a backing piece in place to bridge a gap so that I can lay the glass on it, and similar applications. So, once again, polyesters must *never* be used for structural repairs.

Fillers

The most commonly used resin fillers are chopped cotton and microballoons. Cabosil is used to thicken polyester resins. These thickened resins are used for dry joints, as explained earlier. The Aerosil also has a very handy application in making putties out of gel coat to fix small nicks on a glider's surface. Gel coat thickened with Aerosil can be sanded off later and looks adequately white, so it may not be essential to paint over it.

Core

The last group of materials are the core materials used for the construction of sandwich type structures, including balsa, foam, and honeycomb. They all have various advantages and disadvantages and use depends mostly on the manufacturer's preference. They can, more or less, readily be exchanged in repair without any detrimental effect. Also, sometimes microballoons and styrofoam pellets are mixed together and used for core material in small areas, but they are relatively heavy.

After an accident

After you have had an accident, there are several things which you should do in more or less the following order. This will probably give you the best chance to get the ship flying by the next morning.

Obviously you inspect for the obvious damage first. Check to see if there are at least two wings in the vicinity. After you have ascertained the obvious damage, it is helpful to reconstruct in your own mind exactly how the accident happened. You realize that it is quite easy to get confused as to *just what happened*, but try to do the best you can in this mental process. Now that you think that you know what happened, examine the ship in areas where you might not have looked at before. Quite often you pick up damage you had previously never even imagined would have occurred.

Before you de-rig–if that hasn't been done for you in the accident–check control movements and whether surfaces are still operating. You might have popped loose an aileron bell crank or some other attachment inside, and it might not be possible to see this from the outside, or you might have missed it on the first inspection. In essence, make sure everything is still working the way it should and, if it isn't, make written notes of the problem. A photograph of the entire ship can be helpful to an expert repairer.

When you de-rig, take special notice that all pins and other things having to do with de-rigging are still coming out with the normal amount of grappling, and no more. That will give you a fair idea on how things are in this area. If you have decided that there is a chance that you can repair the damage by the next morning, it is a good idea at this stage to make some specific advance arrangements. Start to get a work area cleaned and some heat into it and a few saw horses ready and odds and ends like this. If you save an hour by doing this, this is one hour you are ahead tomorrow morning. It can mean an extra hour curing time and curing time, you will find, is one of the major limitations in getting the repairs done. It can also mean an extra hour of sleep, at a time when sleep may be at a premium.

To have adequate strength in a repair, you need approximately these times: eight hours at 25°C; four hours at 35°C; and two hours at 45°C. These times are approximate and you usually cannot apply heat until after the resin has jelled to some degree or else you will get some gas development lifting the glass cloths of the repair area.

The best inspection will not help if you do not know what you are looking for. Glass structures usually fail in compression; a compression break, as in wood, is visible by the fact that the resin discolors towards white. Flecks in the gel coat are a good indication that this area of your glider was overstressed or at least stressed. Always have a good careful look in those areas. Putting a light source inside the fuselage or the wing, for instance, will sometimes show up cracks. They appear as darker lines on the outside. You probably also find that a lot of hairline cracks mean a damaged area. Most of the time I have found that there is no serious damage under them, but that doesn't mean that you should disregard them. Definitely check further, as emphasized above.

If you have always made a proper daily inspection on your glider, you probably get to know some of these hairline cracks that sometimes get there from ordinary flying or mishandling while rigging or de-rigging. If you recognize some of these you don't have to worry about them. So that is a very good reason to do a proper daily inspection.

Detailed inspection

Areas that you *always* must inspect are those around fittings. It is sometimes very hard to see damage near the fittings. There are corners and overlapping layers of glass and this can get very confusing. So take a very good look at those areas just to make sure everything is OK. Check all bell cranks if at all possible. Check all push rods and connections. Check everything–whether you think there should have been damage or not. The most important fact on an overnight repair is to get the final layers of glass on as soon as possible.

It usually seems most difficult to bridge holes in the structure. Such holes can usually be filled up with styrofoam, balsa, or anything at all–just use your imagination. Merely bridge them so that you can lay the final glass over them. You can always do the repair again after the meet to get all the rubbish back out again. After you are organized for the glass repairs, there is usually plenty of time to worry about the metal parts; or better still, get somebody else to do that for you.

What can—and can't—be repaired rapidly

I would like to give you some very general ideas on damage you can fix overnight and problems that there is very little chance of fixing. It saves a lot of frustration. You might as well go to bed if you can't fix it—or have a couple of beers. Repairability depends to a large extent, of course, on your own or your helper's ability and experience. If you have no experience in glass repair, obviously you can do very little. If you have a lot of experience, even in associated kinds of repairs like wood, it helps a great deal. It also depends on what sort of aids and tools you have available. If you have to do all the scarfing with a little bit of sandpaper and by hand, you are still going to be sanding and scarfing next week. This is obviously no good. So have some tools readily available for this sort of thing. A quarter-inch drill with some good quality and coarse sanding disks will do an amazing amount. It always depends upon how many curing cycles you have to undertake.

Sometimes it is not possible to get the final glass on before you do some other repairs in the area. You might have two or sometimes more cycles to go through. If you allow about four hours for each cycle and about six hours after the last one, it is quite easy to calcualte how much you can do.

Obviously the application of heat shortens curing time. But heat must be applied carefully. Lamps are generally the most difficult to control. They tend to put hot spots in one area and leave the rest cold or cool. Hot air blowers are definitely the most successful. Do not heat above 45°C, or you will burn the resin. The core materials, if they are foam or honeycomb, can also be affected by heat, so there is only so much you can do about heating up the repair area.

Damage most easily fixed would include holes in any part of the glider that are small enough not to have affected any alignment. You can usually fix minor damage to fittings and attachments. You can usually completely replace simply mounted fittings, such as the forward fitting on the Libelle elevator or similar projects. These types of repairs are quite easy to do overnight.

There are a few repairs that are marginal to do in one night. One of them is, unfortunately, the most common of all damages—the broken fuselage. I think everybody knows that it has been done and can be done overnight. But everything has to be working well for you and you can definitely not do it if you have not done it before. However, if you can get help and expert advice you can, with a little bit of luck, glue the bird together and fly it again on the next day. Also marginal is damage to the primary fittings. If you have a minimum of lining up to do, it might be possible. Almost impossible to fix is major damage to fittings—broken up sections of the wing or completely demolished tail surfaces, ailerons, or things like this. They get pretty difficult and involved to fix overnight.

Splicing glass

Practically all repairs need the splicing on of new glass in some way or another, and I would like to discuss briefly how to do it. As a general rule, each layer of glass requires about an inch of splice length. This is probably a little more than actually necessary for the strength but it gives you a little bit of margin for inaccuracies. You've got to replace the missing glass with at least the same amount of glass. Most important, you've got to place it in the same direction as before.

Splice—wrong—right in unidirectional laminates

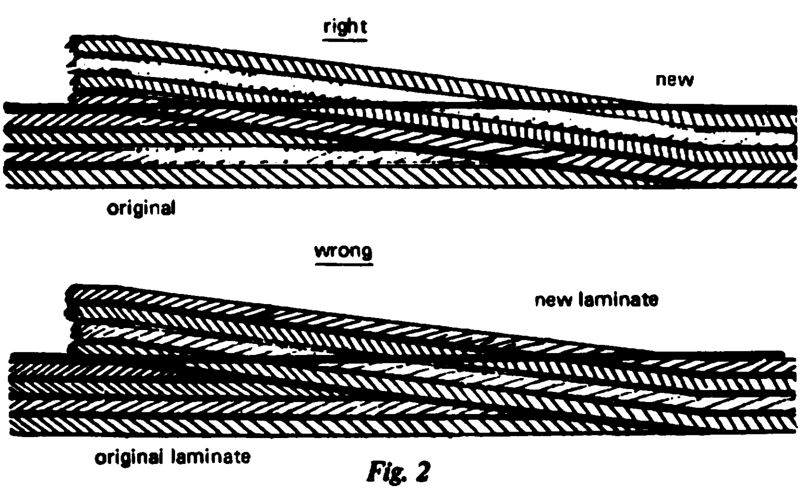


Fig. 2

Sometimes you can substitute other types of glass just as long as you have the same amount of fibers running in the right directions just as they were before. You have to carefully count the layers of glass and inspect the direction of the glass fibers before you can know that. This can be done quite easily. Apply a flame to a broken-out piece and the resin will slowly burn out. You will then have left in your hand several easily countable layers of glass. You can then see the type of glass and in which direction it was applied on the original surface.

Splicing effectively is a matter of practice. I usually start with a fairly big grinder and finish off the edges by hand. The edges are very important: you must obviously not sand through any glass on the outside of the scarf; just sand through the gel coat but not through the glass. It is usually just possible to see all layers of glass in the scarfed area, but this also takes some practice.

The most common mistake made on repairs is the use of too much resin. You need only enough resin to barely saturate the glass. Any more will not help the strength. As a matter of fact, it will hurt it. Adequate room temperatures and, therefore, low viscosity of the resin will help this. Applying a little bit of heat after the last layer of glass is applied will also help saturate the glass with resin and you can then also easily remove the excess resin from the outside with a rubber or steel squeegee.

These comments are really just a few hints and warnings about fiberglass repairs and should not be considered a complete textbook.

ADVANCED SOARING

23 THE MOUNTAIN KING

by EDWARD P. WILLIAMS

Dawn. We were all asleep when Dave Johnson arrived at the bunkhouse. Dave only comes that early when a wave is brewing, so it was no secret why he was there. I've never seen four pilots wake up so fast. It was like the Commandant of Cadets walking into the barracks after the cadets had slept through reveille.

Lloyd Goss, a guest from Bloomington, Minnesota, slid down from the opposite bunk and literally jumped into his heavy winter flying togs. He was scheduled to fly first, and there was no time to waste. You never know how long a wave is going to last. I was slated to be launched after Lloyd, in the number two spot, an ideal position if anything was perking up at the mountain. My enthusiasm had been tempered, however, by a number of false starts. After several forays into the airspace around Pikes Peak, I had not even made a Gold-altitude gain. For me, wave flying was like tilting at invisible windmills. My experience did not jibe with the popular myth that an altitude Diamond can be had for the price of an airline ticket to Colorado Springs.

At any rate, despite my skepticism about the prospects for the day, I began suiting up. It would be a new opportunity for 'character building', if nothing else.

Having seen pilots descend from the wave on the verge of frostbite, I had become a believer in dressing warmly. The fingers and toes were particularly vulnerable and deserved special attention, My first heavy layer of clothing consisted of corduroy pants, an old Navy flannel shirt, an outdoor sweater, and wool skating socks. On top of this went Air Force quilted winter underwear and fleece-lined flying boots with liners. As usual, I had neglected to bring my own gloves; but rummaging through the equipment drawers, I managed to find two sets of odd gloves for each hand. One of the gloves had a hole in the fingertip. Just what effect that would have at altitude was a moot point since nothing else would fit.

Dave and the other pilots were preflighting the towplane and the first glider while Lloyd and I checked our equipment: standard back-pack parachutes, Air Force type A-13 pressure-demand masks designed to function up to 45,000 feet, and old-fashioned cloth flying helmets. Also, we needed mask mike extensions, jacks, and hand switches. After minor adjustments, the oxygen masks felt snug, with no apparent leakage. Lloyd was ready to go. Somehow he was able to down some toast and coffee. I wasn't hungry. Mountain waves keep barbarously early hours, and my stomach was still in bed.

It was then about 6:30 a.m. and the sun was casting a warm, yellow hue across the grassy expanse of Mark Wild's ranch, where the Black Forest Gliderport is located. The wind sock on the hangar was absolutely limp, belying the fact that the wind at the summit, 19 miles southwest and 7000 feet higher than the airport, was reported as 25 knots.

Trudging across the field in old-style flying garb at that ungodly hour, Lloyd looked strangely out of place. You vaguely felt that the airplane out there should have been more exotic than a 1-26: a Spad or a Nieuport would have been more fitting. Shades of the Dawn Patrol.

Dave taxied the towplane around in front of the glider and ran up the engine. We helped strap Lloyd in and assisted with his oxygen and mike connections. The oxygen flow blinker and the "100% oxygen" safety valve worked okay, and he had two-way radio communication with the towplane. We attached the towline. As soon as the slack was gone, they started rolling downhill along the oiled dirt strip, aimed toward the mountain. The glider hugged the ground for several hundred feet. Due to the 7000-foot elevation and the lack of wind, it took time to get off. Luckily, there was over a mile of running space, with only a low fence at the end.

At 400 feet Dave turned northwest, in the direction of the Rampart Range, where the secondary wave is often located. A large lenticular cloud was developing east and north of Pikes Peak, indicating the presence of lift in the primary wave. In the Pikes Peak region, conditions are favorable for the formation of mountain waves when the wind at the mountain top (14,000 feet above sea level) is blowing at least 25 knots, with increasing velocities aloft. The ideal wind direction is 270 degrees, but vectors between 240 and 300 degrees are acceptable. Dave says there are several other atmospheric conditions, such as stability and the degree of positive verticity advection, that influence the incidence, amplitude, and length of a given wave. I'll take his word for that because he's spent more time in and around the Pikes Peak wave than anyone else in the world.

All that fancy terminology can be misleading, however, since wave flying is still more a black art than a precise science. To the soaring pilot, a mountain wave is more than a meteorological phenomenon, a torrent of wind rushing into the stratosphere. Each wave has a personality all its own. It is a human, vibrant thing as unpredictable as a temperamental woman. The Pikes Peak wave can be a coy coquette who bestows her favors sparingly and irrationally. Sometimes she spurns the advances of great soaring pilots, only to smile on some neophyte who just earned his license.

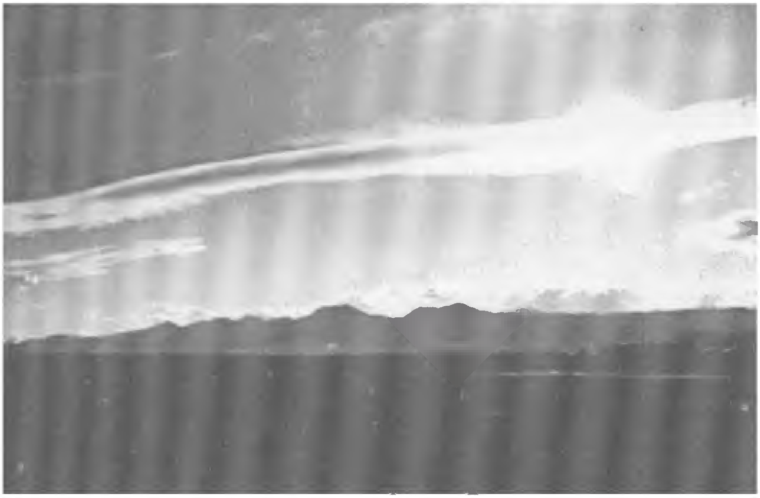
With one ear cocked toward the radio, we pulled the other 1-26 out and readied it for flight. I tied the Winter barograph down in the equipment area aft of the cockpit and turned it on. Mindful of a malfunction that another pilot had experienced on an earlier wave flight, I double checked to be sure the needle was facing upward. The oxygen gauge showed 1800 pounds pressure. The cylinder was nearly full, enough to last three hours, with an adequate reserve. I climbed in and made the normal pre-flight checks. The mask was working fine. I took a few drags of oxygen. Cool and sweet, delightfully pure, it could have come from the Garden of Eden. Heady stuff, could be habit forming.

24,000 ft. over Westcliffe

Over the radio we learned that Dave had released Lloyd at 13,500 in the primary. The lift was fierce, about 800 feet per minute. Beautiful.

Shortly, the towplane landed and it was my turn. As we charged down the field, the 1-26 felt like a big, iron jack rabbit bounding through the tumblewood. After wallowing for an interminable length of time, the wings took hold and we leapt off. To the southwest, the rolling grasslands fell away toward Colorado Springs. Due west, looming far above the horizon, was Pikes Peak and its surrounding ridges, a perfect natural barrier for generating wave lift.

Lloyd reported at 18,000 feet. He was climbing steadily at 600 feet per minute and everything was 'go.' On the way back from the first tow Dave had asked the gliderport to have Denver Air Traffic Control open the high-altitude block. In all probability the gliders would exceed 24,000 feet, and it was necessary to obtain clearance before entering controlled airspace.



Lennie over Boulder

Just east of the Rampart Range, we began to hit severe turbulence, possibly rotor activity downstream from the secondary. The wings were oil-canning, a normal habit of the 1-26 in rough air. They say the 1-26's ability to 'park' is one of its big advantages in wave flying. But I'll vote for the oil-canning as its best feature. As long as those wings are banging around out there, you know they're still on. Gives you a little peace of mind when you're flying the rotor zone.

Coming up on the Air Force Academy airstrip, the radio disclosed the voice of a cadet calling off his airspeed during a glider launch. Sounded like true Spartan discipline. Being a bit of an Athenian myself, I appreciated the irony of military types playing with flying machines designed for hedonistic purposes.

Suddenly, we hit sharp rotor effects. One second the towplane was on its side, the next I was slammed against the canopy so hard my head almost went through it. During the preflight check I had neglected to cinch the shoulder harness up tight. By bracing one hand under the instrument panel, I was able to ride it out, cursing my own stupidity. The only time I'd been thrown out of the seat like that was when my

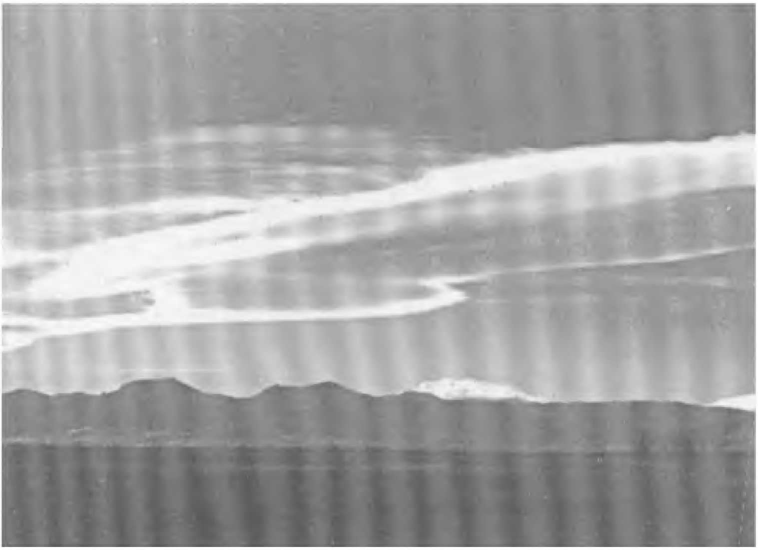
Ka-8 caught a gust on a landing approach near a thunderstorm.

After this series of wild gyrations, the bumpy air subsided and there was a brief opportunity for sightseeing. We had crossed the sharp spine of the Ramparts south of the Academy and were angling southwest, making a direct assault on the lee wall of the peak. Manitou Springs lay to the south, nestled in a crevasse at the foot of the cog railway. Dark green ponderosas adorned the steep flanks of the valleys, lending an air of respectability to the garish, rust-colored soil at the lower elevations.

Lloyd called in again, this time at 21,000 feet. He was climbing well and would probably go much higher. The gliderport advised that the high-altitude area had just been opened, indicating that the Denver Center had blessed our undertaking. At that point we were at 13,500, about four miles back from the summit and slightly below it. It was time to put the mask on. I didn't want to have to fiddle with it coming off tow in the wave.

Lloyd must have been almost directly above us, but we couldn't see him because of the thick cloud cover extending back from the peak. That crazy cloud didn't conform to the neat diagrams I had seen in the literature. From underneath, it looked like one massive stratus cloud deck. But Dave obviously wasn't concerned that it didn't resemble an ordinary garden-variety wave cloud, and that was reassuring.

At 13,700 we were approaching cloud base and encountering weak lift. The stark rock wall of the mountain loomed straight ahead about three miles away. "Forty-nine Romeo, this looks pretty good here. Suggest you get off and give it a try." That was Dave, and was I surprised. We were still under a solid overcast, and it took imagination to conjure up the possibility of wave action under that screwy-looking cloud. But Lloyd was up there somewhere and Dave said to release, so I did. Cardinal Rule Number One in flying the Pikes Peak wave is to follow Dave Johnson's advice religiously. You have to keep your ears open because he is soft spoken, doesn't talk much, and seldom repeats things.



ARMITAGE

The lure . . . and the challenge

"Forty-nine Romeo, be sure you notch your barograph. Move toward the mountain if the lift is weak." The lift wasn't very good, just a little better than zero sink. And I was already worried about the minimum altitude needed to ensure a safe return to the airport. At that location the minimum altitude was 13,500. I had absolutely no margin to spare. How well I remembered that English gentleman who misjudged his glide and paid an unexpected visit to the ranch just short of the gliderport. I was not anxious to duplicate his performance. These Colonial air currents can be beastly tricky.

But it didn't seem right to turn back without further exploration near the lee slope. And there was always the Academy strip, at the foot of the Ramparts, in an emergency. Following Dave's suggestion, I aimed the 1-26 at the lee side of the mountain. I was about 500 feet below the summit. The glider was still settling in a mushy glide somewhere between zero sink and the normal sink rate as the jagged snow-crusted rock mushroomed in the windshield. After all that preflight preparation I felt like a wallflower, all dressed up with no place to go. The crest of the mountain was white with snow, but the steep rock face was bare in patches where the wind had swept it. I was venturing into the hall of the mountain king. For this was the realm of Manitou, the great spirit of natural phenomena, the god of the Utes, Sioux, Shoshones, and Cheyennes.

And then it happened. Shortly after the glider broke into the glaring sunlight beyond the upwind lip of the cloud, a giant hand thrust the machine straight up. For a few exhilarating moments during the initial impulse, the force pressed me down in the seat. Then, the acceleration stopped, and the rate of climb stabilized at 1000 feet per minute! The familiar airstream noise turned to a gentle whisper, a low murmur similar to the sound of a jet with its engine throttled back, indicating that the smooth streamline of the wave had encircled the airframe. An aerial Rumpelstiltskin had magically transformed my humble 1-26 into a high-performance super-bird with laminar-flow wings. The door to the upper sky had opened. I had found the mother lode!

I held the nose into the wind, which was blowing due east over the summit. Once the initial surge of entering the wave had passed, I seemed to be hovering in a stationary position. My airspeed, about 55 mph indicated, was just enough to offset the wind velocity. The machine seemed like a great hot-air balloon rapidly ascending along a steel cable moored to the lee wall of the peak. I was parked on an invisible elevator that ran through the ceiling of the world and out into space. Manitou was in a beneficent mood that day.

Despite the fantastic rate of climb, the whole scene was incredibly peaceful, the kind of serenity you experience scuba diving at a depth of 30 feet, skimming along a coral reef among the muted rhythms of the sea. But not until the glider passed into the clear and began climbing could I appreciate the magnificence of the lenticular cloud-form spun by the wave. The cloud lay immediately behind me, tapering back into the stratosphere from its straight, forward edge. Like a huge glacial ice field, its smooth white undulations stretched into the far distance. The open portions of the atmosphere were icy blue, accentuating the brilliances of the cloud in the same way that the porticoes of the Parthenon are enhanced by the Grecian sky. From a vantage point part way up the side of this white colossus, I realized it was a classic lenticular of heroic proportions. Over a mile deep, it had thrived on the unusual humidity of the day, having enlarged to such an extent that it had assimilated the rotor cloud. That day there was no visible distinction between lenticular and rotor. And concealed in the belly of the lenticular, the rotor could present quite a surprise for the unsuspecting instrument pilot.

Eighteen thousand feet. My rate of ascent was 800 feet per minute. Lloyd called in at 24,000. While his vertical speed had slowed to 100 feet per minute, he was still making progress. I tried to contact him on the radio without success. My transmitter was apparently out. Fortunately my receiver was working, and I could hear the others loud and clear.

With increasing height, I began to fret over the oxygen system like a maiden aunt chaperoning a teenybopper. Any malfunction at those altitudes was extremely critical. Unlike scuba diving apparatus, which warns the wearer of a short air supply by making breathing more difficult, aircraft-type oxygen equipment does not give your lungs a clear-cut signal of impending trouble. Instead, you have to rely on the gauges and stay alert for telltale signs of anoxia—a feeling of intoxication or lightheadedness. My two key instruments were the oxygen pressure gauge and the oxygen-flow blinker. The pressure looked good—about 1000 pounds left. The steady opening and closing of the lips on the oxygen-flow meter, symbolizing life itself, was also reassuring.

Twenty thousand feet. Outside air temperature, minus 20 degrees. It was easy to stay lined up in the wave by maintaining a constant position relative to the cloud. As an experiment, I allowed the airspeed to drop slightly below the wind velocity, causing the glider to drift downwind tail first, toward the slope of the big lenticular. This maneuver felt just like being in a small boat, bobbing backwards in a heavy swell. As I played with this leeward sliding motion, I encountered a pronounced elevator flutter. This phenomenon worsened the farther back I went. Thinking that this condition might have been an incipient stall, I lowered the nose, and the buffeting gradually diminished, then stopped entirely. This sequence of events was puzzling because my airspeed, even at that altitude, seemed well above stalling speed. And then it all clicked. The same kind of flutter had happened on an earlier occasion when I fell out of the backside of the secondary wave near the Ramparts. The intensified tail buffeting experienced farther back in the wave must have been turbulence in the transition zone between the smooth, laminary flow of the wave and the scrambled air downwind of the wave. By depressing the nose, I had raised the airspeed, which in turn had moved the glider farther forward into the smooth-lift area. The elevator buffet was a helpful warning that the ship had slipped too far back in the wave. From then on, whenever this condition occurred, lowering the nose yielded good results.

Twenty-one thousand feet. I was finally even with the top of the wave cloud. From that level it looked like a massive, highly cambered wing of infinite length. I found that a continuous band of lift extended for some distance along its leading edge, similar to the lift area ahead of a squall line. Flying parallel to the front of the big white cloud was like skiing across an immense snowfield. I flew half a mile along its face without any appreciable change in the strength of the lift.

A little trickle of liquid ice ran down behind my collar. A side benefit of high-altitude flight. The oxygen mask had turned into a miniature ice-making machine. Within a few hours it was likely to produce enough crystals to chill a man-sized martini.

Lloyd reported over the radio that he had me in sight. At that time he was at 25,000, about 4000 feet above me. No sign of him overhead. I craned my neck right and left as far as the mask hose would permit and yet couldn't see him. He must have been somewhere behind, in the blind spot.

Far below, Captain Zebulon Pike's wave-generator looked like a modest protuberance on the earth's crinkled skin. It seemed incredible that this remote instrumentality could impel the glider to such a great height.

ARMITAGE

"A vaporous envelope containing millions of tiny silver needles"

At 23,000 feet, the lift had deteriorated to about 50 feet per minute. Lloyd was at 26,000 feet, holding level, but unable to climb any more. All indications were that the wave was topping out well below 30,000 feet. The chances for a Diamond-altitude gain were slim, but at least Gold altitude was in the bag. With luck, it was always possible that the wave would pulse and increase in intensity if I could just hold position.

It was time to draw heavily on patience, the wave pilot's stock in trade. On earlier occasions I had lost the wave by shifting position too quickly upon reaching a zero-sink condition. This time I vowed to stay put until the situation clearly warranted a change. One experienced pilot had told me of waiting in zero sink for 20 minutes until the pulse came.

The canopy had frosted over in thin streaks, but not so much as to impair visibility. Keeping the air vent open seemed to prevent any marked frost accumulation. In spite of the low outside air temperature, I was reasonably comfortable.

At 24,500, still rising at 50 feet per minute, the ship flew into a vaporous envelope containing millions of tiny silver needles. While the sun was shining through the top of this gauzy layer and I could clearly see the terrain directly beneath, horizontal visibility was reduced to a few hundred yards. Hanging there suspended without power in a translucent cloud of delicate ice crystals produced an eerie feeling of loneliness. It was as if the world had been left behind and I had passed into a Shangri-la where dreams were transmuted into realities. A delectable foretaste, perhaps, of the Elysian Fields . . .

These reveries were broken by the sight of Lloyd, soaring about 1000 feet above me. The belly of his 1-26 glowed dramatically in the extraterrestial glare of the rarified air, a pure white cross against the azure sky. After a few minutes of formation flying, the white metal bird slid away to the south, undoubtedly searching for better lift.

Thirty minutes later, a great deal of patient effort had boosted me to 25,300. At that level the best I could do was zero sink. No amount of prospecting forward, backward, or sideways would yield a different result. As if by magic, Lloyd had gained almost a thousand feet over my peak altitude. Evidently, I had much to learn.

When it became apparent that I could go no higher, I paused for one last look at the panoramic view. Far to the southwest were the sharp stone crags of the Sangre de Cristo Range, a romantic link to the early Spanish explorers. Directly below was Captain Pike's majestic mountain, historically a beacon for adventurers, fur trappers, Indians, and gold-bugs. The wild spirit of that rugged land has been captured forever by place names on the map: Quandry Peak, Leadville, Tin Cup Pass, Battlement Mesa, Black Canyon, Goldfield, Cripple Creek, Jack's Cabin, and Rifle. How fitting it was that a new form of pioneering was underway in the skies above that fabled mountain.

Navigation on the trip back from the peak was complicated by the fact that the wave cloud had gradually oozed downwind across the foothills and out over the western end of Colorado Springs. I flew on top for about four or five miles in the general direction of the gliderport. Then, near the Air Force Academy, I found a large hole and spiraled down from 20,000 feet with the spoilers fully extended. The surf from the wave stretched downwind all the way back to the field. I noticed some sizable rollers at an altitude of 3-5000 feet over the airport. With a high-performance sailplane it might have been possible to take a low tow from the gliderport, intercept a series of these downstream waves, and work back up into the main wave. An interesting challenge for the future.

The ground wind at the gliderport remained relatively calm, and the landing involved no sweat. We checked the barograph trace—I had peaked at 25,300 feet, equivalent to a net gain of 12,000 feet, more than enough for Gold altitude.

Oddly enough, that Gold-altitude leg was more aesthetically satisfying than a later Diamond-altitude flight that I made to 31,000 feet in cloudless air. In any event, regardless of the specific conditions, every wave flight is a unique experience in the furtherance of a soaring education. Working a wave is generally the best way to achieve altitude badges in this country. It's a lot less painful than tangling with the Black Bear (cu-nim), or even the White Bear (fair weather cu), and it can provide a lot of kicks. If you haven't tried it, perhaps you should consider some wave action. There's abundant game in the high mountains for the patient hunter.

24 DIAMOND COUNTRY

Flying the Nevada distance mine

by GEORGE D. WORTHINGTON

Summer with its fabulous lift and beautiful cloud-streets is quietly and swiftly approaching. Where is the best place to try for a diamond distance in a 1-26? Where have the longest distance flights been made in the United States? If there is only a 10-day period in which job and family commitments can be set aside during the summer, where is the best chance of getting a gold badge—or a diamond badge—or a California distance record? What is the best time of the summer for a 10-day campaign?

I wish I could report that I have conducted and completed a 10-year scientific study aimed at answering these questions and can therefore authoritatively give factual and absolute information on all the best areas in the U.S. Unfortunately, this isn't the case. In fact, I am somewhat of a newcomer to soaring and have relatively limited experience. Even so, the experience of the past two summers may be of interest to those who ponder the answers to the above questions.

In the last 21 years all of the world distance records made within the United States, with the exception of goal and return, were made from Odessa, Texas. With this evidence in mind it would seem that Odessa is possibly the best area of the U.S. in terms of soaring distance potential. However, from personal experience I am inclined to feel that the Minden-Truckee-Reno/Stead area has the advantage over Odessa. I base this mainly on the fact that I have obtained (a) earlier cross-country departures (b) higher cross country speeds and (c) longer flights from the high country of Minden-Truckee-Reno/Stead as compared to those of Odessa.

In July 1971 I spent three weeks at Odessa. I flew maximum out and return type distance flights nearly every day. On the average I could not get a satisfactory cross-country start before 11:30 a.m. The cloud bases at that time of day were generally low, being about 3000 feet above ground level. This meant that gliding range without additional lift was a maximum of only 21 miles. The terrain in the area has few farms, and suitable landing areas are quite scarce. In addition, the lift in general at 11:30 a.m. seemed sporatic and unreliable. It was usually 12:30 or 1:00 p.m. before conditions improved so that lift became reliable and the cloud base rose to about 4000 feet. Also, it should be pointed out that the Odessa area is very flat. Therefore, the only dependable indicators of possible thermals are the clouds. The net result of these conditions was that in over 80 hours of cross-country soaring at Odessa, my longest out and return flight was 386 miles. The average speed of all my out and return cross-country racing efforts was 52 mph.

In contrast to the above, at Minden-Truckee-Reno/Stead my average speed during 200 hours of out and return cross-country racing was 58 mph and the longest out and return type flight was 520 miles. Takeoff times for cross-country flights were in the neighborhood of 10:45 a.m. with actual starts beginning about 11:10. Not only were these starts made much earlier than at Odessa, they usually began at 11,000 feet which is about 6000 feet higher than the valley floors. Cloud bases at 11:10 a.m. were in the neighborhood of 12,000 feet 'out on course'. Consequently, when cloud base was achieved, it allowed a great freedom of action. Glide range became about 50 miles. This created a greater factor of safety and confidence. The lift at 11:10 a.m. was to a relative degree far more consistent than at Odessa.

Mountains were very prevalent in the Minden-Truckee-Reno/Stead area. A cloud over the spine of any of these mountains offered a very high degree of probability of lift underneath. In the absence of clouds the fact that the area did have numerous mountains offered the chance of using their spines, or sun inclined surfaces, or up-slope wind conditions as excellent 'fishing' areas for thermals.

Finally, in discussing long distance soaring potential from Odessa verses Minden-Truckee-Reno/Stead, it should be noted that personalities have had a lot to do with the history of each area. Wally Scott and Al Parker in the past ten years have set about five world distance records from Odessa. Both pilots live in Odessa. Both are in business for themselves and can soar on any potentially promising day. They have the option of looking at the weather forecasts each morning and deciding to use only the most promising days of the summer. Their ships stand assembled and ready in hangars. They are ambitious, experienced and have the best sailplanes available. I think that it is very likely that if champions of that calibre lived in the Reno area instead of Odessa, those world records would be credited to the Reno area.

As the final part of this article, I would like to point out the differences that seem to exist between Minden-Truckee-Reno/Stead. Truckee seems better than the other two for originating straight distance flights. The reason for this is that Truckee offers an earlier and higher cross-country start.

When you first see Truckee you might find it a bit awesome. The airport is almost 6000 feet above sea level and located in a small valley almost entirely surrounded by mountains rising up to 12,000 feet. The impression of confinement to the soaring pilot is irresistible. Can one really get high enough early enough to start a cross country? On two sides (east and south) the mountains form a barrier rising about 3000 to 4000 feet above the valley floor. It generally requires an altitude of about 10,000 to 11,000 feet to escape from the valley. Experience showed that releases at 2000 feet above ground level were followed by reliable and rapid ascents up to escape altitude. The prevailing winds in the area during the summer are toward the northeast. Highway 40 runs generally toward the northwest from Truckee. These two factors have always suggested to me that the best possible direction for a long distance flight from Truckee is to the northeast toward Salt Lake City. If a flight over 350 miles is planned however, it is best to avoid the Great Salt

Lake Desert (generally a sink hole) and aim slightly to the left of it toward Northern Wyoming.

Truckee's great disadvantage is that it is poor for out-and-return flights. Late in the day Truckee is very hard to enter from the south or east due to the influence of Lake Tahoe. The waters of the lake are cold. The prevailing winds pass over the lake, fan out, and the result is very poor soaring in the downwind area after 5:00 p.m. Although this is true of Truckee, it is relatively easy to re-enter the Reno (International), Stead and Minden areas at the end of the day, compared with Truckee. In following this narrative, refer to the accompanying rough map of the area, which identifies important geographic points and areas of flying activity.

For the purposes of this return exercise, let us assume that the pilot is operating at nearly maximum out-and-return range—say about 300 miles for the average experienced pilot in a 1-26 or nearer 500 miles for the typical AS-W 12 conductor. This presumes that the pilot has planned on using the last available minutes of lift at the end of the day to return to his starting point, or as close as possible. Let us also assume, not unreasonably, that the pilot is returning from on a course that is the reciprocal to his outgoing flight to the east, desirable because of the prevailing Westerlies that he will have been using to speed his outward flight during the strongest (lift and wind) hours of the day. He will thus be on a course, returning, lying somewhere between 160° and 310° (usually delineated by the angle subtended by Lovelock in the north and Mono Lake in the south). In all probability, our pilot will have made a special effort to get up near cloudbase as the day declines, using the best thermals, and thus he will find himself in area 'B' at an altitude (MSL) of between 14,000 feet and 16,000 feet depending on the particular day. By now, however, the day is starting to die and lift is declining, as the time approaches 6:30 p.m. in the June-July, maximum daylight, soaring months.

Our pilot will note, as he looks ahead warily at his Truckee destination, that the clouds have evaporated throughout area 'A', and that this blue hole is spreading and

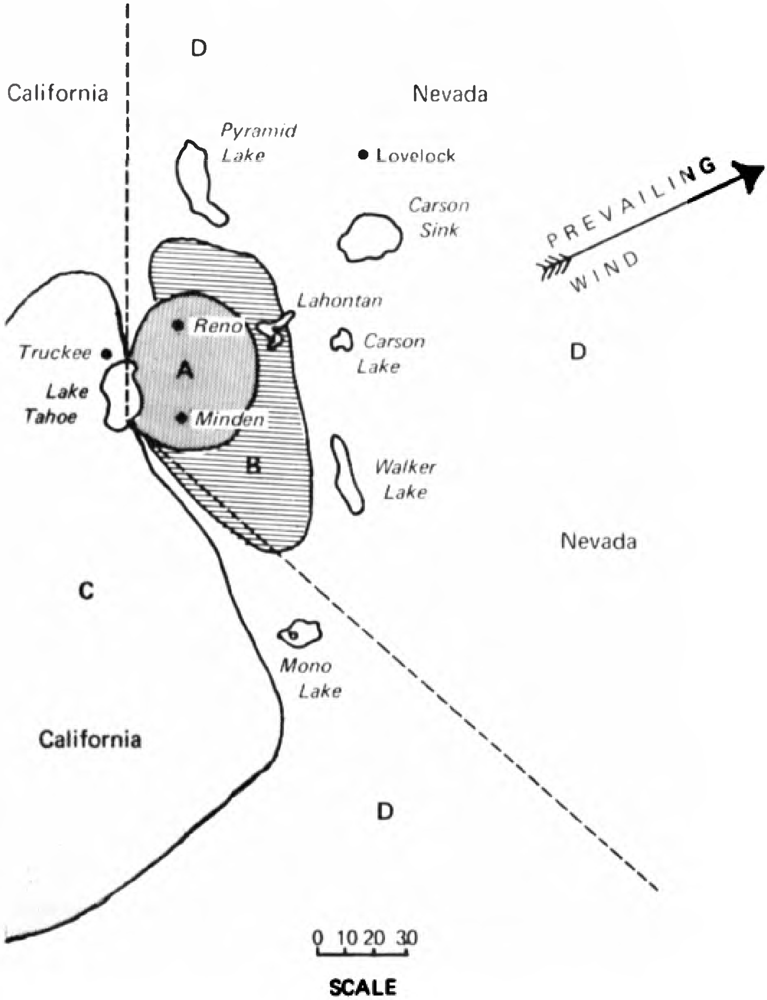
6:30 PM

AREA A – **No lift due to cool Lake Tahoe.**

AREA B – **Still Contains some lift.**

AREA C – **Never used due to forbidding terrain.**

AREA D – **Generally has some lift except for special** areas.



enlarging rapidly. Lift is declining, disappearing in the area and thwarting his passage. However, in area 'B', lift and clouds are still present, although weakening. Approaching from the south, from the Mono Lake area, Minden is but 15-20 miles away, making it easily accessible from a 9-11,000 ft. AGL altitude compared with Minden's 4,700 ft. MSL. In an AS-W 12 he would be able to reach Reno without further lift in a straight glide through area 'A', or could avoid that area by diverting to the east towards Yerington or Lahontan where lift would probably be sustained for perhaps another hour or even a little longer. The only disadvantage to this latter maneouver would be the cross wind effects that would later turn into probable headwinds as he turned west towards Truckee.

Truckee is, of course, surrounded by high mountains, especially to the south and east, so that an AS-W 12 pilot would need about 13,000 feet MSL over Minden to have a chance of getting in. Other critical threshold altitudes for the AS-W 12 pilot would be 11,500 MSL over Reno, 13,000 over the Heavenly Valley ski area and 13,000 feet over Hallelujah Junction. Because of the lack of lift in area 'A' after approximately 6:00 p.m., these altitudes are not likely to be easily attainable, or even altitudes remotely close to them. Thus, realistically, Reno-Stead is a useful access point from the northeast, with Reno International or Carson City suitable alternates if there is a little altitude in the bag or sink is less severe than anticipated. From the south (still with Truckee as the goal), if Minden is easily reached, Carson City lies 10-12 miles nearer the goal, and Reno International is the next logical stepping stone 25 miles further north.

An exception can often prove the rule. On July 16, 1972, as I consult my log book, I had soared in my AS-W 12 from Truckee to Darwin and had managed to get back as far as Carson City by around 6:15 p.m. I was at 7,000 feet MSL, or hardly more than 2,000 feet AGL (Carson City is 4,697 feet MSL). For an hour I worked mini-lift over the hills above Carson City. My goal was still to get to the Reno-Stead area, on the slim chance that clouds I could see just to the east of that area were still generating lift, and might get me up to around 13,000 feet MSL for a glide back into Truckee. At one point during that hour I did gain enough height that a low, desperate glide into Reno-International might have been possible, but even that possibility seemed too risky for the potential benefits it might bring in shorter mileage back to Truckee or in reaching a legitimate stepping stone that would permit the Reno-Stead vicinity to be penetrated. In short, there were no clouds over Reno, and the chance of lift there seemed minimal.

Finally, at 7:40 p.m., I was ready to abandon the attempt. I was still about 2,500 feet AGL above Carson City airport, where I finally realized I would have to land, safe and sane. I had been flying since late morning and would have been content to get down quickly, so I headed West towards the mountains that rose to 10,000 feet about 4 miles away. I flew at 100 mph to give a reasonably high sink rate (numerically lower than 20). After about 2 miles, I encountered LIFT, definite signs of coherent lift. Conditioned reflexes honed during an 8½-hour flight, in which I had grasped at all lift encountered, and my lack of resolve in deciding to land (a decision originally made in a state of fatigue), caused me to bank sharply into this new lift with that revivifying sense of rebirth so well known to soaring pilots. I clung to the lift, while an argument raged in my mind. Logic, cool wisdom and a weary body insisted that I land at Carson City. A soaring pilot's desperate hope and optimism—that 'while there's lift there's hope' sensation—denied descent. While the mental battle continued, the AS-W 12 continued to climb. The full range of a soaring pilot's thoughts and feelings assaulted my weary mind and body—incredulity, skepticism, hope, doubt, disbelief, heresy, distrust, elation, despair. By the time the lift petered out, I was at 10,500 feet. It seemed enough, with Truckee only 18 miles away.

There was a quick one-man council of war in the AS-W 12 cockpit. Although the distance was only 18 miles, I had to clear a 7,200 foot pass in the last one-third of that distance, at which point my altitude would be declining fast. What were the winds like on the route? Would there be any severe 'down' along the way (for where there's lift, there also must be sink)? The course led over the north end of Lake Tahoe, and would the cool air over the lake at 7:50 p.m. generate serious 'down'? I remembered that there is NO place to land within the North Lake Tahoe basin area–none whatever. Finally, the decision was made to try.

The decision to try was 'footnoted' to the effect that there would be time and opportunity for decisions along the way, but soon–at the half way point, and over the waters of the lake–I was at the point of no return. I was committed. It was truly a glorious moment, one at which the over-used term 'moment of truth' came to mind and surged through the senses. I might not make it, but I was making the attempt. I liked myself . . . all the way to the twilight touchdown at Truckee and a new California O&R record!

The point is this. There will 'never' be lift in area 'A' after 6:30 p.m., but . . . there is a tiny chance that there might be. This is why, in short, you can re-enter Minden, Reno, Carson City or Stead as late as 7:00 p.m., after a long out-and-return flight, but 'never' Truckee.

In conclusion, it is my opinion that the Minden-Truckee-Reno/Stead area is probably the best in the U.S. for long distance soaring potential. if plans are being made to take advantage of this fabulous diamond country, I would advise using the time period of June 1st until July 15th as optimum. It is also suggested that take-off be scheduled for 10:00 a.m. Go at the first sign of activity, and certainly not later than 11:00 a.m. An early start is the real key to long distance soaring. Also, it is extremely advisable not to limit your progress because of ground crew considerations. Fly as fast and as far as you can and rely on a carefully pre-arranged plan for teaming up with your crew after you land.

I am aware that the proponents of the soaring glories of Odessa may want 'equal time'. Perhaps, a three week sampling of Odessa soaring is very minimal. Maybe there are better areas elsewhere in the U.S. If there are, I hope to hear of other choices to add fun and zest to the general concept of identifying the best in the U.S. for the purpose of long-distance soaring.

1972 SOARING FLIGHT SUMMARY

PILOT: George Worthington
SAILPLANE: ASW-12, Contest #7R
FLIGHTS MADE FROM STEAD, MINDEN, TRUCKEE AREA

Date	Distance St. Mi.	Speed mph	Flight
21 May	27	55	Minden-Coleville
22	230	58	Truckee-Mammoth Lakes-Minden
23	410	62	Truckee-Salt Lake-Wendover
25	325	69	Truckee- (out and return)
26	100	–	Minden- (out and return)
27	265	64	Minden- (speed triangle)
28	303	67	Minden- (speed triangle)
29	203	31	Minden- (unfinished speed task)
30	180	43	Truckee-Susanville-Minden
31	440	66	Truckee-Salt Lake Airport #2
12 June	200	60	Truckee-Lee Vining-Carson City
13	346	46	Truckee-Winnemucca-Minden
14	203	55	Truckee-Lovelock-Minden
15	321	65	Truckee-(O&R)
17	400	64	Truckee-Lone Pine-Truckee
19	100	–	Truckee-(O&R)
20	520	58	Truckee-Darwin-Stead
22	200	57	Truckee-Battle Mountain
24	385	64	Truckee-Salt Lake Desert
26	448	67	Truckee-N. Great Salt Lake Desert
28	499	59	Truckee-Darwin-Carson City
29	340	66	Truckee-Mojave Desert
14 July	475	59	Truckee-Darwin-Minden
16	505	57	Truckee-Darwin-Truckee (State Record)
18	295	60	Minden Nationals
19	209	51	Minden Nationals
20	162	46	Minden Nationals
21	278	66	Minden Nationals
22	338	62	Minden Nationals
24	231	69	Minden Nationals
25	281	61	Minden Nationals
26	317	48	Minden Nationals
27	310	63	Minden Nationals
31	190	59	Truckee-Calconda
1 Aug.	300	38	Truckee-Winnemucca-Minden
2	180	40	Truckee-Lee Vining-Minden
3	346	55	Truckee-Bishop-Truckee-Minden
4	425	66	Stead-Lee Vining-Susanville-Minden
5	422	54	Stead-Lone Pine-Minden

SUMMARY TOTAL: Number of flights—40; Total miles—11,779;
Average Distance per flight—24 miles.

25
THE BIG ONE
1-26 triple diamond

by LASZLO HORVATH

Another beautiful day! The cloudbase is over 14,000 feet above the ground, and business at our Estrella Sailport in the desert grandeur of Arizona is booming. And it certainly looks like it's going to be the same tomorrow. I almost hate to think about it. I've checked tomorrow's schedule at the Sailport–and wouldn't you know it, there's not a single plane available all day. Again. How in the world can I get hold of a 1-26? I can probably get another instructor to take over my scheduled flights, but where can I get a bird! Wait a minute, you numbskull–you do have one! The one with the broken canopy. Hey, that's it! All I need now is a canopy. Let's see . . . Elliot Kurzman? No, he wants his 500 kilometers, too. Well, I'll just have to start calling private owners as soon as I get home and hope that one of them won't want to fly tomorrow.

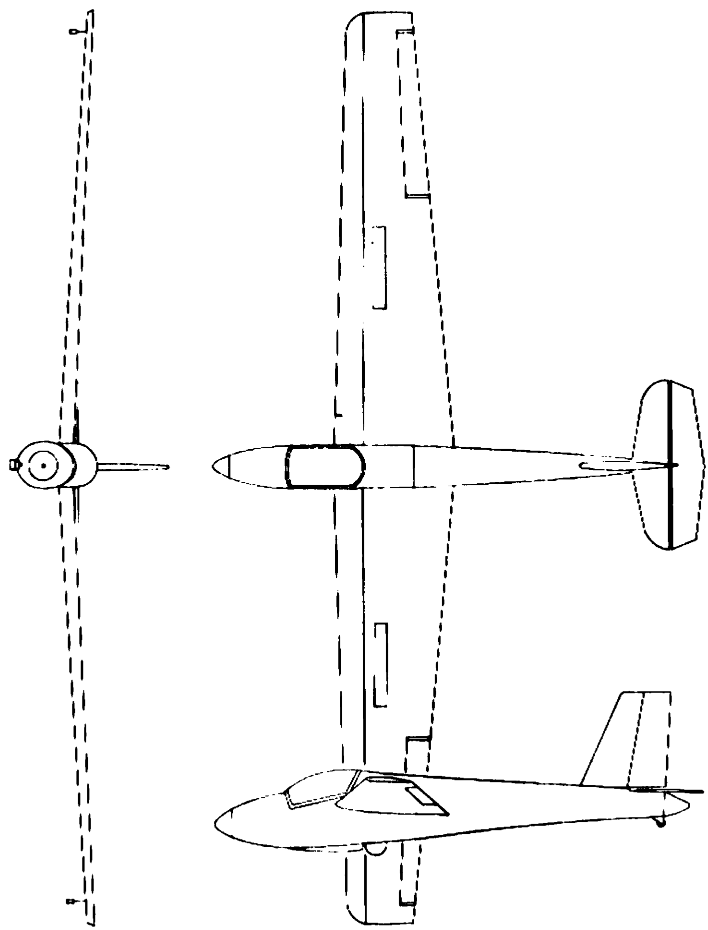
My first call is to the Detwilers. Really a long shot, because both John and Charlotte are pretty much regulars at the Sailport. I'm apologizing, explaining to John that all I really need is his 1-26Ds canopy so that I can make my Diamond distance the next day.

"You think it's going to be that good?" John asks.

"I do."

"A 500-kilometer out and return with a 1-26?" he asks.

"Yeah, I always wanted to do one," I answer.



1-26

"I'll tell you what, Laz, we've been flying too much lately anyway. Go ahead! Take it! And I wish you lots of luck."

I'm so happy as I hang up that I don't even remember if I said thanks. (Many thanks, John and Charlotte!) Finally, I'm getting another chance: Last year I messed things up by loading my 1-26 to the limit; I covered 306 miles but was unable to use the weak thermals toward the end of the day and so I landed a few miles short of the Sailport. But not tomorrow! Only the bare essentials come with me this time. And I mean bare.

Beautiful day! We start operations at nine in the morning and the cu have already begun to pop over the Mongalon Rim to the east of us. A couple of hours and it should be good enough to take off here. Over the Rim it always starts early; but by midday, over-development renders it useless. Well, time to tend to business; one of my pilots didn't show this morning. Hmmmm. Our time-keeper wakes me up:

"Laz, we have several demos here. Can you take them up?"

"I'll be happy to take them, Jill," I say unconvincingly. "May I help you folks?" I ask, thinking to myself that it's good-bye cross-country for today!

A few minutes later I realize that I could start on the X-C now if only I had another pilot to fly demos. The thermals are already good: 2-300 feet per minute. Oh, well, us working people have to mind business when we have business. "Next, please!"

It's 11 o'clock. Burns me up! I haven't even been able to put John's canopy on 41S for just in case . . .

I can't believe it, my lost pilot shows up at 11:01! "My car . . ." he explains. But I haven't time to listen as I jump out the backseat of the glider, apologizing:

"Please excuse me, sir! This great young pilot will take good care of you. He'll even let you fly the glider . . ." And I'm running toward John's ship for the canopy.

Exactly 24 unbelievable minutes later I am on the flight line ready to go. During these 24 minutes every able-bodied person has given me a hand to get ready for this flight: declaration, camera, barograph, water, food, clothing, maps, radio, wing-tip wheels—oh, yes, the *canopy*!

Do you ever have a day that is yours? A day where you feel nothing can go wrong? This is just the feeling that comes over me as I signal the tow pilot and wave good-bye to the onlookers.

I always release in the first usable lift, but not today. Today I'm going to take a high tow! Finally, at 2700 feet above ground, I abruptly pull the release and make a 90-degree right turn onto my course line. This is insane. No lift—but I'm going . . . going at best glide speed and steadily losing altitude. I've heard about final glides from release! So why didn't I cut loose at 2200 feet in the boomer? I don't know.

I spot a swirling dust devil ahead of me. A minute ago I had doubts. But now the old ticker begins to slow down to normal. As I approach, I check the rotation of the thermal and lower the nose of my 1-26 with impatience. You little devil, you! I hope to get one of you everytime I'm in trouble today. By the time I reach the dust devil, I'm down at 1500 feet above the desert floor (which in turn is 1300 feet above sea level). As I roll into the lift, I note the time so I can check my rate of climb. And as I circle upward, I'm aware that a crosswind from the northeast is slowly pushing 41S back.

At 7500 feet I say good-bye to my little devil and radio information about it back to Elliot Kurzman, who has taken off about 15 minutes behind me. I'm traveling southeast, paralleling the main highway to Tucson, with a number of airports along the way. There isn't much sink, and an occasional bubble, plus some meticulous handling of controls to follow the speed ring, slowly takes me away from the gliderport. The next few thermals are progressively better, getting higher and stronger. Fifty-eight minutes after release I've covered 30 miles and the altimeter indicates 11,600 feet.

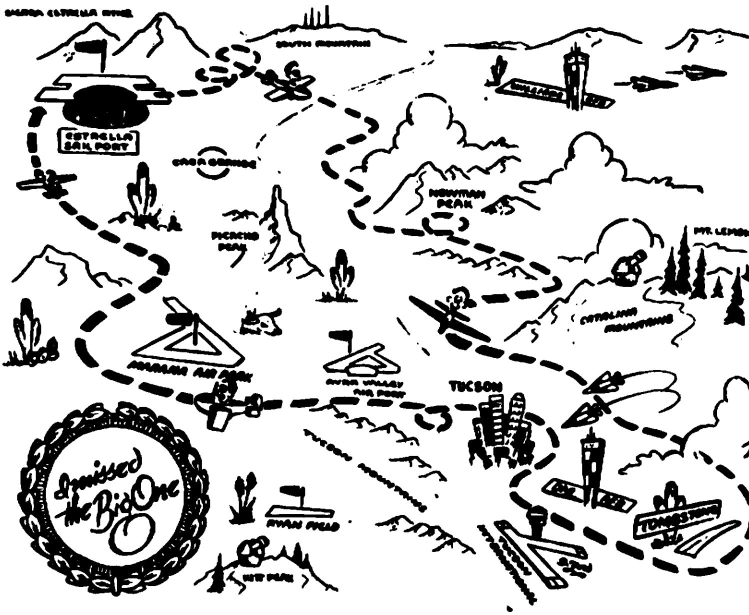
My first disappointment comes at 4530-foot Newman Peak, 50 miles out, where I reach the first cu at 1 p.m. Expecting nice smooth lift, it turns out to be rougher than a sled on a washboard. Despite the choppy lift, however, I manage to climb 5400 feet in 10 minutes before rolling out and lowering the nose.

Hey, the soaring is really starting to get good! Now I even have time to look around and enjoy the scenery (in addition to my usual thermal scouting ahead). I always go around the cultivated areas if possible, but I can't help but enjoy looking at the patterns that the cultivation creates. The neatness, the orderliness of the irrigation has a beauty of its own. How man can draw straight lines every mile is beyond me. And, of course, there's the desert, with its dry washes to let you know instantly where the good thermals should be, and the rugged rocky mountains slicing up the flat lands. This is what's so beautiful about cross-country flying! Being able to see so much from such a small platform!

At 2:02 p.m., I'm some 90 miles out, looking down from 16,600 feet at the high mountains just northeast of Tucson. My turnpoint at Tombstone Airport, 70 miles away, seems only a rock throw from here. As I proceed onward toward the turnpoint, I reach the highest point of the flight: over 18,000 feet MSL–and I'm not even at cloudbase. But ahead I notice a black wall approaching the turn from the northeast. Dust storm! My thoughts race. Elliot! If he hasn't closed the gap between us since takeoff . . .

But I've got a problem of my own. Can I beat that monster to the turnpoint? Almost crying, I actually have to force myself to level the wings and leave the 1000-fpm lift. By 3:02, however, I'm over Tombstone and leaving a thermal at 16,500. Two minutes later I take a single picture of the airport. OK, monster, you may cover it up now! Checking the time, I realize that during the last hour I've knocked off a distance of 68 miles! In a 1-26. Incredible.

Returning over the higher, less civilized terrain between Tombstone and Tucson, things begin to slow up a bit. The dust storm seems to have been a signal for the weather to over-develop all around. I notice snow coming through the vent. My thermometer now shows 24°F, but it's supposed to be a hundred down on the ground! The liveliness of the air has disappeared. Whoa, slow down, kid! After a long, long



glide, finally, east of Tucson, I get a gentle smooth thermal. Then nothing again. Heading for Mt. Lemon to the north of Tucson, I hope to find something under a few scrawny-looking clouds hanging over the 9000-foot mountain. And all the while, my altitude is paying out. On the ground high winds indicate that a dust storm has moved through, leaving no lift behind.

Desperately looking around, I suddenly notice a little dust devil far in the distance about 45 degrees to my left. I almost yank the stick right out of 41S in my hurried effort to make the turn! It takes an eternity, but I make it. And, holy smoke, I do mean *dust*! Another dust storm from the northeast. The way it looks to me, it might reach all the way from Tucson to the Sailport! My insides just start to glow. A free ride home? For a few minutes all I can think about is Bill Cleary's flight in the 1971 Nationals when he rode home on a dust storm, ending up with a 50-mph average for the 150-mile triangle.

Reaching the leading edge of the dust at 4:40 in the afternoon, I am rewarded with a thermal that lifts me 11,000 feet in just nine minutes. The rest is child's play. Out in front of the leading edge of the dust, I'm able to cruise at from 40 to 90 mph at 12,000 feet while keeping the variometer needle on zero.

Touching down on the number two runway at 5:55, it has taken me six hours and twenty-three minutes to complete my 318-mile out-and-return flight, an average speed of 49.8 mph. My *third* Diamond in a 1-26.

Oh, yes, you're wondering about the title to this article? OK, here comes the sad part. You see, I declared Tombstone as my turnpoint all right, but I forgot to declare the Estrella Sailport as my goal. Flight disallowed!

As if to add insult to injury, I missed Diamond altitude by just 150 feet to prevent my faithful 1-26 from unofficially accomplishing all the requirements of a three-Diamond badge flight—becoming perhaps the first sailplane ever to do so without the benefit of wave lift.

26
O&ROGRAPHIC RECORDS
Beating 'em–coming and going

by BENNETT ROGERS

It's wonderfully reassuring the way a single individual can sometimes change the basic nature of things. Take long-distance record soaring as an example. It used to be a pretty cut-and-dried affair. You flew during the summer when the sunshine shone longest over hot, dry places like Texas where the thermals boomed strongest. And then one man, Karl Striedieck of Port Matilda, Pennsylvania, recognizing that the World Out-and-Return Record was susceptible to a different brand of tactics, decided to cast his lot with the power of the wind rather than that of the sun. On March 3rd, 1968, Striedieck ridge-soared a Ka-8, medium-performance club-type ship, 476 miles out and back along the Appalachian Mountains to break the World O&R Record held by Dick Georgeson of New Zealand. Not only was Striedieck's flight conducted in the heart of winter weather, but in the eastern United States where no international records had been established for more than 30 years.

A year later Striedieck lost the O&R record to Bobby Clifford's *Libelle* in South Africa. Clifford's mark of 488 miles was in turn eclipsed a year and a half later by Super-Tex Wally Scott's 534 miles in an AS-W 12. Both Clifford's and Scott's records were posted with conventional distance flights, the pilots mostly flying high, frequently circling, and always hoping for the least possible wind since any consistent flow aloft would ultimately cut the overall speed of the flight. But from this point on, the name of the

O&R game was to change from Temperature & Lapse Rate to one of Topography & Pressure Gradient.

Swooshing along with an exhilarating sense of motion triggered by his intimate proximity to the upreaching terrain, rarely circling, constantly dependent upon the strength and direction of the wind caroming up off the slopes beneath him, Striedieck regained his record a little over a year later when he flew his new AS-W 15 569 miles in November of 1971. As a result, Karl was voted that year's FAI Lilienthal Medal, gliding's highest international award.

But all this was just a prelude to what was to become an unprecedented binge of record breaking this past autumn. It started on September 7th when New Zealander Dick Georgeson returned Striedieck's 1968 favor by retaking the O&R record with a flight of 623 miles to join the exclusive 1000-kilometer club. Georgeson, like Striedieck, relied on the upward deflection of mountain winds, but in the high-rolling form of wave action rather than simple ridge lift. As Georgeson comments: "The Southern Alps lie across the westerly wind which flows in from the Tasman Sea and often produces standing waves and lee waves of a good magnitude. One of the problems is to get the same weather lying the length of the country. In the south. the cold fronts tend to come in early and cloud Southland over. even though the rest of the country may not be covered by them for many hours or even days."

On Tuesday evening, September 5th, the TV weathercast indicated a high approaching North Island and what looked like a low developing that would pass south of South Island. A forecast from the Weather Office on Wednesday confirmed that the situation still looked good, and by 4:30 a.m. on Thursday the 50-year-old Diamond-Badge pilot began what was to prove a long and eventful day. Rigging his 19-meter *Kestrel* in the dark on the airstrip at Hanmer on the South Island, Georgeson had one dreadful moment when a gust of wind caught a wing and rotated it downward, exposing its full area to the force of the wind. But somehow his tow pilot managed to hold it without collapsing and they got the leading edge back up into the wind.

At seven o'clock he released from the Cherokee towplane at 3265 feet above the field. Despite the early start, Georgeson noted that "it was evident from the beginning that the whole venture was going to be a race against darkness. The wave was raggedy, no clearly defined lenticulars, a lot of scruffy roll cloud, and the beginnings of a high cirrus arch were to be seen in the west." Since losing the out-and-return record to Striedieck, Georgeson had made numerous attempts to recapture it, but the weather had never proven suitable and the flights had usually been abandoned in the early stages. Now as he moved south against a quartering 50 to 60-knot headwind toward his turnpoint at Mossburn almost exactly Diamond distance away, he must have pondered whether getting to Mossburn and then back again wouldn't turn out to be just another reality-shortened dream.

"I had a slow but steady progress," he recalled, "arriving over Lake Coleridge powerhouse at about 15,000 feet at 0905 hours. The wave pattern, although not marked by clouds of any sort, seemed to disappear and eventually I was forced to turn downwind and ended up a little south of Snowdon Station at about 7000 feet. At Snowdon Station lives Lucy Wills, a cousin of Philip Wills. She once drew me a picture of a peculiar cloud which sometimes sat in the vicinity of Mount Hutt and which had a spiral which went up a number of thousand feet and then leant forward into the wind–almost like the top of a witch's hat. I had also seen this cloud once and tried to fly a sailplane in the vicinity, but it was too violent. Today, I struck turbulent, rough lift. Bearing in mind Lucy's picture, I circled and did not bother to treat it as a wave and rose rapidly at over a thousand feet a minute, and as I climbed, the aircraft drifted forward into the wind and eventually ended up at about 15,000 feet some two miles further upwind than I had originally started.

"Progress was slow and hard as I continued south in the lee of Mt. Hutt, there not being much in the way of indications even of roll cloud. The process of traveling was that of imagining where the wave might be lying, crabbing along the imaginary wave and if the rate of lift fell off, turning first into the wind, and if it continued to fall off, turning sideways to the wind and drifting back to where one imagined the wave was lying. The process seemed to require continual effort and vigilance and one always appeared to be losing the wave.

"Shortly after 1100 hours, I was in serious trouble at about 4000 or 3000 feet above the ground. I seemed to have completely lost the wave system. The usual rule-of-thumb we had was that once below 8000 it would be very difficult to get going again; the wave system usually did not operate below this level, except in unusual or exceptional circumstances. At this stage I felt I was losing time badly and it actually looked as though the flight was off. However, striking weak lift, I tried the technique of circling, and again it worked. I climbed slowly, and 18 minutes later was at 12,000 feet. Morale had picked up, and calculations showed if I could keep traveling at this speed, I would reach Mossburn around 1430. This was acceptable, as we believed from estimates made the previous night that it should take eight hours to reach Mossburn and three to come home."

But Dick was now beginning to fall somewhat behind this timetable, and as a result he decided to shift gears and made a climb to 30,000 feet in some particularly strong lift he had encountered, from which point he could run almost all the rest of the way to Mossburn. At 1330 hours, however, he left the lift at 26,000 feet when it dropped to 500 fpm, and shortly after this he was tremendously elated to see the turnpoint off in the distance.

Photographing the turn—almost hidden by smoke from a fire—while plummeting in heavy sink, the big *Kestrel* finally descended as low as 5000 feet before picking up some weak wave and eventually working back up to 18,000 feet. From here, Georgeson had a tremendous run north to Omarama, averaging better than 150 mph over the ground. But, after what he felt in retrospect was a bad decision on what route to continue home on, he found himself low enough that he thought he would have to pick out a landing site—only to have the flight rescued over the very same spot where he had been saved five hours earlier.

Shortly, after 5 p.m. the tower at the Christchurch airport informed Georgeson that his tow pilot, Bruce Drake, and his wife, Helen, were taking off in the Cherokee and would endeavor to find him in case he needed any assistance on the last leg into Hanmer. With Hanmer looking an awfully long way off to him, Dick admitted he could use all the help he could get:

"The wave system appeared to have completely disappeared; there was no evidence of wave, nor was the blue wave which I had been following for some time providing lift any further. I could hear Christchurch radar giving Bruce Drake his headings to pick me up and I was amazed how long it took him to catch me. However, he was under the impression that I was a good deal higher than I was. When he finally picked me up, I was down to 7000 feet downwind of Hanmer and sinking at 1000 fpm. Things now looked bleak. It was almost the time to be looking for a safe paddock and landing while there was sufficient light. The only thing left to do was to turn downwind and hope that a lee wave existed some 20 miles downwind of the ranges.

"Bruce headed for the Hurunui River, an area where Bruce had previously found wave. I was down to 4000 feet when he called back that the wave was working. I was not far behind him and soon I was in it, climbing. At 8000 feet I decided I could not afford to wait any longer due to the approaching darkness, and at 1610 I started the final glide in to Hanmer. Bruce had found a track in that gave reduced sink, and was desperately searching for lift further upwind. He had his nav lights on and it was easy to pick him up. The reduced sink held well and I was able to box along at about 80 to 85 knots. However, I was not at all confident that I had enough height to get through the gorge, which was probably about half a dozen miles long, into Hanmer. Bruce then called up to say the Cherokee was losing altitude fast and that there was heavy down toward the gorge. I had no option but to continue. I felt the light was not good to attempt a landing and the point-of-no-return had been reached.

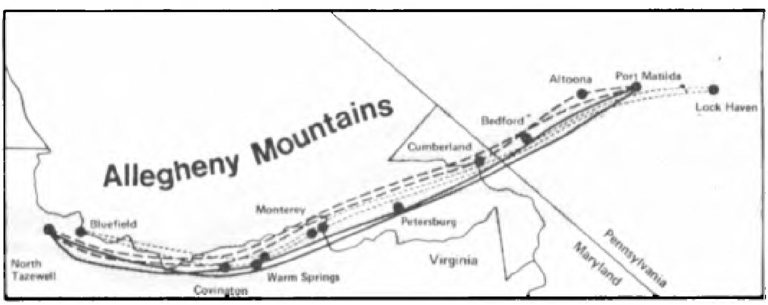
"Bruce called to say he had found a rotor, that it was very rough, and that it was giving tremendous lift. Shortly afterwards, however, he said it had broken up and he had lost it. I reminded him that if this sink continued, which had suddenly gone up to 1000 fpm, I would be in serious trouble. The air became violent and very unpleasant. The sink continued and I was pushing the aircraft along as fast as I dared, somewhere between 90 and 100 knots, to try and get through the down. Down to 2000 feet, or 1000 feet above the valley floor, the light was very poor indeed, and to the west I could no longer clearly see the ridge. And I still had some six miles to go.

"I seemed to go on and on and on . . . violent up, violent down . . . the vario going from one extreme to the other. The cameras were all around the cockpit . . . also the maps. I had even lost one mike over my shoulders. The situation was beginning to look a bit sick. I turned east on to the ridge, the violence continued, but the sink stopped. Just then I rounded the corner over the Waiau Bridge, and smooth hill lift ensued and the next minute I was quietly going up. The relief was incredible.

"Terry Shannon, my official observer, called on the radio saying to stay where I was until the flare path with cars had been laid out. This gave me the opportunity to tidy up the cockpit in preparation for landing. At 1825 Terry called me and said all was clear. I made a big sweep of the field and came in to a straightforward and easy landing with the wind blowing about 25 knots."

For Dick Georgeson, it was the third time he had laid claim to the World Out-and-Return Record (not to mention a world altitude-gain mark as well), all in Slingsby sailplanes manufactured in New Zealand's mother country, England. In 1961 he had averaged 50 mph in a *Skylark 3F* and four years later he had logged 54 mph in a *Dart 15*. Now, in the far superior *Kestrel*, his speed had moved up only to 54.5 mph, indicating that the soaring conditions had not been as strong as during his previous successes. But, of course, the difficulties of a flight only increase the satisfaction of the achievement.

And now it was up to Karl Striedieck to neutralize all Georgeson's hard-won efforts and attempt to get his record back. On October 7th, exactly one month to the day after Georgeson had taken Striedieck out of the recordbook, the 35-year-old Air National Guard pilot lured himself from bed at 5 a.m. with the expectation of finding winds across the Appalachians that might allow him to answer the challenge from the other side of the globe. The winds were there all right, but they were accompanied by an unpleasant surprise in the form of a drizzly overcast. Consequently, Striedieck was forced to delay his takeoff until 8:04, at which time his brother Eric used a Jeep to launch him by auto-tow from "Eagle Field," his own ridge-top strip near Port Matilda.



With northerly winds quartering on his tail, Striedieck headed his AS-W 15 south-southwest down the familiar series of ridges. "At Altoona," he said, "the ceiling was below the ridge top, which necessitated a 35-minute hold while it lifted enough to get across the gap there. I almost went down flying the ridge to Bedford, because the wind was quite northerly and this ridge runs 030-210 degrees. At Bedford I wasted another 45 minutes getting high enough to cross the gap."

Though he never felt the need to actually pick out a landing field, he reported being "scared" about 25 times. But the farther south he moved, the easier things became. Reaching Cumberland, Maryland, just before 10:30, the cloud base rose to 6000 feet and the overcast began to break up. Leaving Cumberland he was able to climb more or less on course beneath wave clouds that stretched down the ridge. Near Warm Springs the clouds were again on top of the ridge, but near Covington, Virginia, the air dried out. He reached his turnpoint at North Tazewell, Virginia, at 1:18 in the afternoon.

With the wind more perpendicular to the ridges, the trip home was relatively uneventful and followed the outbound route except for a short stretch between Bedford and Altoona. The ol' Pennsylvania Ridge Runner finally touched down back at Eagle Field at 6:18 p.m. with 45 minutes of daylight remaining. His distance of 636.9 miles (1025 kilometers) exceeded Georgeson's by approximately 14 miles and will earn Karl one of the new FAI 1000-Kilometer Diplomas. In taking back the record, Striedieck was in the air for 10 hours and 14 minutes, giving him an average speed of 62 mph (a shade over 71 mph without the two holding actions).

Just two days later Striedieck was ready to have a go at breaking his latest record. But this time he would have direct competition–Jim Smiley, the well-known *Libelle* driver from Clover, Virginia, who had on occasion proven himself without peer in contest speed tasks. The day after Striedieck's flight, October 8th, Smiley had noticed that there was a good north wind blowing across the ridges of Virginia. At nine o'clock that evening he began the 200-mile drive to Bluefield, West Virginia, to prepare for an early take-off the following morning. Having talked with Karl by phone, he knew what he had to beat.

The cold front went through and then stopped to the southeast, helping to maintain steady northwest winds on the 9th. And so the stage was set for two pilots—both the same age, both professionals (Smiley is a copilot for Pan-Am), and both flying 15-meter glass ships—to simultaneously assault the "Striedieck Strip" from opposite ends. Jim's takeoff point, Bluefield, was 15 miles northeast of Striedieck's North Tazewell turnpoint, and his declared TP, a dam 11 miles southwest of Lock Haven, Pennsylvania, was 22 miles northeast of Eagle Field.

Smiley's takeoff was delayed by the last-minute need to move his start-finish line in closer to the ridge. At 8:52, the time of takeoff, there were very light surface winds. However, Jim had driven too far not to fly, and there were indications that the ridge was working. Lin Bachtell, Smiley's SSA Observer, towed him to his departure point just over the border of Virginia, where he released in the orographic lift being generated by a seven to eight-knot wind. Jim immediately headed the *Libelle* northeast, cruising at speeds between 80 and 95 knots, flying mostly straight in the ridge lift under a sky that was clear and dry with good visibility.

"The first 80 miles to Covington was no problem," he recounted later. "I was there at 0950. However, a big jump to the Hot Springs ridge was staring me in the face, and there was no thermal activity yet. It was my first temptation to turn for home. I never made it to the big ridge, but worked up the smaller wooded one nearer by. A few miles before Monterey I was able to climb high enough to move to the next ridge But the winds were still rather light and I was unable to stay up at a comfortable altitude. After Cherry Grove the leaves were rustling around a little and the going got better. Thermal activity was also picking up—along with my spirits.

"The climb to cross over to the Cumberland-Bedford ridge was made at about 1000 fpm, and the surface wind was 12-20 knots with associated turbulence. At 1240 I climbed to about 5000 feet to cross the wide gap at Bedford. To the turn and back to Cumberland was good going and the winds were still stronger."

Meanwhile Karl Striedieck was sitting on the ground after aborting his flight about 200 miles out because of weak conditions.

Smiley was back at Cumberland almost an hour earlier than he had originally estimated he would be. This pleased him greatly, because in the big rush to depart he had failed to bring anything to eat or drink. This, combined with the banging his head was taking against the canopy in the rough air, made him exceedingly anxious to get back home as quickly as possible.

The wind was dying a little, giving him a better ride, and he used a thermal once in a while to safely cross ill-defined stretches of ridge. By four o'clock, he had only 150 miles to go and was telling himself not to blow it now. He continued straight on down the ridge to Mountain Grove, Virginia (the turnpoint on Striedieck's very first record flight in the Ka-8), where a slight downwind transition was necessary. Working a 200-fpm thermal till it died, he established himself on the final 80 miles of easy ridge home. Five to eight knots of continuous wind for another hour would put it in the bag.

Arriving over the finish point, he soared an additional 45 minutes before landing so that witnesses could be brought out and the field checked out by his wife. The outbound leg of his 656.6-mile flight had been covered in five hours (65.7 mph), while he had returned in just four hours (82 mph), giving him an overall average of 73 mph.

"Isometric exercises really work," he lamented the next day. "Today I have very sore stomach and right arm muscles to prove it."

And so once again Karl Striedieck was an ex-world record holder.

Six days later Karl decided it was time to try and do something about it. Again he would have another sailplane out on the course with him—this time Bill Holbrook, who would leave from Eagle Field with Karl, hoping to bag Diamond distance. By the end of the day Bill and his *Libelle* would record the longest badge flight in soaring history. As Karl tells it:

"We took off at 0700 with Jeep tows from my wife, and it was soon apparent that the winds weren't as strong as we had hoped for but nevertheless enough to provide 80 to 90-mph cruise speeds. The Altoona gap nearly shot me down, and I dropped my water as I contacted ridge lift near the bottom of the ridge. At Bedford, Bill beat me across the gap by going west and contacting wave action. We met again at Cumberland after both sighting the same golden eagle about six miles west of Bedford.

"It was slow going to Petersburg, but we straggled along in weak wave flight and then got going again as the ridge improved. Near Seneca Rocks I blew 20 minutes when I got out of ridge lift and had to make a save. By this time Bill was miles ahead and I wasn't able to catch him again until Tazewell, Virginia.

"From there to the turnpoint there was no wind, and we were reduced to using the very poor thermal lift that was available. We only had about 1500 feet of working altitude, and at one point I announced that I was giving up and turning around. However, the thought that Bill was going to the turn for his Diamond distance and therefore had a chance of completing the task, much to my embarrassment, made me change my mind. We both made the turn at about 1315.

"The return flight was similar except that I bypassed Covington in a gamble to catch Bill, and we met again near Blue Grass. We stayed together until Altoona, where he landed after getting too low crossing the gap. I barely scratched around the corner and lifted hard enough on the stick to get back up the ridge into the stronger lift at the top. From there it was 60 to 100 mph to the field.

"If it's possible to get an ulcer in one day, I must have one after this 12-hour workout!"

Striedieck was once again king of the hills, with a record distance of 682.6 miles (1098.5 kilometers) at an average of 56.9 mph—the first man to hold the same world gliding mark on four separate occasions. And Holbrook had set a "record" non-record of 657 miles. (Documentation for all the American record claims must be approved by SSA and verified by the National Aeronautic Association and the

Federation Aeronautique Internationale before the records become official.)

What the future holds for the "O&Rographic" record, of course, remains to be seen. Surely, still longer flights will be made; that's the nature of the record business. Striedieck, himself, has previously speculated that as much as 900 miles may be possible under the right circumstances. But perhaps the most significant thing about all this flamboyant flying is that it vividly demonstrates that Eastern pilots don't need to give up distance flying at the end of the summer. Indeed they can now make flights as long as any in the world at a time when they used to quit flying entirely. For pilots who have grown accustomed to having their soaring conditions sneered at by uppity Californians and Texans, it's all pretty heady stuff.

27 THE WAY TO GO

by BILL HOLBROOK

Six hundred and fifty-seven miles in 12 hours—but I was still 23 miles short of the goal at dark with a barograph that ran out of ink six hours early and film that failed to record the takeoff declaration! This must be the most frustrating of all soaring lessons!

Karl Striedieck was the teacher and I was the student that October 15th. The flight taught me a lot, most important of all, to "be prepared." After reflecting on my errors, I called Charles Lindsay at the National Weather Service and asked him to work with me toward a world record attempt. At his suggestion I made a formal written request to the NWS for support. This came through with Chuck being directed by the Service to provide the help I needed. From the first of February on, we talked over the prospect for a record attempt along the ridge route nearly every day.

A detailed flight plan was prepared from Bald Eagle Mountain in Pennsylvania to Clinch Mountain in Tennessee, down the ridge by way of mountains with honest descriptive names such as Loop, Knobley, Back Creek, Short, and Beartown. Over hamlets with equally understandable titles; Hopeville, Rocky Gap, Indian Draft, Maiden Spring; past Rosedale (the October turnpoint) to Hansonville, Virginia, the new goal. Each mile was plotted and each altitude noted.

The operational plan was to ferry the towplane to Piper Memorial Airport, Lock Haven, Pennsylvania, when the forecast looked favorable, and to launch from there as early in the morning as we could safely fly.

The flight over the 816-mile ridge route would take 11 hours and 50 minutes at 70 mph, so we had to have a day of at least 12 hours. The first day with 12 hours between sunrise and sunset was March 18 according to the Hagerstown Almanac, an infallible source of astrological data and home remedies for rare diseases.

Wil Schuemann towed me on an abortive attempt on Monday, March 19, which ended across the road from a shopping center in Altoona, Pennsylvania, at 7:00 a.m. in the morning. My *Libelle* was well iced and sitting in three inches of new snow. It was not the first flight from Lock Haven to Altoona, but 70 miles in one hour should make it a record for the fastest flight in a glider between the two cities before 7:00 in the morning.

Bill and Alice Fuchs helped us launch and the Piper people were very hospitable. Everything worked but the weather. It was a good trial run.

On Friday, May 4th, I made my usual call to Chuck at Suitland, Maryland, the home of the National Weather Service. When he answered, he said he was just going to call me, because the next day, Saturday, the 5th, looked good. I called my partner, Ed Byars in Morgantown, West Virginia, to arrange for him to act as tow pilot and official observer. I then called my wife, Sophie, who is my Number One Crew Chief and secretary-treasurer. She set everything up for the trek to Lock Haven to begin at 5 p.m. after a final weather check.

Fortunately, my working days of flying included a two-hour layover in Greater Pittsburgh Airport where the Weather Service has an office with meteorologists who understand soaring and are familiar with Karl's record flights. I noticed that Karl's name was on the log as checking the weather at 8 p.m., Thursday, so maybe he would also be out on the ridge tomorrow. The prognosis and the 500-millibar charts were right on the forecast as Chuck had said, so Saturday would indeed be worth a try.

Two barographs were sealed using the dependable smoked drum. Both cameras were sealed with batteries for flashbulbs. The water ballast was doped with enough antifreeze to assure dumping at the forecast temperatures, several large plastic sandwich bags with rubber bands were stowed to take care of biological needs, and a half box of dried peaches was loaded for fuel.

The alarm clock was set for 4:30 a.m. When we awoke, the wind was blowing about 10 to 15 knots and it was spitting snow, exactly as forecast–3000 overcast with scattered light snow and winds 310 degrees at 10 to 15 knots. The pictures of the declaration were taken with flashbulbs in the hotel, two frames on each film. I hurried out to the field after two glasses of Instant Breakfast. Ed brought the Cub out to the east end of the runway while Sophie and I pulled the fuselage out of the trailer. Preparations went quickly and smoothly except for the one pint of ballast in the cockpit when the right wing ballast bag burped. This hitch accounted for the odd distribution of seven gallons of ballast–two in the right wing and five in the left. This also put us two minutes behind schedule, towing off at 6:02 a.m. Release was over the east end of runway 27 at 6:07 a.m.

Away I went down Bald Eagle Mountain at 100 knots in comforting bumps about 100 feet above the trees! I checked in with Sophie on 123.3, and both she, in the car, and Ed, in the Cub, answered. Ed dropped the towrope, landed, recovered it, and then took off to accompany me. A little later he buzzed Eagle Field, the home of Karl and Sue Striedieck, on top of Bald Eagle, to see if there was any activity. None? Good!

I reached Altoona in one hour and flew into a wave to top out at 5000 feet. I dropped down through the breaks when the wave quit and on to Bedford. After a couple of turns and a false start, the biggest gap in the ridge route was crossed at 7:52 a.m., not far enough behind schedule to worry about.

The weather was clear with a few cumulus at 6000 feet over Cumberland where the 1-26 Open House was just beginning. Ed landed the towship and took off in his Bonanza for Clemson, South Carolina, to pick up his daughter. The fact that the course to Clemson lay directly over my route had not escaped us.

The further south I flew, the better conditions became. Good thermal activity reinforced the ridge lift at Hopeville, West Virginia, and good became great at Indian Draft. Near Covington, Virginia, I picked up the Tri-Cities and Bluefield 10 a.m. weather forecast. Both stations were clear with surface winds from the northwest at 10 to 15 knots. Beautiful! Just as Chuck forecast.

The turnpoint was made at 12:07 p.m., exactly six hours after release, but four minutes behind the flight-plan ETA. I made three turns over the intersection of US Route 19 and Alternate US 58 at Hansonville where two pictures were taken with each camera, and then I started back to Lock Haven in booming conditions–so booming that I could not get down on the ridge, but stayed from 1000 to 2000 feet above and slowed to the rough-air yellow line of 90 knots.

The sack holding one of the barographs came loose from the fittings over the wing spar and dropped firmly down on the nape of my neck where fifteen minutes of diverting gymnastics were required to make it bounce aft. It stuck there for the rest of the trip. The low canopy on my *Libelle* served a good purpose as I was able to stretch up so my head remained tight against it instead of banging it at the gust frequency of one hertz.

The cheers of the Cumberland Group could be heard when I called for them to look up to the west where they could see me headed for Lock Haven at 4:05 EDT. The 1-26 meet was completing the day's flying and the cookout was proceeding toward the happy hour.

I slipped across the Bedford Gap at 5000 feet in strong thermals after rushing through three 1-26s working Wills Mountain ridge lift on a task from Cumberland to Bedford and return.

After the Altoona Gap was flown at good altitude, I climbed a little to relax as it appeared all was in good order for the final 70-mile run. Upon gazing to the west I noted another *Libelle* at a distance close enough to easily read 1B on the tail. At this same moment I heard, "Kimo Savee, do you see him yet?" Sue Striedieck was on the air. So Karl was out on the ridge after all! And where in the blazes did 1B come from? Where was his turnpoint? Then I heard Karl say "Yes, we have him." I asked the big question and the answer was that they heard the Cub that morning and knew who it was and why. Karl and Tom Knauff in 1B were providing escort from Altoona to Lock Haven.

Enough relaxing. We raced as fast as the turbulence would allow for Lock Haven. At Milesburg, about ten miles out, Karl turned back and I called "Room Service," the ground station for my *Libelle*, "Whiskey Hotel." Sophie's voice came back, "Room Service," I said, "you're loud and clear."

I enter the pattern at Piper Memorial and dump the ballast–oops, where is the dump valve handle? I feel the valve stem but no handle. Something (probably my 'chute) has knocked the handle loose in the turbulence. Oh, well. I touch down wet but lightly on the numbers, punch the clock, and note the time–6:03 EDT. That works out to an elapsed time of 11:54–four minutes late! Shucks, poor planning again.

More picture taking, kisses from "Room Service," and hearty congratulations from Alice Fuchs and from Tom Knauff, who landed at Piper Memorial behind me, even though his trailer and family were 40 miles away at Eagle Field, Karl's strip.

Best of all was a note on the kitchen table at home: "Way to go, champ!" from Lisa, my youngest daughter and Number Two Crew Chief. It really was the way to go, 783.2 miles and still two hours until dark!

Postscript

Some months before her father made his record, 17-year old Lisa Holbrook wrote *The Ups and Downs of Crewing*.

For many years I have crewed for my father without knowing what it is like to crew by myself and have his winning or losing depend on me. Last Labor Day weekend my mother had to bow out for some reason or another, so I was left to crew alone. I was excited by the challenge and hoped that my father would do well. You are probably wondering why I am writing this article, because many crews consist of only one able-bodied person. I feel there is a need for the pilot to know what the crew is thinking and doing while he is sailing off into the wild blue yonder. Therefore, I will now proceed to describe to you, the pilot, what a typical soaring day is like in the eyes of a crew member.

We always begin a soaring day with washing the sailplane. This can become a ritual doing it day after day. I know that everyone does this if he wants to have an equal chance, be it AS-W 17 or 1-26. It is just too bad that sailplanes are white. If they were black, we could maybe get away with leaving dirt here and there. It seems that all pilots think that they should be equipped with white gloves to give their sailplane the traditional "white glove test." There is one thing that we crew members can be thankful for, and that is the discovery that washing a sailplane is better than waxing it. My father used to make us wax his Standard *Austria* before putting it in the box and when we got it out the next day. This never made sense to me, but he always came up with a semi-logical explanation. At this time I feel I should point out the most discouraging thing for a crew member so that all pilots may take note, and that is to clean the sailplane better than ever and then have your pilot land out and complain that maybe if he had had a little better L/D he might have made it back. So obviously you feel guilty for not cleaning that small wing area that was too hard to reach.

Next on the day's agenda comes time for the memorable moment of filling the wings with water. We just began this evil practice, and I mean evil, last summer. If everyone puts water in his wings, then it seems to me we are right back where we started, where the pilot with the best L/D wins. I must admit the first time we tried this (and every time thereafter) the cockpit got full of water either during the process or while the sailplane was in the air. One time we thought we had been very careful and had done everything just right because we had not spilled a drop. Upon our return from the pilots' meeting we picked up a passerby and told him he could look at our sailplane. When we arrived back at our site the passerby picked up the wing and suddenly gallons of that evil liquid poured out of the wings, out of the tail, and into the cockpit. After a hectic hour in which the passerby could not understand what was going on, or if this was typical, we discovered our water bags had a leak. But it did add a little excitement to our day. Of course, if the water bags do get filled uneventfully, we then proceed to the takeoff line–which at some airports may be miles, and at others just a few yards away. Naturally, the pilot needs his rest so the loyal crew member begins the lonely trek, hike, or jog up to the takeoff site.

My father has this terrible habit of listening to the tape deck in the car as we move up the line. One memorable day Tschaikowsky's "1812 Overture" was at its climax and at every shot of the musical cannon the accelerator was pushed closer and closer to the floor. I enjoy good music–but not while I am running the 440-yard dash at Olympic pace. Once at the takeoff site we naturally have to wash the sailplane again because of the dirt that has settled on it during the "1812 Overture."

Another common occurrence is forgetting the parachute or film. By this time you have taken the car back down to the trailer and must resort to manpower. After running down to the trailer, you begin to consider trying out for the Marathon. (Why not?) The pilot immediately complains upon your return that your heavy breathing is steaming up the outside of the canopy.

You hope to have a few moments peace after running the wing for takeoff to collect your thoughts and look at the map while the sailplane is on tow. You catch your breath while walking back to the trailer to turn on the radio and listen for the sound of your pilot going through the gate and getting a good start. But sometimes there is the absolute horror of a relite. Now there is the mad rush to find your pilot, drive back to the airport at over 100 mph, re-assemble the sailplane, and then say good luck again–realizing that it did not help the last time. Finally, your pilot is on his way far enough out to make a relite impossible and to make it a contest day.

Many pilots believe in leaving their crews at the field, but for me this is the lowest form of torture. Being left at the field out of radio contact with only the phone to listen to is like condemning me to die of an ulcer. Every time the phone rings my heart stops, my stomach turns, and my eyes black out. The worst is to hear that the Number One pilot is down. With that in mind, all the crew members hook up their trailers and stand even closer to the phone. But it does not ring and you hear a distant scratchy voice on the radio that sounds like your pilot. Everyone jumps, waiting to hear your interpretation of the message–is he going down, or has he made the first turnpoint? Later on you hear something else, and this time you are sure it is your pilot.

It seems the best 'sports' are in the soaring movement. Everyone is always congratulating everyone else at the slightest news they might have heard from their pilot. There is always an offer of help if he is down and congratulations if he made the second turnpoint. Now your ears strain at every crackle on the radio whether you are out on the road or at the field to hear that wonderful sound of, "One mile out" (When you do hear it, you can congratulate yourself on what a wonderful job you did cleaning the sailplane and running the wing.) All of the bad thoughts about crewing disappear and you begin to dream of your pilot capturing first place. Suddenly, someone spots a sailplane on the horizon, very low and coming in over redline speed. You jump up and down, trying not to look too happy, because everyone is standing behind you wishing it was his pilot and congratulating you on his success. You hear a whistle overhead and look up to see your contest letters zip by. Suddenly, you find the energy to run out to the runway to catch that wing (that you did such a good job cleaning). He lands and comes rolling over for you to catch the wing. This has to be the most thrilling and exciting moment for a crew member. All your worries vanish and you dissassemble while watching everyone else finish.

With just these few moments of glory I am much more capable of lasting through a contest whether he came in first or last. I hope that every crew member has a chance to experience this moment because without it contests seem time consuming and worthless.

28 THE TICKING BOX

Take on a challenging new competitor–yourself

by ELEMER KATINSKY

Once upon a time there was a little box which made wiggly lines on the side of a drum, ticking merrily along . . . and this is where the tale will return to reality. This seldom utilized and often mistreated instrument, the barograph, is one of the most valuable aids to the advanced soaring pilot. Unfortunately, most pilots forget this benevolent helper after they have earned their last FAI badge, not realizing the wealth of information still to be gained from a barogram.

How many hours do you fly, dear reader? Thirty, fifty, maybe a hundred hours a year? You've probably spent quite a few piasters on soaring; besides the pleasant memories, what did you gain from those flights? How can you evaluate (even years later) that rather expensive venture around what was supposed to be a 300-km triangle? Human nature tries to cover events with a pleasant pink blanket of forgetfulness, and pilots intensify this by telling tall tales after the flight during debriefing in the nearby pub. These stories are full of 1000-fpm thermals and 120-mph glides, ignoring the half-hour spent at 300 feet above a dry lake in near zero sink.

Cool it, my friend! The only thing worse than deceiving others is deceiving one's self. Let's substitute fact for fancy, figures for fantasy, and see how you're *really* doing. Do you always get the best potential cross-country speeds from your sailplane? Are you flying at 95 percent efficiency, or is the truth nearer to 50 percent? If you're not afraid to find out, dust off your little ticking box and take it along on your next flight, *turn it on, man*, and get a good trace.

The nitty gritty

First, let's get down to the nitty gritty. A few days after a flight, take out the barogram, spread it out and start reading it. Have a polar of your ship on hand, too. This chore may even turn out to be more interesting than the late show on the boob tube!

To aid the reader in understanding the steps to follow, I have used a barogram of a practice flight I made last summer from El Mirage to Big Bear Lake, California (Figure 1). The trace was made by the author's Peravia barograph which gives a continuous trace, but the procedures detailed in this article are applicable to either smoked or ink-lined barograms. Also, it is a good idea to make a copy of the trace on vellum to use as a worksheet.

Flight data

During the flight you should note certain 'events' and record them on the time scale as shown (My Peravia has a smart little electric switch that places a dot on the horizontal time scale when I push it on the instrument panel. A note on my knee pad identifies it for future reference.) Times and altitudes of the following events are necessary for this analysis:

Takeoff
Release
Start gate crossing
Departure from the field
Turnpoints
Start of final glide
Finish, and

Anything interesting (e.g., the *low point* where you were about to dip your wingtip into Miss Jones' swimming pool, while watching her magnificent curves diving into cool water.

The second step is to extract the information contained on the barogram and cockpit notes and reduce it for display in

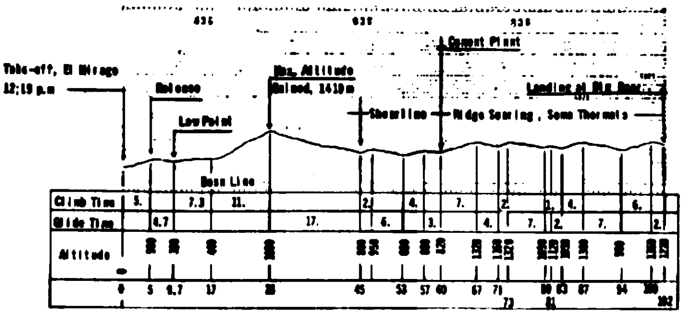


Fig. 1

Data No.	EVENTS, REMARKS	TIME Elapsed hr.	min.	Climb min.	Sink min.	ALTITUDE Actual M	Gain M	Loss M	RATE OF Climb m/sec	Sink m/sec	DISTANCE (Km)
1	2	3	4	5	6	7	8	9	10	11	12
1	Take off	12	19			0					
				(5)			(500)		1.67		
2	Release		26			500					
					4.7			110		0.39	7.35
3	Low Point		28.7			390					
				7.3			150		0.34		
4			36			640					
				11			1360		2.06		
5	High Point		47			1800					
					17			1000		0.98	25.63
6	Shoreline	13	04			800					
				2			150		1.25		
7			08			950					
					6			270		0.75	9.1
8			12			680					
				4			200		0.83		
9			16			880					
					3			60		0.33	4.5
10	Cement Plant		19			820					
				7			500		1.19		
11			26			1320					
					4			160		0.66	6.06
12			30			1160					
				2			160		1.33		
13			32			1320					
					7			230		0.55	10.52
14			39			1090					
				1			30		0.5		
15			40			1120					
					2			70		0.58	3.0
16			42			1050					
				4			250		1.04		
17			46			1300					
					7			320		0.76	10.52
18			53			980					
				6			380		0.79		
19			59			1360					
					2			140		1.16	3.0
20	Landing	14	01			1220					

Table 1

tabular form as shown in Table I. It will be noted that the barogram's horizontal lines of information have been displayed in vertical columns in the table. (All my variometers and my barographs are metric, therefore I use metric units for the calculations.)

At this point I would recommend the reader spend a few minutes examining and comparing the barogram and the table.

The information in column 12 (distance between thermals) is not available, of course, from the barogram. It is only an approximation and is calculated as $s = V_g t_2$. This would be true only if the gliding speed was indeed V_g. But obviously in zones of strong sink one flies faster, and with the help of the speed polar a correction of 's' can and should be made. With these corrected values one can prepare a 'thermal map' by locating and measuring the distances between each thermal on the air chart. If thermals have been pinpointed on the air chart, distances may be taken off directly.

Next, we need to determine rates of climb and sink. This can be a somewhat tedious process, and I recommend the use of a 'barogram evaluator' (Figure 2). This handy device was

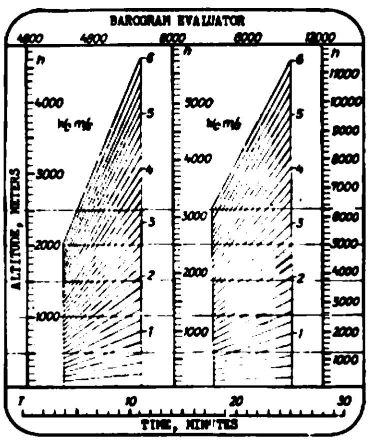


Fig. 2. Barogram Evaluator. Directions for use: Place vellum copy of the barogram on this device and move it vertically until one of the thermal strength lines coincides with the barogram. Be careful that the time scales remain parallel. Rotate the barogram around the time axis to its backside to measure sink rates. The climb-speed (W_c) scales are shown for 4800-m. and 6000-m. barograph ranges. For 1200-m. barographs, multiply the rates read on the 6000-m. scale by a factor of 2.0.

developed by George Petroczy of Hungary (who finished ninth in the World Championships in 1970 with a clipped wing Standard *Austria*). The device, as pictured, is scaled for my Peravia, but a reasonably ingenious do-it-yourself reader can adapt the design to his own instrument.

When the data reduction has been completed and tabulated, the next step is to calculate the following:

Total climb time:

$T_c = 44.3$ min. (sum of col. 5)

Total glide time:

$T_g = 52.7$ min. (sum of col. 6)

Total altitude gained:

$H_c = 3180$ meters (sum of col. 8)

Total altitude lost:

$H_g = 2360$ meters (sum of col. 9)

Total distance:

$S = 79.7$ kilometers (sum of col. 12)

Average speed:

$$V_s = \frac{S}{T_{total}} = \frac{79.7 \times 60}{102} = 46.9 \text{ km/hr.}$$

Average glide speed:

$$V_g = \frac{S}{T_g} = \frac{79.7 \times 60}{52.7} = 91 \text{ km/hr.}$$

Average glide ratio:

$$\frac{L}{D} \text{ avg.} = \frac{79.7 \times 1000}{2360} = 33.8$$

Average thermal strength:

$$W_c = \frac{H_c}{T_c} = \frac{3180}{44.3 \times 60} = 1.19 \text{ m/sec.}$$

Average sink rates:

$$\frac{H_g}{T_g} = \frac{2360}{52.7 \times 60} = 0.746 \text{ m/sec.}$$

Ratio of climb time to total time:

$$\frac{T_c}{T_{total}} = \frac{44.3}{102} = 0.434 \text{ or } 43.4\%$$

Now, grab your trusted polar and find out what your optimum speed between thermals should have been. For those who are unfamiliar or rusty, this quick graphical method (Figure 3) is presented.

Scoring oneself

You are ready for the final step. Score yourself by computing:

$$\frac{\text{Average glide speed}}{\text{Optimum cruise speed}} = 1000 = \begin{array}{c}\text{Point}\\ \text{score}\end{array}$$

Substituting the numbers for my Big Bear Lake example:

$$\frac{91}{130} \times 1000 = 700$$

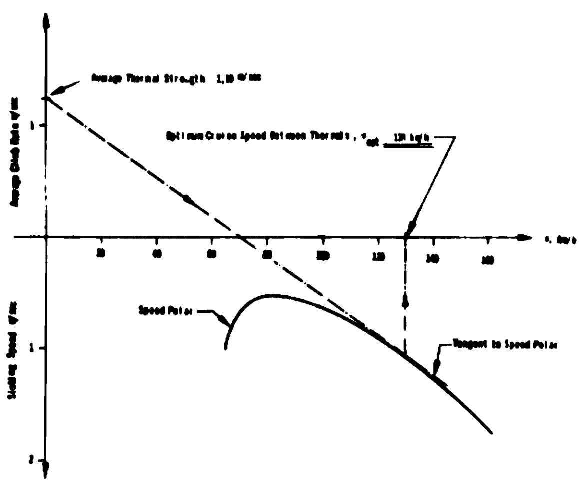


Fig. 3. Optimum speed between thermals

Okay, so I rated 700. How did you do? If your score is above 850 you are doing pretty well. When you consistently top 900 it is time to buy a better sailplane. (Or admit you fly in Texas; effects of wind and utilization of cloud streets can make the V_{gt}/V_{os} exceed one, therefore this number must be viewed with caution.)

If you are a lazy bum like me, you undoubtedly prefer to let some stupid diodes to the work for you, using handy-dandy computer programming. It's much simpler and you'll get a lot of information for your money and the little time you spend preparing your input data. A simplified flow chart of the program is shown in Figure 4. Input is simple (please stop laughing), basically a digital tabulation of the diagram as shown on Table 2. The computer output for the flight analyzed in Table 1 by hand calculation is shown on Table 3.

Now you know how to do the work. Look at your numbers and reach for the handkerchief . . . or perhaps you learned what *not to do* next time. My student pilots hear this jingle from me quite often. "Do your learning on the ground

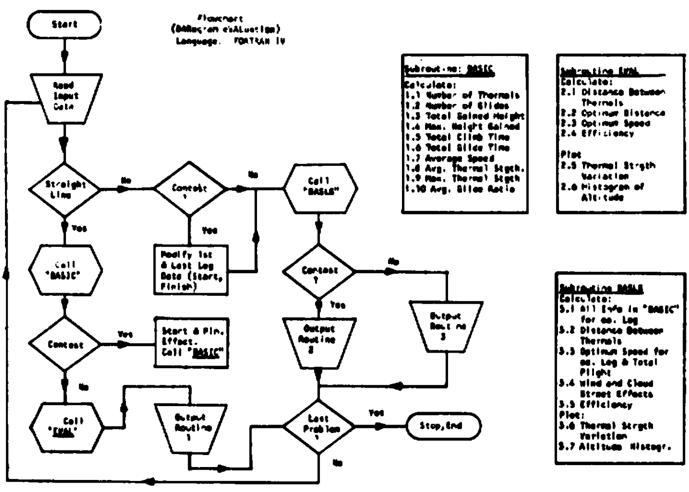


Fig. 4

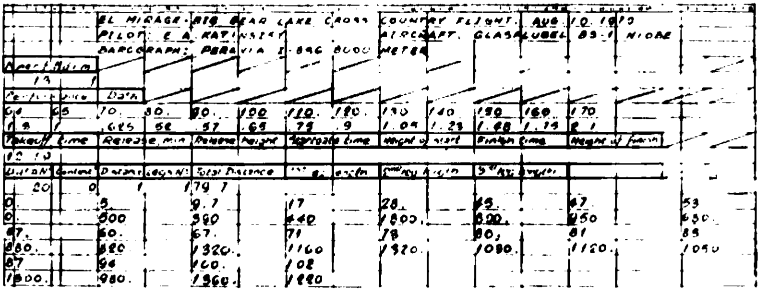


Table 2. Computer input

BAROGRAM EVALUATION FOR A STRAIGHT LINE NON CONTEST FLIGHT.

EL MIRAGE-BIG BEAR LAKE CROSS COUNTRY FLIGHT.AUG.10.70
PILOT E. E. KATINSZKY   AIRCRAFT GLASFLUGEL BS-1
BAROGRAPH PERAVIA I-836   METRIC UNITS

AVERAGE SPEED	46.90
AVERAGE GLIDE SPEED	90.74
AVERAGE GLIDE RATIO	25.87
AVERAGE THERMAL STRENGTH	1.19
AVERAGE RATE OF SINK	-0.74
TOTAL CLIMB TIME	44.30
RATIO OF CLIMB TIME TO TOTAL TIME	0.45
TOTAL ALTITUDE GAINED	3380.0
MAXIMUM GAIN OF ALTITUDE	1410.0
NUMBER OF THERMALS USED	8.0
NUMBER OF GLIDES	9.0
TOTAL GLIDE TIME	92.7
AVG.THERMAL DISTANCE	8.9
OPTIMUM SPEED BETW.THERM.	133.9
OPTIMUM DISTANCE	117.1
EFFICIENCY FACTOR	0.680

GLIDE NO.	ALTITUDE LOST	SINK RATE M/SEC
1	-110.0	-0.38
2	-1000.0	-0.97
3	-270.0	-0.74
4	-60.0	-0.93
5	-160.0	-0.66
6	-230.0	-0.56
7	-70.0	-0.58
8	-320.0	-0.76
9	-140.0	-1.16

THERMALS

NO.	INTENSITY
1	1.283
2	1.249
3	0.832
4	1.189
5	1.312
6	0.699
7	1.041
8	1.055

Table 3. Partial computer output

where you have lots of time to think, meditate, and chisel sailplane flying into your brain. It is like programming a computer. Then, during training flights, coordinate the movements of your limbs to the rotations of the aircraft. Debug your program."

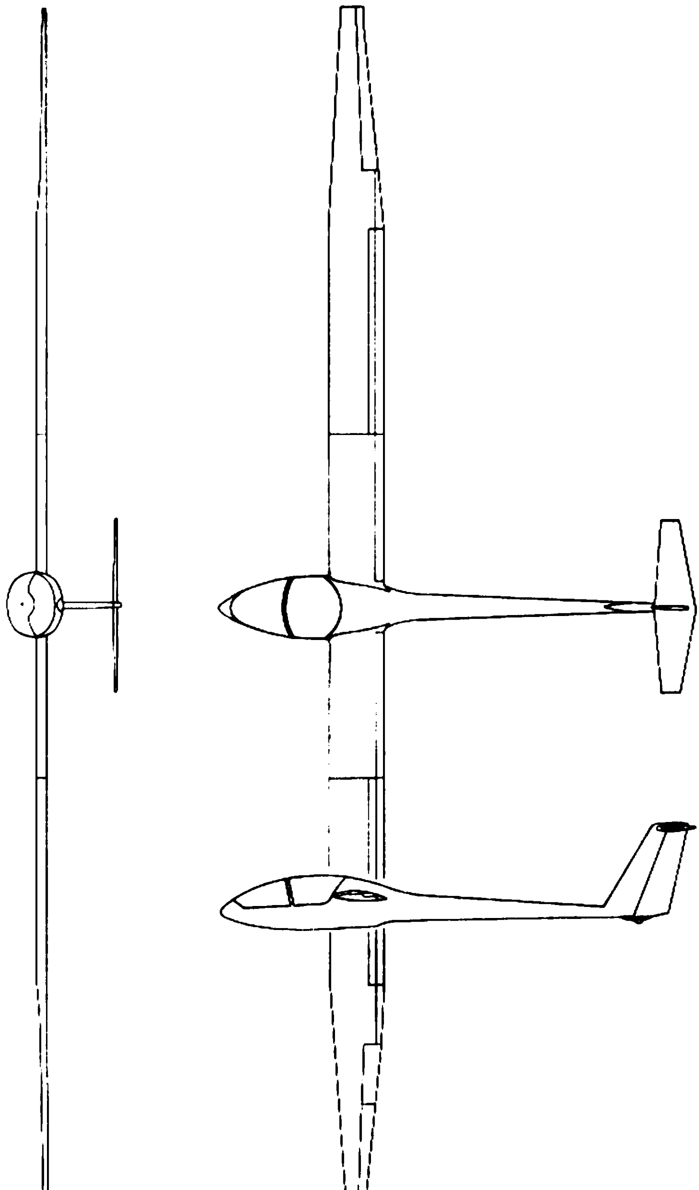
Barogram analysis is the same 'debugging' for the advanced soaring pilot. Good luck . . .

29
MAKULA AT MINDEN

by JOHN SERAFIN

In only three weeks the '72 Nationals at Minden, Nevada, were due to begin. We were expecting Ed Makula's arrival from Poland any minute. Instead, the 42-year-old former World Champion called directly from Warsaw, asking what had happened to all of the necessary paper work to clear his trip . . . official invitations, visa arrangements, personal guarantees, etc., etc. What a bombshell! All of the necessary arrangements had been meticulously attended to by a number of hard-working people more than two months previously. Many long distance calls to consulates, embassies, the State Department, SSA headquarters, etc., and all of the red tape was repeated in a record two days. Ed arrived in Phoenix three days before the contest began. The holdup? The desk drawer of a bureaucrat specializing in red tape!

Hugo Taskovich placed his Caproni A-21 at Ed's disposal, the same Italian ultra-high-performance two-seater that A.J. Smith had flown in the Smirnoff Cross-Country Derby the previous May. The original plan called for three weeks of flying before the competition to get to know the ship and, more importantly, to get to know the peculiarities of the air masses of Minden. Also, if Beautiful Lady Luck permitted, to set a Polish or perhaps a world's multiplace record or two. However, this time the Beautiful Lady frowned at our plans. With only a couple of short flights, one a checkride with our B.S. Smith, the first contest day was on. This time the Beautiful Lady not only smiled at me—she kissed me. I was Ed's passenger for the first contest day!



Caproni A-21 Calif

What's it like to observe a virtuoso of the sailplane in concert under contest conditions from a front-row seat? Sheer ecstacy! I learned more about piloting and cross-country techniques from this flight than from any previous dozen or so of my 37 years in soaring! Also, it turned out that this guru possesses psychic talents. On the last leg of the triangle, while keeping the Caproni's big 20-meter span within the rough and narrow lift along the slopes, Ed muttered to me. "The guys who chose to fly Standard Class ships here know what they're doing. The one who's going to win this contest will be flying a small-span ship and know this Minden area micro meteorology well. I sure would like to be flying a Standard *Cobra* or *Orion* right now." The final standing revealed that Ed was right–five times! Toward the end of the contest Ed requested a rap session with a pilot knowing this area well–so I lined up Carl Herold, who knows it perhaps even better than the palm of his hand. Some of Carl's comments certainly proved profitable, especially during the goal & return record run.

Suddenly, it was the end of a well-run contest, and the traditional banquet night was hearing Mr. Edward Makula as the featured speaker. Acting as his interpreter was young Dr. Roman Kaluzniacki, mathematician recently turned soaring pilot. He was Ed's on-board computer during most of the contest flights. Of the five or so languages that Ed speaks in addition to his native Polish, I sometimes wonder if he needs an interpreter at all! The speech was interesting, exciting, and spiced with humor. "They told me to fly high, but they didn't tell me to fly fast."

Since Ed still had twelve vacation days remaining from his job as an airline captain with the Polish airline LOT, he decided to stay at Minden to apply some of his newly acquired know-how of Minden meteorology (plus a better feel for the Caproni) by taking a stab at setting some multiplace records. With the aid of mathematician Dr. Kaluzniacki and official SSA observer John Spealman, Ed laid out some world record courses. John was an experienced hand at the official observing of world-record attempts, having acted as such during some of Joe Lincoln's world multiplace record runs.

Attempts at speed triangles, distance, goal, or goal & return would of course be related to the weather conditions of any given day. Benny Sapyta, Ed's crew chief at the Marfa World Championships, was set up as our meteo-info input source operating from the FAA Flight Service Station at Roswell, New Mexico, plus support from Doug Armstrong and Neil Cunningham of the Reno F.S.S. The plan to keep attacking the 100-km triangle as much as possible and go for the big ones when big sky weather came along.

It was the last day of July. Ed glanced at the meteo info, then up at the sky and said, "It looks like a 300-km triangle day." We crossed Spealman's starting-line string at 2:30 p.m. and headed out SE into blue skies where shortly Ed located some 600-fpm lift to 10,000 ft. ASL and we streaked for the 9000-ft. hills on course to Bridgeport, the first turnpoint. These slopes got us to 15,000 ft. ASL. Three more 600- to 700-fpm thermals and we were taking photos of Bryant Field

Makula—300-km record in the bag

at the turnpoint from 5000 feet above ground. Next, Ed slope-soared on the hills NE of Bridgeport and made fine use of a weak wave downwind of these hills as we headed for the 11,000-ft. peaks west of Walker Lake. Small cu began to build at about 12,000 ft. ASL, but without any lift under 'em. The peaks before Walker Lake gave 800 fpm to 16,500 ft. ASL. From here Ed headed straight for Rawhide, the second turnpoint, with almost no lift all the way. It soon became obvious why this nothing in the middle of nowhere is called Rawhide: "raw" for the few unpainted board buildings whose color matched that of the surrounding desert sand, and "hide" for how well it is hidden in the valley. We were worried that because of the lack of shadow at this time of day and the low color contrast between the buildings and the terrain, the turnpoint photos wouldn't turn out too well, so we took extra shots with both cameras–just in case.

Heading back home was miserable. A strong headwind all the way, and four mountain ranges which had to be crossed with a downwind side approach to each–this was real sweaty-palm flying! At Yerington the altimeter showed us only 1400 feet above ground. Yerington Airport sure looked nice from this altitude, but Ed drove straight for the 9000-ft. peaks before Minden. I still can't figure how he scaled these slopes rock by rock (which seemed to take time eternal) and suddenly shot us through the notch, with scant feet to spare, straight for the finish line. Now it was possible to get John on VHF just in time for him to lie down below his stretched string and clock us at an average of 114 kph (70.8 mph for the 199-mi. course) . . . Ed's first world record at Minden. And in such mediocre meteorology. What could Ed do in the Caproni if conditions were booming all the way around the course?

On the first of August, we had official SSA observer Spealman hard at work, lying flat on his back, sighting up the starting-line string at the Caproni, as Ed and I made three roaring assaults at the 100-km, triangle that day. No record, but it sure got our total three-man system smoothly snychronized. With John as official observer and me as official second-seat sandbag, our chase crew was zero. As Ed said, "No off-field landings allowed except for the goal or distance tries."

On the second of August, Ed declared the southernmost of two 500-km triangles previously laid out: Douglas County Airport–Chalfant–Gabbs–Douglas County Airport. At about 1:45 at 10,000 ft. ASL, Ed said, "We should have chosen the northern course where the clouds are visible; let's land." So we VHF'd John to round up Bill Greenwald and his Piper PA-25 towplane again and to bring out the northern course declaration, which was photographed directly from the Caproni cockpit, and we were airborne again pronto. As we went across the Spealman start-string again, it was almost 2:30 p.m. This late a start for a 500-km triangle, I thought, Makula's gone mad! Pretty soon we were under cu's at 14,000 ft. ASL and moving fast for the first turnpoint at Susanville. Twenty miles before the turnpoint, the thermals turned off and suddenly we were gliding in butter-smooth air. Susanville was photographed from 2700 feet above ground. High cu's were visible about 50 miles out on course to Lovelock, turnpoint number two, but we were still sailing in smooth air at minimum sink, fortunately with a tailwind and with the terrain on course dropping off. A couple of miles east of Honey Lake, Ed nursed a 200-fpm dry thermal for 3500 feet of climb, making it possible to max L/D over to the clouds north of Pyramid Lake; and, wow, it was suddenly 1000 fpm to 18,000 feet!

Fifteen miles from Lovelock the air was smooth again, and as we rounded the second turnpoint at 6000 ft. above terrain, the view down the homeward bound course was a cloudless blah. And it was already quite late in the day. So what now my love?

So now Ed flew 60 miles back down the second leg and 10 miles north of it to where a cloud was and cranked out 18,000 ft. ASL at about 700 fpm. Minden was now 105 miles south, which would almost make this a one turnpoint triangle flight! It was one long smooth glide at max L/D along Pyramid Lake toward home base. The Caproni A-21 glide ratio certainly is impressive–anyone doubting its 45 to 1 capabilities should fly it, he'll like it! We passed just to the east of Reno International Airport, which, with the notorious Carson City sink area just ahead this late in the day, sure looked mighty inviting–but not for Ed. He was bound for the foothills of Virginia City, where sure enough he struck pay dirt—a 200-fpm bonanza for a 700-ft. gain, just enough to foil the Carson City sink and to gingerly cross over John's finish line string at an even 100 kph average for the course. Three hundred and twenty-two miles. at 62.1 mph, the second world record for Makula at Minden.

August 3rd brought three more tries for the 100-km triangle record to no avail. Breaking this record may seem the easiest of the three speed triangle-course records because it is the shortest. Actually, it is the most difficult, because there is no allowance for even the smallest error.

On August the fourth, Hugo Taskovich, distributor for the Caproni sailplanes, came to Minden just in time to fly as a passenger on another of Ed's attempts for the evasive 100-km triangle record. On his second try that day, at 4:30 in the afternoon, Ed synchronized with a local front, coming in from the southeast and roared around a 117-km (73-mi.) course that began and finished at the intersection of Nevada State Highway 19 and U.S. Highway 395 (just southwest of Douglas County Airport at Minden) with turnpoints at Dayton and Valley View Airport. Streaking in for the finish line at redline plus 10%, plus 10% of the 10%, we could tell by the way Hugo sounded, as he tried to transmit the one-mile-from-the-finish-line position, that the Caproni was really traveling through rough air . . . His voice seemed to be bouncing between the single sidebands! Hugo said it was like re-entry in the Gemini capsule.* He had his head and one hand braced against the canopy top and kept grabbing things which were floating around in the cockpit and sticking them under his legs! With an average speed of 128 kph (a fraction shy of 80 mph), Makula was obviously mastering Minden meteorology!

For the next three days the weather was blah, so we caught up on our world-record paper work and showed Ed some of the gambling casinos at Tahoe City.

On August eighth, Ed looked at the sky and declared a 716-km (445-mi.) goal & return south to Darwin, California.

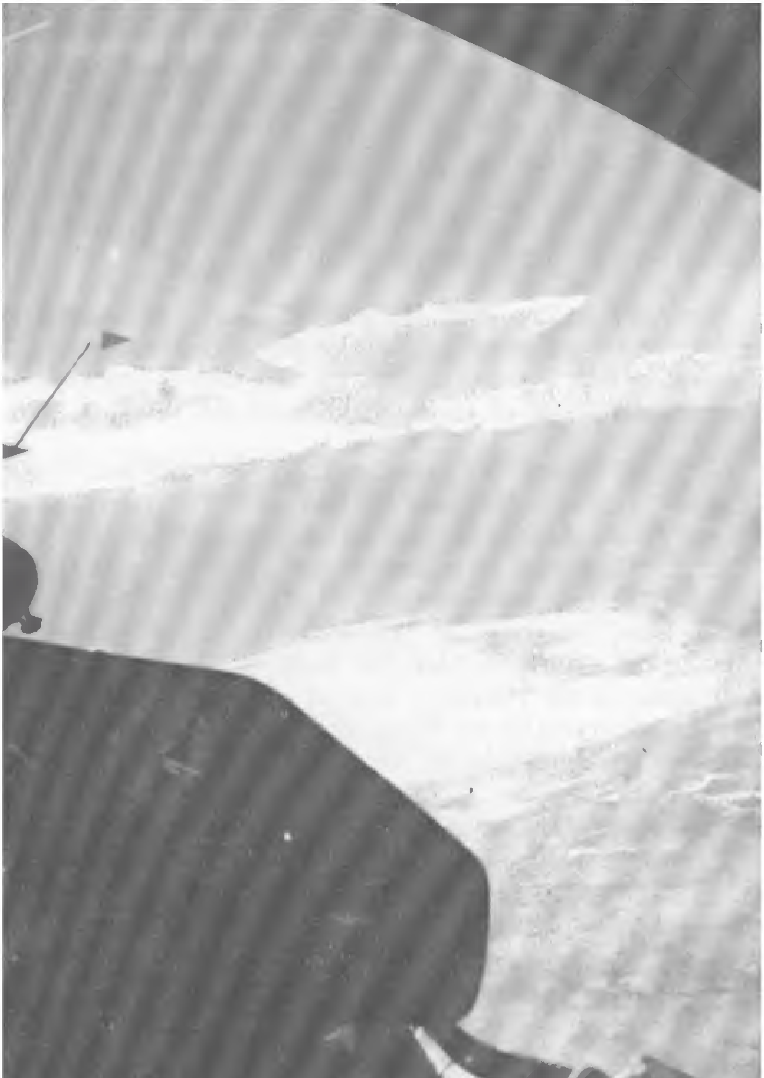
---

*Didn't know Hugo had been an astronaut. Ed.

By now, we had run out of cardboard placards to print declarations on, so John suggested using the side of the Caproni trailer, which worked out best of all with plenty of leftover space for future record tries! Tow release time was 12:48 p.m. with lift up to 800 fpm to 12,000 ft. ASL. Directly south on course scattered cu's were visible; to the southwest were high cu-nims. Lift was around 600 fpm to 15,000 ft. to the Lake Crowley area, where Ed crossed the top of famous Owens Valley to the western slopes of the White Mountain Range. The visibility down the valley was fantastic. We could see all the way to China Lake, 120 miles south. The slopes generated lift up to 1000 fpm to 18,000 ft. ASL.

Waiting for the weather

As we passed the famous wave soaring site of Bishop, California, names of famous soaring pilots who flew here came to mind: the late Bob Symons, who pioneered this area; Ray Parker, chief pilot for the standing wave project which was carried on here in the early '50s; Paul MacCready and the beautiful *Orlik*; Johnny Robinson; Bill Ivans; Harland Ross; Harold Klieforth; and Dr. Joachim Kuettner, who waveflew a TG-3 from here to Williams, Arizona, a distance of 375 miles



SERAFIN

*Makula (note hand) taking world multiplace goal/return—
anvil cloud is over Mt. Whitney*

at almost a 100-mph average! Also the late Karl Erik Ovgard, my friend from Sweden, whom I helped bring to the States to participate in the wave research project. He had flown the wave in Sweden and in Czechoslovakia. Karl's passion was wave flying. Here at Bishop, in 1952, Karl was so entranced by the climb in a fabulous wave that he forgot to mind his oxygen equipment and outflew its capabilities. He paid for his passion with his life. The Mistress of High Altitudes doesn't forget mistakes in the love of wave flying!

East of Bishop at 18,000 ft. ASL at optimum cross-country cruise speed for 1000-fpm light conditions, I discovered that our oxygen system was malfunctioning. So we immediately went on short ration of this valuable elixir.

North of Owens Lake the dry thermals weakened to 600 fpm, and Ed carefully chose his way east of this dry lake to Darwin, our turnpoint, which we photographed at 3:27 p.m. from 15,500 ft. Ed now headed back carefully past Owens Lake to the sunny western slopes of the White Mountains. From here, the view of Mt. Whitney was inspiring. We climbed the 11,000-ft. peak just north of Lone Pine at 1000 fpm again to the 18,000-ft. base of some scattered cu's. Ed left the north end of the White Mountains at 18,000 plus and we were streaking through the pass at Topaz Lake toward Minden in no time. Landing time was 6:05 p.m. for an average speed of 87 mph. Ed had flown to the goal in 2:39 and returned from Darwin to Minden in 2:38—that's really keeping schedule! No wonder he is considered such an excellent airline captain!

So those were the four records of Makula at Minden. There perhaps could have been more, but Ed positively had to be back at his job *on time* in a couple of days. So John and I rushed him to San Francisco, where Hugh Taskovich was to have arranged an English visa for Ed for his return to Warsaw via London. But it was that blooming red tape again, and it could not be done in less than a week. So Hugo rushed Ed over to the Italian Consulate and introduced him as the pilot who flew a Caproni sailplane to four world records and—*mama mia!*—an instant visa.

THE LIGHTER SIDE

30
OUT OF THE EGG
Starting the hard way

by JOHN JOSS

"Get that wing tip off the deck, you bloody fool. And keep it up and level with the other one! Did I waste all of my time at the preflight? Is there anyone in there?" My instructor glared stonily into my face from a distance of about ten inches. It was hard to avoid flinching as he breathed on me; his eyes, bloodshot from last night's gin in the wardroom, regarded me malevolently. Why in hell had he volunteered to train twenty uncoordinated Royal Navy cadets from Dartmouth to fly, he was thinking. An instant's inattention was shattered: "WINGS LEVEL . . . LEVEL . . . LEVEL," he roared. The roar stopped abruptly, interrupted by a heavy bout of coughing. As ferocious counterpoint, a Seafire hurtled in over the fence for a simulated carrier approach, 12 Merlin cylinders raging into the morning air.

The year: 1951. The place: Royal Naval Air Station, Culham, near Oxford—"H.M.S. Seahawk". The occasion: ab initio flying training in the Royal Navy. The 'aircraft': primaries. The method: sit on the ground facing into wind, and keep the wings up and level, under the direct and abusive supervision of a Lieutenant Commander older than Methuselah—at least 35—a Scot with several thousand hours in everything from Swordfish ("Stringbags") to sea Sea Vampires. We struggled with the 'aerodynamics' of the primary. We watched in anticipation as fighter squadrons in Seafires and Sea Furies went about their business. Could we ever reach those Olympian heights? At 17, it was a heady dream at best.

Out of the egg

"Hold that altitude, ten feet, TEN FEET. Hold it, you incompetent moron. Watch my 'bats', and KEEP THOSE BLASTED WINGS LEVEL OR I'LL HAVE YOUR GUTS FOR GARTERS!!!!" My instructor perched in acute discomfort in the back of the Jeep as it bounded across the grass, yelling instructions through a megaphone across the fifty-odd feet separating us–fifty feet of tow wire. We were graduating from just sitting there to actually flying the thing. It was hard to generate much affection for the primary in comparison with the svelte sensuality of the Seafire. But it could at least simulate flight and it did respond to conventional control actuation. The miniscule plywood seat and single lap belt constituted a precarious perch; the wind howled in the wires, the fabric-covered wings creaked and groaned in sympathy; the thought of flying higher than ten feet in the contraption filled me with dismay. "CUT . . . RELEASE . . . DIDN'T YOU SEE MY BATS? . . . YOUR BODY MAY BE HERE BUT YOUR MIND IS IN SOME BOOZER WITH SOME BIT OF FLUFF . . . CUT!" Galvanized into action, I pulled up the naked wire with my left hand, and the tow fell away. With all the grace of a greased refrigerator sinking into a bog, the primary sank to earth instantly, jouncing to a halt on its slim wooden skid. I had 'soloed', from ten feet! No duration record was set, however.

"Any landing you can walk away from is supposed to be a good one", said my instructor with heavy sarcasm, as the Jeep rounded back and pulled up alongside. "Your control of that thing between your legs–the stick, I mean–bodes poorly for your future. You should have ended up ten feet underground instead of on top of it. Let me try, for the hundredth time, to explain the nuances of the flareout to you. Then we'll try it from twenty feet. OK?"

Little by little we added height, lengthening the tow wire, until instructions by voice were impossible and only the green dayglow bats conveyed the instructor's wishes. By the time we were releasing at 250 feet, there was time to practice one stall, straight ahead, immediately after release. Then, at 500 feet, there were gentle turns to the left and right, or a complete 180° reversal before landing. The terminology flew thick and fast . . . wind gradients near the ground, angle of attack judgement, speed control by listening to the airframe, minimizing slip and yaw by co-ordinating the hands and feet, planning the complete flight path at the instant of release. Finally the winch replaced the Jeep, and tow altitudes were up to 1,000 feet.

Gradually the abuse level receded as survival became more likely. The class also receded in numbers, as some members decided that becoming a bird was not for them. There was an important advantage to a smaller class: each of us got a larger share of flying time available from the three busy primaries. I was first in class to get my 'A', to the accompaniment of grudging hyperbole from my instructor: "Not a total disaster, then. Perhaps there's a glimmer of hope you'll eventually learn to fly." The 'B' badge followed rapidly therafter.

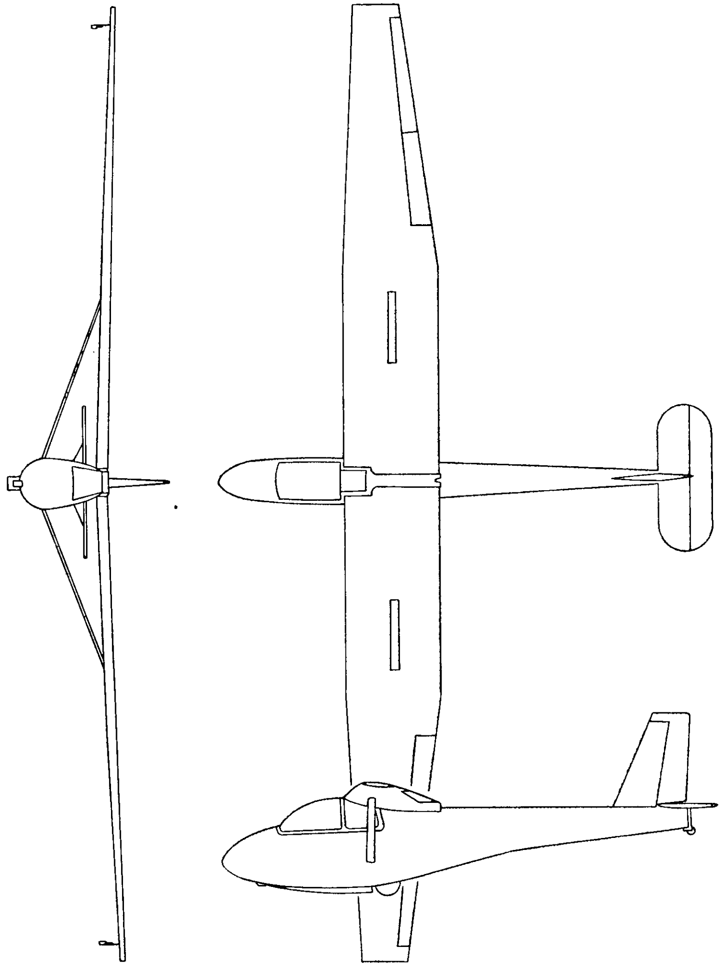
"Let's take a look at how the other half lives." My instructor was in a jovial mood as we waddled across the grass, encumbered by parachutes, to the Tiger Moth. It stood resplendent in the yellow paint of a Royal Navy training aircraft, waiting for us. "I've already done the preflight," he said. "She's all ready for us. You go up front, and I'll climb in the back." We buckled on our parachutes and strapped ourselves into the tiny cockpits. Unaccustomed to the procedure, I noted as I finished that we already had power, and the chocks were being waved away. "OK, you taxi."

Where was the voice coming from, muffled and indistinct? "That tube in front of you!!!!" It dangled suggestively from the frontal recesses of the cockpit above the instruments. There was a funnel-shaped protruberance on the end slightly reminiscent of an oxygen mask. I picked it up and spoke into it: "Me taxi? Roger." Discovered, the infamous Gosport tube. Today, its successors in the sleekest jetliners are called inflight entertainment systems!

It was difficult to see over the nose, but we wove across the grass until we were parallel to the main runway. "Turn into the wind, and when the tower gives you a green I'll add power and you take off." Off to the right I could see the tower, and then from the glasshouse a green Aldis lamp flashed steadily. The Cirrus engine at the front roared into vibrant life, shaking the airframe violently, and we started to accelerate. "It's just like a primary with power", said the voice through the Gosport tube. "Be sure to control that power swing with the rudder. Wait for fifty knots and let it take itself off. Climb out to 1,000 feet straight ahead."

We accelerated to an amazing 65 knots, climbing relaxedly, the altimeter slowly winding up. "Level out now, and turn left slowly–keep the top of the engine cowling level with the horizon and we'll hold our altitude with this power setting. Now roll out and hold this heading." I complied, and we wafted across the green Oxfordshire countryside. Suddenly a strange and eerie noise started. The hair on the back of my neck stood up, and I looked around me in alarm. Suddenly, as I swivelled round to look into the rear cockpit, I realized that it was him. Grinning hugely behind the issue Mark VIII goggles, mouth working vigorously, my instructor was rendering his repertoire of bawdy Scots ballads. "Face the front, ye damned Sassenach", he yelled at me. "We're going to try a few minor aerobatics once you've got the hang of straight and level." I might even let you drive it by yourself later, provided you can return us to 'terra firma'.

We climbed laboriously to 3,500 feet, and the demonstration began. It started with a loop, but he added a little flair to it by floating over the top at ridiculously low airspeed ("It can't stall as long as you keep the angle of



2-33

attack low, but you must handle those controls d-e-l-i-c-a-t-e-l-y"); then we rolled in all the regimes of which the little Moth was capable. The maneouvers seemed to be timed with the music, if you could call it music, as we worked the repertoire through once again. Finally, "let's see you try" was the instruction. Years later, even an F4 Phantom—with its 400°/sec roll rate and its brakes-off-to-10,000-feet-in-35 seconds—cannot fully recapture the joy of those moments. The subsequent solo was equally memorable.

* * *

"On a scale of ten, with ten best and one worst, I'd give you . . . oh, let's say a 'six' on that approach and landing." My instructor stands alongside the cockpit, lips pursed reflectively. "You keep hunting for the ground. It's not a blasted flight deck! And you stand a risk of overshooting by coming in too high. Hard to 'go round' in these babies. Just use the airbrakes as glide path control device, maintain speed and attitude, and let it land itself just to the flareout point." He must be wondering whether I've ever been behind a stick before. Certainly, I'm wondering. Perhaps nineteen years is too long a layoff . . .

The year: 1972. The place: Calistoga Soaring Center, in the heart of the wine country, north of San Francisco. The occasion: repetition of ab initio soaring instruction. The aircraft: Schweitzer 2-33s. The method: air tow to 3,000 feet, under the direct and polite supervision of a civilian instructor even younger than I am (still). As we struggle with the aerodynamics of the 2-33, I watch in anticipation as experienced soaring pilots in Libelles and AS-W 15s and Diamants go about their business. I've read about many of them, and their competition records and their Diamond distance flights and their wave exploits at Minden and Truckee. Can we ever reach those Olympian heights and attain the coveted Diamonds? Only time will tell.

31
OLD DOG NEW TRICKS
Who says you can't teach him?

by RICHARD A. WOLTERS

This is how the comedy of errors leading to Silver badge number 1494, and my first competition flying, all got started.

Just under 11 months earlier, Arthur Hurst had taken me for a ride in a 2-22. I was sold on this business and immediately took lessons. Before I had my license I bought a Ka-8B. Even the man down at the friendly Household Finance Company now knows the names of George Moffat and Gleb Derujinsky; I sold him a bill of goods, too.

I had done all my flying at Wurstboro Airport, where an off-field landing is considered a dirty word. Our soaring gang went to the Sugarbush, Vermont, Regionals a year ago, and I had a great time—at the bar. In my eye, Art Hurst was the real hero; in his first competition, he flew well over 100 miles, an absolute impossibility in motorless flight. Gordon Lamb did 200 and some, and Gleb flew over 300, which is beyond any normal man's abnormal comprehension. I ventured all of eight miles, then scurried back to "Mother" at the airport. Arthur Hurst said to me, "Don't worry about going into competition. There's always somebody behind you." The Labor Day weekend at the Philadelphia Glider Council field proved to me that that statement is true. There certainly is someone always behind *you*. That person, I discovered, is me.

I went down to the Mid-Atlantic Regionals at the Philadelphia gliderport just to hear the talk and be with the good people I was finding in this game. Secretly I hoped to get my Silver distance. When I got there, I was about to log my 99th flight, and was somewhat apprehensive about flying more than arm's length from Mother.

I had thought many months about that first off-field landing. With no power training, navigation was like Greek to me; and I am the guy who lives in New York but still gets lost in Central Park.

It was a cu of a first day at PGC, and everyone but me agreed that all I had to do was get up, drift with the wind. I would certainly make 30 to 40 miles. My wife gave me a kiss as I climbed into the cockpit. That usually gives me extra lift and I went up.

The day was very uneventful . . . for them. I sat up there at 5000 feet debating which way to turn . . . back towards the airport or into no man's land. I floundered all over the sky trying to cut the cord. Slowly, a massive depression set in. Sure, my wife said she'd crew, and come and get me, but I couldn't remember how good she was at climbing trees.

That night I was discouraged. Everyone seemed to sympathize. Bob Buck told me this was the big step. Sure, I had no idea where I would land, what kind of conditions I would find, where I would end up, what the farmer might say. It wasn't just uncertainty . . . I was scared. True, I was only going to be going 30 or 40 miles, and guys today are going to the moon, but this was to be me. In the middle of the night I became so disgusted with myself that I got up to hook up the trailer and flee home. When I started dressing, my wife said, "Get back in bed." I did, and awoke the next morning with indigestion. It was a very quiet breakfast. Charley Coy, the young college boy we had as crew, was very thoughtful and talked about girls. My wife was extremely understanding; she said, "Don't worry, we'll come and get you. I'm a good tree climber."

I dropped off tow at 1500 feet, not because I wanted to; I had to! A boomer of a thermal kicked me in the pants, smacked me against the canopy. Within six whooshing turns I was to cloud base, pushing things down and pulling things out to keep myself from being sucked up in. "Oh God," I moaned, "I'll go, but slow things up a little." Exerting extra care, to sound calm, I radioed in to hook up the trailer . . . I was off.

I knew exactly where Doylestown was because that was the town I had lingered over the day before, trying to make up my bloody mind whether it should be go or no go. Doylestown? I found it on my chart, marked off my seven miles of accomplishment and headed east . . . I think. I must say here that I did make my Silver distance on this trip, but I must also say that from Doylestown on, Pennsylvania was a Chinese puzzle and New Jersey was the moon. At one point I saw a mess of railroad tracks down on the ground; I tried to find them on my chart and couldn't; by the time I found the mess of railroad tracks on my chart, I couldn't find them on the ground. As I approached a river, I recognized it as such . . . which gave me renewed confidence.

I scratched up a thermal off a shopping area (it must have been a discount center because the thermal was small) in goodness knows what town and tumbled over the river. I needed the extra height because I don't swim well. I called in to my crew saying, "Going over the Delaware River, have no idea where." Trying to figure that out became fascinating; it replaced fear.

When I got into Jersey all the towns, factories, roads, monuments . . . anything, all looked the same. Nothing came across like they said it would when I took the FAA exam. I finally discarded the aircraft chart and took out a road map. I found a mark! I located a town that I had known as a boy; it was called Mount Holly. Now I knew where I was, exactly 50 miles off course. That was quite a feat in not only navigation but geometry itself. How is it possible, I wondered, to be 50 miles off course on a 40-mile flight. I was shaken out of my higher mathematical stupor when I recognized that I was headed directly into the miles upon miles of flat, desolate Jersey pines, the exact course I planned *not* to take.

One might say at this point that the rest of the trip was uneventful. I was prepared to die. I saw the Jersey pines approach as I flew over a town. I had to make a decision on the edge of that hamlet, to tree or not to tree.

I was extremely pleased with my first off-field landing. I opened the canopy and sat giggling, self-satisfied with me. I wasn't even out of the cockpit before the farmer drove up in his truck and said, "Everything all right, Mister?"

"Everything's all right."

He gave me a hard, steady look. His mouth dropped open. Fear came into his eyes. I followed his gaze. Over my heart my shirt was wet and bright red. My first thought was, "My God, I'm dying." And what a shame after such a perfect landing.

My felt pen had leaked in my shirt pocket!

Caesar never entered Rome with more pomp and dignity than my entrance back at the PGC field. Even I was slightly embarrassed to be carried on Charlie's shoulders.

My official observer, Gordon Lamb, went over my barogram, checked everything out, and shook my hand. I played it very cool, as if it all were just another triumph in a series of victories. Bob Buck also shook my hand and said, "Now you can enter the competition." Me and my cool, triumphant ways. Now my troubles were going to start all over.

Next morning's pilots' meeting was absolute Hindustani. Robby Buck wrote Sanskrit on a blackboard. The task was to an airport called Grimes on the way to Harrisburg . . . I think. I had never seen Grimes and, for that matter, never did get to see Grimes. When Billy Penn, standing on top of City Hall in Philadelphia, loomed up before me, I immediately knew an important navigating fact: I might possibly be flying east instead of west. With calm assurance, I made a 360-degree turn.

This was all very frustrating for me because I had just put a $500 radio into my new plane and now I couldn't even use it. I listened and was hearing such things as: "Gulf Lima, Gulf Lima, go to position number 21" (that was Gordon Lamb telling his crew what to do); "Charlie Item, Charlie Item, get to the middle of the triangle" (that was Gleb Derujinsky giving his commands). Ben Greene was giving instructions to his crew. Oh how I wanted to get on my Mentor, but what was I supposed to do . . . open my radio and say, "Old Dog to ground, Old Dog to ground; help, I'm lost"?

Billy Penn on top of City Hall in Philadelphia did give me some sort of a clue . . . not much, though, because I was born and raised in Philadelphia. I finally made a navigation decision. Philadelphia is on two rivers, as any school boy knows. The big one is the Delaware. I could tell which one was the big one. I flew up the other one, the Schuylkill River. I started to get over familiar territory, coming to a town I was sure was Pottstown . . . I think. So, I was now on the Schuylkill River at Pottstown. At last, I could let the world know I was in the competition. I proudly got on my radio, opened with my competition numbers, "Old Dog to ground, Old Dog to ground," and in my excitement announced, "I'm flying over the Susquehanna River, just east of Bethlehem." For your information, the Susquehanna River is 100 miles south of Philadelphia, and I don't think Bethlehem has a river going through it. But I do live on Susquehanna Road today, accounting for that part of the error; I guess subconsciously I just wanted to be home. Bethlehem must have come into my mind because someplace inside I must have figured I was getting close to God. My poor ground crew . . . they just looked at their charts . . . the guy upstairs had gone nuts.

I flew up the Schuylkill River, finding thermals here and there, getting rather low. I at least had landing spots now. So, I flew until I came to a big ridge that was filled with no landing spots, again. I gained a little height, and looked over that ridge and saw a few houses; as I got higher, I saw more houses; higher still, I saw a whole damn city over that ridge. Then I noted a big double-lane highway leading out of that town. I was elated to make a discovery! I found the highway.

My chart told me this town had to be Bethlehem. Now I could follow the road out to the airport, Grimes Airport.

Goodness only knows where my ground crew was at that time. We hadn't been in radio contact for ages. I took that road. Incidentally, later I found out the town wasn't Bethlehem, it was Reading; that road wasn't going towards Grimes, it was heading south or east, and taking me back to Philadelphia. I floated on good zero sink over the highway for at least ten miles.

Something terrible must have been happening down on that double highway. The crazy cars scattered to the side of the road as I went along. They sure are nuts down there. Terribly unsafe. As the road went down, I went down; as the road went up, I went up. When the road started to make a steady climb and appeared to be coming up to meet me, we parted. There was a field. I dumped it in for a good landing.

The farmer's wife offered me coffee. I would like to state here and now for the record that that was the worst coffee I have ever had in my life. I found, between slurps, that the name of her town was Plowsville, I'm positive it got its name because they stir their coffee with a plow. My wife came, thanked the farmer and his wife for taking such fine care of me, and she took me home. Her thanks to them disturbed me; then again, her coffee's not too good either.

The next day was not a very eventful day for me . . . at first, that is.

Carefully I picked my time to go up, took off, and was down in eight minutes . . . a meet record. I had landed, off-field at Rosenberger Airport, 37 telegraph poles or two miles from PGC. I figured that I had done my day's work . . . I had made an off-field landing and that's quite an accomplishment. I sat in the cockpit waiting for my crew to arrive. My crew is always prepared . . . they had sandwiches, cold drinks, cake, so now I was ready for the better part of the day.

When they did arrive, they frantically jumped out of the car. Charley madly started stripping the tape off the wings.

My wife demanded that I get out of the cockpit. With bolts flying, they started taking that plane apart, making sure that I helped. They worked with a frenzy, I had no idea what they had in mind. Possibly, I figured, there was an early party starting back at the field. Then I thought it was a very strange way for a crew to be acting since I was supposed to be the captain of the ship, and with the ship goes the crew. They hustled that plane back into the trailer, shoved me into the back seat of the station wagon, sped down the highway, got back to the field, took me back to the starting line, and insisted that I help them put the ship together. When they demanded I go to toilet, I then realized they were going to send me off again. Did you ever see a sailplane pilot put his ship together with tears running down his cheek?

Actually, that flight turned out to be one of my best flights of the contest. I was off and flying at about 5000 feet after an uneventful, dry-eyed take-off. A good thermal, and there I was at cloud base. I headed down the highway, following Route 309. This time my crew was determined they were going to stay under me and not let me out of sight again. I radioed instructions of where I was, and they radioed back, "Never mind using your radio, fly your ship!" Don't you think this is a rather disrespectful attitude for a crew to display towards the captain? I straightened out my white scarf, stuck out my chin, and flew towards Carbon County Airport with true competitive determination.

I must say that the night before this took place, Gordon Lamb sat down with me, took out a chart, and showed me exactly how to navigate. He said such things as, "See, that's north and that's south." He pointed out a lake on the chart and said, "See that little blue thing? That's a lake. Now when you come out of a thermal, head for that lake. When you reach that lake, pick out another lake, head for the second lake, and that way you always keep your direction in mind. Use your compass, don't just come out of a thermal, spin off and go. Fly from lake to lake!" I thought that this made good sense, and the first thing after the pilots' meeting next day, I got out the chart and looked for lakes on my course . . . there were none.

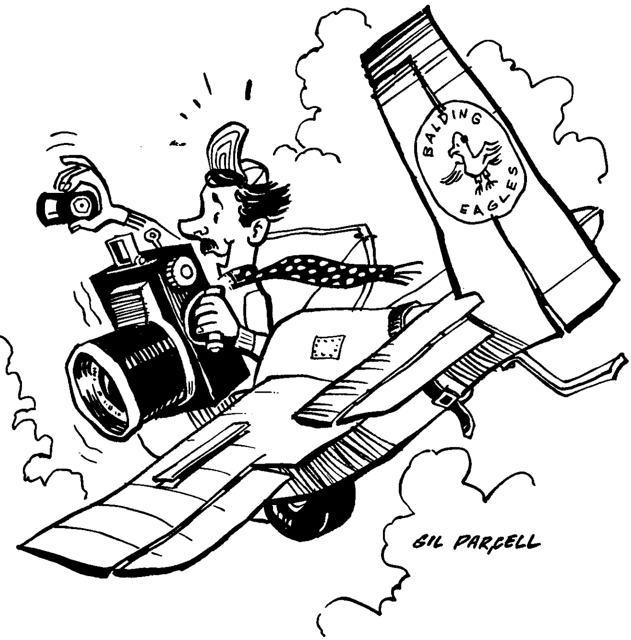
During this flight I used my compass, and very shortly I was crossing the Pennsylvania Turnpike on this speed test. Yes, I was on course, but I was getting very low at the intersection of 22 and the Turnpike. I got so low that a farmer started to wave at me. I waved back to be friendly, because I was going to use his field, and was just about to do so when I picked up a thermal and up I went to 4000. I stuck the nose of the Ka-8 down and went 70 mph ahead. Speed was the thing for today, but since I was bucking the wind, I was almost on the ground in ten minutes. I picked up another thermal and really went up fast, but unfortunately drifted back on the wind. There I was, going over that same farmer's field, and he was still waving at me. That maneuver took one half hour, I flew ten miles with no gain . . . another first for the PGC Mid-Atlantic record book.

But with chin out I went ahead again and did make some distance. I was encouraged to hear on my radio, Gleb say to his crew, "OK let's start again." I figured he hadn't gotten away from PGC. I was ahead of him! Later I learned the truth. He was going around twice.

Twenty miles ahead I saw a high ridge with a big hump on it. I headed for the hump, wishing it were a lake. That was the course I was going to have to take. Before I got anywhere near it, though, I was down looking for thermals. I flew over an orchard . . . the most beautiful apple orchard I'd ever seen. I got lower and lower and lower over this orchard. I could see the apples. It looked like it might become a real problem of geometry: how would one put the 50-foot wing of a sailplane between those beautifully regular 25-foot rows of trunks. It wasn't quite necessary, though, because I did get a good boomer at the last treetop second and thermaled up to 6000 feet.

Incidentally, I want to say that when I landed I asked my witness, J. Winthrop Schildwasser, about that big, beautiful apple orchard. He said to me, "That's no apple orchard–them's cherries."

Well, anyway, I got a thermal over the cherries . . . or apples . . . and it took me up to 6000 feet, as I said. Then I dove for that hump on that ridge. As I passed over it, I



"HERE'S MY TURNING-POINT! NOW LET'S SEE... I'LL TRY 1/100 SEC AT F.8 ... AND I MUSTN'T FORGET TO ALLOW FOR THE YELLOW FILTER..."

gasped, then cheered the news to my crew. There was "my" airport . . . my first-time-ever turnpoint. In my excitement, I goofed on my call letters. I opened the radio and said, "Old Ground to Dog, Old Ground to Dog. Coming on the first turn-point." Oh how I wanted to scoop the words back from the world. To add to my embarrassment, Ben Greene opened his radio and barked back at me. Within seconds I knew I was competing against a pack of dogs.

I went on past my turn-point and started photographing it. Again I got excited, and because I figured I might never ever see a turn-point again, I shot up the whole roll of film. When I saw the treetops in the view finder, I started to whistle, "Nearer My God To Thee" . . . PLEASE. Since I've come through very weakly all my life, He did the same. I only made a few hundred feet and called another airport two miles away on my course. "I may have to land," I said.

They read me and came back saying, "Sorry, the airport is closed."

I called back and said, "Sorry, I may have to land." There was no other place near. They finally gave me the instructions and I landed.

The reason the airport was closed was that half of it was being taken up by a county fair. Needless to say, I got into the fair gratis. Having a sailplane come in was quite an event for Leheighton, Pennsylvania. The newspaper people were there almost as I landed. They were asking me all sorts of questions: What was this event? Who was in it? Where was I from? Etc. etc. When they asked me how I was doing in the contest, what could I say . . . last place? So I kind of just shrugged my shoulders. Then they asked me my name, and I said, "Gleb Derujinsky."

Oh, yes, I forgot to say. Gleb won the Open Class and I won the Standard. How many were in my class? Don't ask. It might embarrass a friend.

32
PILOTS AND CREWING
The intelligent women's guide

by GREN SEIBELS

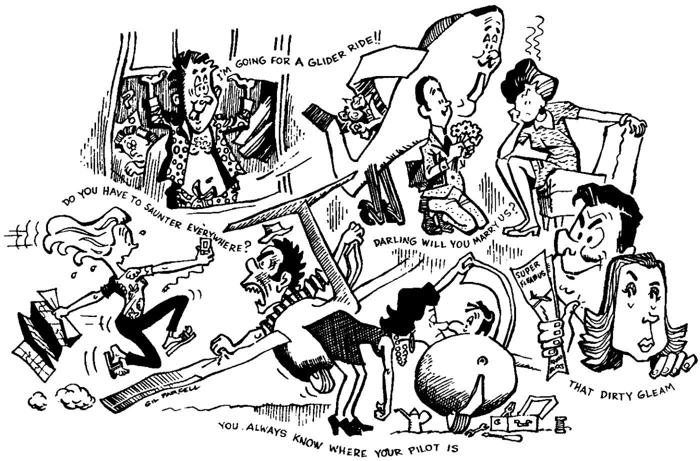
In view of the insatiable American appetite for self-examination, it is mildly surprising that no one has yet done a television documentary, or even one of those brisk, upbeat Reader's Digest *pieces, on the phenomenon of the Soaring Wife.*

Specialists in labor law could have a field day with the whole concept, involving, as it certainly does, long stretches of involuntary servitude, child labor (if there are any children), vacations without pay, and the dubious rewards of dedicating the best years of one's life to a manic depressive with interesting overtones of paranoia.

Although no states yet recognize addiction to soaring as ground for divorce, any lawyer worth his fee could cook up a savory case of mental cruelty from the bare facts of almost any soaring weekend. The rarity of such litigation is a touching tribute to the grim determination of soaring wives Not To Give Up.

(The soaring pilot's attitude is neatly summed up in the advice proffered to fledglings by one of the world's foremost soaring champions: "The best crewman you can possibly get is your wife. Now for those of you single fellows who are not married—*this is the most important thing in picking your mate for life*.")

Reprinted with permission from *Soaring Symposia*.



We'll assume that your man is aviation-minded, has already fallen in with evil companions of the soaring world, and has been well and truly infected with the virus.

The symptoms, of course, are unmistakable. Ever since the honeymoon, the head of the house has devoted his Saturday mornings to snoring and gurgling like a hardened narcoleptic until the sun approaches the yardarm, preparing himself for a hard weekend of doing nothing.

The change is sudden and cataclysmic. At the first crack of daylight, he is up and prancing around, demolishing the peace with loud requisitions for his sunglasses and windbreaker and other long-neglected outdoor gear. To your sleepy and outraged demand for an explanation, he will cheerfully reply that he has been invited for a ride in a glider.

Sentimentalists will note the date and time. For this pronouncement, along with the events that swiftly follow, will precisely mark the major turning point in your lives. Until this day, you may have thought of yourself as the living mate of a doctor, engineer, architect, lawyer, or marine biologist. Forget it. Henceforth, you will be sharing the haphazard life of a soaring pilot.

As your pilot progresses through solo checkout, the first true climb in a thermal, his first flight of more than one hour's duration, and so forth, his euphoria will prove contagious. Despite the long, tedious drives to the gliderport, the standing around with nothing to do while he soars, the slightly weird new friends you seem to be making—you will nonetheless bolster your courage with the thought that this new obsession at least gets you both out into the clean, fresh air and sunlight.

Additionally, it's more respectable than gambling; alcohol is *verboten* until the hangar is closed; the other wives are too busy working for their own pilots to make a play for your man; and at last you've escaped those dreary baseball games on the TV. Cherish these illusions as long as you possibly can. Cross-country soaring lurks just ahead.

"What's the little silver badge?"

"Oh, you get this for doing a five-hour duration flight, a 1000-meter climb, and a 50-kilometer cross-country."

Pandora's box is now officially open.

If you are outgoing, generous, bubbling with energy, cheerful, obedient, intelligent, resourceful, unflappable, mechanically gifted, persistent, strong and healthy, crafty, intuitive, and have a way with highway patrolmen, you possess the raw materials of a competent crew chief. Furthermore, if you *never* forget to put the beer on ice in the trunk, are good at map reading and navigation, are undismayed by barbed-wire fences, wild bulls, or surly rustics, and can back a car and 30-foot trailer through rush-hour downtown traffic with the insouciance of a Teamster, your path will be somewhat eased.

Of course, there's the radio. Two-way VHF radios are hopefully installed in car and sailplane to promote communications between pilot and crew as their paths inevitably diverge. Depending on the disposition of experienced readers the foregoing sentence will provoke laughter or tears.

So long as your pilot is sitting safely on the ground only a few yards removed from the retrieve car, your radios will blast away at deafening volume, and all is presumably well. However, it is one of the Immutable Laws of Soaring that at some point between his release from tow and his arrival over the first checkpoint, communications will collapse.

For the remainder of the day, one of you will clutter the airwaves with poignant, hopeless calls to a heedless partner whose receiver emits only an irritating hiss.

The first cross-country often sets the basic pattern for all the others to follow down through the years. Once the primitive radios fail, you will each become totally absorbed in your own special problems. His will be relatively simple: Keep flying.

Yours will involve a complicated guessing game, trying to assess the weather conditions aloft while dodging weekend traffic below, occasionally kicking the lifeless radio, worrying about the fuel gauge, all the while engaging in an inner debate concerning your hero's likeliest landing spot. You know, deep down, that his chances of reaching his goal are about one in a zillion; yet, if you cautiously hole up somewhere enroute, and he does actually make it all the way, you will stand revealed to all the world as a wife of little faith.

On the other hand, you hate to drive 200 miles only to have to turn around and retrace 165 of them.

It is somewhere along here that the soaring wife becomes aware that her gallantry is being put to a rather severe test. It is but the first of many.

Sooner or later (usually later), wife, trailer, pilot and sailplane will rendezvous. The setting will be obscure, absurd, and all but impossible to reach from the highway. To smooth away all her hours of accumulated tension, frustration, and despair, the normal soaring pilot will open the conversation with:

"Where in the hell have *you* been?"

Your good husband may hold an honorary doctorate in accounting; he may have hewed to a stern budget since the day he delivered his first newspaper, he may even be able to tell you how much change is in his pocket without looking. All for naught. That dirty gleam in his eye signals loud and clear, "My Own Sailplane." And hang the cost.

You might as well capitulate and learn the names of all the modern sailplanes, because these odd combinations of numbers and letters will be cluttering your conversation at home for many weeks to come. Before it's over, you'll be able to recite the L/D of an H-301B or AS-W 15 in your troubled sleep. You'll also observe your husband wrestling with the ultimate rationalization: That he can save money, actually *save money*, by no longer having to pay those god-awful rental fees.

But don't dwell on the negative side. You're not so much losing the long-planned backyard swimming pool, or the little beach cottage, or the extra bed and bath for weekend guests; you're gaining a sailplane, you lucky thing.

One thing–they're bulky, and hard to lose. And when you know where the sailplane is, you also know where your pilot is. He's in it, or under it, or at most, within arm's reach of it. You'll also note, if you're mathematically inclined, that his list of things to do on the plane will grow in geometrical inverse proportion to the amount of spare time available.

And the question of priority will be settled once and for all. The roof leaks, the faucet drips, the hot water is cold, the dog is due for his shots, the FBI and the IRS are ringing the doorbell–all can bloody well wait while the new variometer is being enthroned.

The successful soaring wife watches and waits. When she sees a batch of epoxy cement being stirred, she simply hauls out all the wounded furniture and shattered china with the gentle suggestion: "While you're at it . . ." Since no glider-mender in history has ever been recorded as having mixed too little epoxy, she is on very firm ground, indeed.

Pneumatic and electronic geniuses have long since developed methods to dampen and compensate our variometers. Nothing whatsoever has been done for the men who use them . . . or, what's worse, for the wives of the men who use them.

The most phlegmatic of airmen–types who would scarcely raise an eyebrow if they witnessed a squadron of angels doing slow rolls down Main Street–become emotional yo-yos after exposure to soaring. Catching sight of the first, fat little cu as he drives toward the gliderport, his spirits will climb at five meters per second. The very same little cu, surreptitiously glimpsed from the boss' office window during a weekday sales meeting, can plunge him into enough gloom to darken the rest of his day.

With the onset of winter, he becomes a twitchy, stir-crazy, persecuted neurotic. You'll find him huddled in the den, weeping silently over back issues of *Soaring*. The monthly telephone bill is grossly inflated with lengthy long-distance tolls as the fraternity exchanges condolences. His performance of household chores (postponed six months until the advent of bad weather) will be impeded by sudden fits of bad temper, impatience, ennui, lethargy, and a general air of aggrievement. Prometheus Bound.

Yet when the first soarable day of spring *finally* arrives, he instantly galvanizes into the Man of Action. With manic energy, he has the car stuffed with soaring gear before breakfast, calls the weather bureau three times in 30 minutes, and dances an impatient jig as you return to the house for your pocketbook.

Topping out a good thermal and spotting a competitor desperately scraping in zero sink thousands of feet below, he will break into gales of merriment and childish glee. Reverse the situation, and he will balefully glare at the higher man with the pure hostility Cain reserved for Abel.

Let's face it—his heart is at cloud base.

While simple cross-country flights tend to reveal some of the seamy side of soaring (from the wife's private viewpoint), the soiled laundry doesn't really flap in the breeze until your team enters competition. Under this type of pressure, your pilot will exhibit symptoms that make the Jekyll-Hyde syndrome seem a study in tranquility.

In the months since he began soaring, he will have licked, one by one, most of the myriad problems that beset sailplanes. Leaky plumbing behind the instrument panel, short circuits in the wiring, loose connections in the antenna—all these and countless others will have made their unwelcome appearance during his apprenticeship, and will have been dealt with. Or so it would seem.

Please learn well, and inwardly digest, yet another immutable Law of Soaring: Everything will go wrong on the first day of a contest.

If your tie-down is a half-mile from the nearest electrical outlet, some vital bit will come unsoldered. A special wrench, essential for assembly, will have been left in the motel. The battery will have mysteriously gone dead overnight. A Kamikaze insect will lodge itself deep inside the pitot tube. The gremlins have put in a sleepless night.

As these omens announce themselves in relentless succession, the pilot-red-eyed and raw-nerved rapidly exhausts his vocabulary of words you never learned at boarding school, and is soon gibbering hysterically at each new disaster.

Devising stratagems born of sheer desperation and executed with unsightly wads of masking tape, bobby pins, and other toolbox flotsam, the home team occasionally glances up from its herculean labors to glare with malicious envy as other crews smugly push their hale and hearty craft toward the start line, loudly guffawing with one another, oblivious to the tragic nervous breakdown that is taking its toll. Pure hatred, unblunted by a single charitable impulse, has a cathartic effect.

During these trying moments, you will resent the law against private ownership of a Thompson submachine gun; it seems the only adequate way to express your feelings.

Hostility quickly gives way to clutching fear, however, as you help wheel this jury-rigged, treacherous, malevolently fragile craft to its allotted space on the grid. Your pilot, by now reduced to a glassy-eyed subhuman state of contest nerves, is actually going to strap himself into this aeronautical comedy of errors and depart for places and dangers unknown.

But after a couple of brisk jogs back to the car for the forgotten microphone and the overlooked sectional chart, you find that you have recaptured the aura of skeptical indulgence which is the hallmark of the experienced soaring wife.

By now, of course, your radio problems have been pretty well solved. But strictly adhering to the Gungho Contest Pilot's Handbook, your man maintains absolute radio silence until he has rounded the first turnpoint, whereupon he grants a monosyllabic codeword. Galvanized, you storm out of the filling station where you were irresolutely hovering, realizing with an audible sob as you turn into the main highway that you forgot to fill up.

As the day wears slowly on, you will sooner or later discover Immutable Soaring Law Number Three: Troubles never come singly.

Let s say you're reaching for your mike to tell the Lone Eagle to stand by for the next few minutes; you have your hands full. As if on cue, you hear his voice—perhaps an octave higher than usual—announcing that he's "down to 400 feet in sink, position SQUEEEEEEeeeeee!" You quickly tell him to stand by while you close the car trunk; it seems to be interfering with the radio reception.

He, irritably: "Why's the trunk open?"

You, with cool logic: "Well, I had to get some beer to put in the radiator."

He (after a pause): "Beer . . . in the radiator???"

"Well, while this cop was writing the ticket, the engine kind of boiled over and I think it broke a water hose."

"Click."

Quite sensibly, for a man who is circling in zero sink at 300 feet over what appears to be a National Forest, your pilot decides against further exploring this seemingly bottomless can of worms.

Many contests and several years later, when you've grown accustomed to the little streaks of gray in your hair, and have outgrown envying your friends whose husbands take them to Bermuda or Europe for vacations, you will someday at the gliderport notice a sweet young thing holding hands with her husband as they diffidently sidle up to your sailplane and peek inside the cockpit.

Stifling the impulse to do a good turn for an unknown sister, you will saunter over and say, "Isn't it beautiful?" And if the husband lets go of his wife's hand in order to caress the sleek white nose, you might as well start making friends with the sweet young thing. You're going to be seeing a lot of each other.

APPENDIX

Where to dig deeper

Soaring—and flying in general—is rather a cerebral activity, with plenty of reading not merely desirable but necessary if we are to remain *au courant* with our sport and with the myriad regulations that sometimes seem to stultify it. With all affection and respect for my many military and airline pilot friends, much of their work seems to fall more into Advanced Bookkeeping than the spiritual uplift of a voyage to the stars. Those who also soar seem to prefer it to weapons delivery or aerial bus driving.

My bookshelves are crammed to bursting with flying books of all kinds, many of which are now sadly out of print. But here is a list of mostly available stuff that you can get from your local soaring shop or FBO, or from some of the more enlightened bookstores such as Daltons. As far as exclusively soaring sources for books are concerned, I must recommend John Ryan at Rainco in Phoenix, Graham Thomson in Santa Monica, the Wilds at Waveflights in Colorado and the Schweizer Aircraft Co. in New York, since these four organizations go to a great deal of trouble to provide quality literature for soaring pilots. And I thank all of the individual soaring operators, such as Jim Indrebo at Calistoga and Bud Murphy at Sky Sailing (Fremont) who also stock my books.

BIBLIOGRAPHY

AERONAUTICS, Gibbs-Smith. Aeronautical history and color photos

AFTER SOLO, edited by Wm. Doherty, Jr. 1-26 experiences

AIRMAN'S ODYSSEY, Antoine de Saint-Exupéry. A collection of his earlier works

ALL ABOUT FLYING, Barry Schiff. Encyclopedic introduction to private flying

ART & TECHNIQUE OF SOARING, Wolters. See and feel your way through the complete training procedure; sensational photos

AVIATION, Gibbs-Smith. Historical survey

BIPLANE, Richard Bach. Transcontinental biplane

THE BLUE MAX, Jack D. Hunter. Paperback. World War I German pilots and their exploits

BOMBER, Len Deighton. More than you ever wanted to be told about World War II, but brilliantly written

BRITISH GLIDERS & SAILPLANES, Norman Ellison. 1922-1970. Catalog with histories and performances

CARRYING THE FIRE, Michael Collins. Outstanding story on the space program by one of its best pilots

CLOUD STUDIES IN COLOUR, Scorer & Wexler. Cloud form descriptions

CLOUD STUDY, Ludlam & Scorer. Analysis of cloud forms and photos

COLOUR GUIDE TO CLOUDS, Scorer & Wexler. Photos of cloud forms and movements in color

CORRESPONDENCE COURSE & STUDY GUIDE FOR GLIDER PILOTS, Charles McKinnie, Jr. Perfect book to meet FAA Part 61.35 requirements for written tests, etc. New!

A DIRECTORY & NOMENCLATURE OF THE FIRST AEROPLANES, Gibbs-Smith. Events of the first 100 years

DUEL OF EAGLES, Peter Townsend. Development of the philosophies of the British and German Air Forces beginning in the First World War

ELEMENTARY GLIDING, Paul Blanchard. Names and describes the glider, parts and functions for the beginner

EXILE TO THE STARS, Ed Mack Miller. Struggle for command of an Air National Guard unit

FAA AVIATION REGULATIONS, Ted Bahnson. 1974 new edition

FATE IS THE HUNTER, Ernest K. Gann. Experiences of one of aviation's most articulate pilots

FIFTY MODERN SAILPLANES, Zuerl. In German, photos and specs

FIFTY POWERED SAILPLANES, Zuerl. In German, photos and specs

FLYING ANNUAL & PILOTS' GUIDE, 1972, Editors of Flying. Basic background on aviation and aircraft

FLYING HAND LAUNCHED GLIDERS, J. Kaufman. Guide to building, trimming and flying hand-launched gliders

FLYING THE OLD PLANES, Frank Tallman. Where it all started, marvelously told

FLYING TRAINING IN GLIDERS, Ann & Lorne Welch. Perspective for instructors and students from experienced people

FREE AS A BIRD, new Philip Wills' book. Personal account of glider pilot experiences and more

A GAGGLE OF ONE, Gren Siebels. The master humorist at his finest

A GIFT OF WINGS, Dick Bach. "Flying is my religion," says Bach, "my way of finding the truth." 46 Chapters

GLASFLUGEL REPAIR MANUAL, Ursula Hanle. Primer on fiberglass sailplane maintenance and repair

GLASS REINFORCED PLASTICS, Brian Parkyn. Excellent 'background' on fiberglass technology

GLIDER MAINTENANCE MANUAL, Stafford Allen.

GLIDING, A Handbook of Soaring Flight, D. Piggott. Read about soaring training and experience

THE GLIDING BOOK, Watson & Serjeant. Describes the soaring movement and its achievements

GUIDE TO ROGALLO FLIGHT. Basic hang-gliding for beginners

HANDBOOKS, STANDARD AIRCRAFT. Everything about specs, nuts, bolts, AN parts, riveting for the builder or owner

HANG GLIDING, Dan Poynter. Basic handbook of sky surfing

THE HIGH AND THE MIGHTY, Ernest K. Gann. Paperback. A crisis develops on an airline flight across the Pacific

HISTORY OF FLIGHT, American Heritage. Handsome volume of aviation's heritage

HOW TO GET STARTED IN SOARING, from SAC. Lots of information

HOW WE INVENTED THE AIRPLANE, Orville Wright. David McKay Company (out of print). A gem taken from Orville Wright's testimony in a lawsuit

IN THE COMPANY OF EAGLES, Ernest K. Gann. Paperback. French World War I pilot tries to revenge a friend shot down by a German

INVITATION TO FLYING, 1972, Aviation Division of Ziff-Davis Publishing Company. Order from Ziff-Davis Service Division, 595 Broadway, New York, NY 10012

ISLAND IN THE SKY, Ernest K. Gann. The story of the professional pilots who flew for the Army Air Transport Command during World War II

JONATHAN LIVINGSTON SEAGULL, Richard Bach. A story of great skills

THE JOY OF SOARING, Carle Conway. Complete training manual

LEONARDO DA VINCI'S AERONAUTICS, Gibbs-Smith. His sketches/quotes

LOGBOOKS. State Sailplane Pilot's or SailplaneLog when ordering

MAN POWERED FLIGHT, Keith Sherwin. Pictorial history and analysis of design structure & operation problems

METEOROLOGY FOR GLIDER PILOTS, Wallington. The basic text.

MODERN AIRMANSHIP (Third Edition), Neil D. Van Sickle, USAF. Instructional handbook covering the whole spectrum of aviation

NEW SOARING PILOT, Ann & Lorne Welch & Irving. Technology

NIGHT FLIGHT, Antoine de Saint-Exupéry. Paperback. A classic story of the early night air mail flights in South America

ONCE UPON A THERMAL, Richard Wolters. 'Old Dog's' delightful new book. Dramatic and fun-filled

ON QUIET WINGS, A Soaring Anthology, Joseph C. Lincoln. One of the most beautiful soaring books; outstanding illustrations

ON SILENT WINGS, Dwiggins. A photo-illustrated history of gliders

ORAL TEST GUIDE FOR GLIDER PILOTS, McKinnie. Very handy

PILOT'S CHOICE, Gren Seibels. Required reading for those who understand soaring. Describes competitions, pilots and soaring sites with a since of humor and wit

PILOTS' WEATHER, Ann Welch. New, with photos, maps, charts, etc.

PRACTICAL AIR NAVIGATION, Thoburn C. Lyon. Revised version of government publication on navigation

PROCEEDINGS OF THE 1970 SYMPOSIUM ON COMPETITIVE SOARING, Byars and Holbrook. 9 sessions on competition with illustrations

PROCEEDINGS OF THE 1971 SYMPOSIUM ON COMPETITIVE SOARING, Byars and Holbrook. From the greats on aerodynamics, competition, etc.

PROCEEDINGS OF THE 1972 SYMPOSIUM ON COMPETITIVE SOARING, Byars and Holbrook. Latest edition on practice, philosophy and preparation for competition

ROLL AROUND A POINT, Duane Cole. A top aerobat's explanations of acrobatic maneuvers

SCHULE des SEGELFLIEGENS, Maja Schiele. In German, meteorology, etc.

A SENSE OF LIFE, Antoine de Saint-Exupéry. A chronological collection of Saint-Exupéry's shorter writings, including "The Aviator," an excerpt from an early novella, and "Nobleman . . . Bondsman," the preface in Grandeur et Servitude de l'Aviation

SIR GEORGE CAYLEY, Gibbs-Smith. Genius accomplishments in history of aviation 1773-1857

SIR GEORGE CAYLEY'S AERONATUTICS, Gibbs-Smith. Text details figures and even gives calculated wing-loadings. 1796-1855

SOARING: The Sport of Flying Sailplanes, William T. Carter. Versus Air Force Academy guide to soaring for beginners

SOARING, Dixon. Paperback. Soaring in modern times

SOARING, Dan Halacy. Describes simply the glider techniques

SOARING CROSS COUNTRY, Byars & Holbrook. Required reading for pilots who are tired of local thermals

SOARING FOR DIAMONDS, Joseph C. Lincoln. Paperback. A tale of one pilot's journey in the sport

SOARING ON THE WIND, Joseph C. Lincoln. Beautiful photographic essay on silent flight

SOUTHERN MAIL, Antoine de Saint-Exupéry. A story of early French air mail flights

THE SPIRIT OF ST. LOUIS, Charles A. Lindbergh. Paperback. Detailed story of Lindbergh's solo nonstop flight across the Atlantic, including the log of his famous plane

THE STORY OF GLIDING, Ann & Lorne Welch. From myths and madness to Al Parker's 1,000 kilo record flight

THE STORY OF THE BRITISH LIGHT AEROPLANE, Boughton. Detailed technology, with photographs

STRANGER TO THE GROUND, Richard Bach. His first book, and a great one. F84F pilot in Europe

TECHNOLOGY & SCIENCE OF LOW-SPEED & MOTORLESS FLIGHT. Proceedings of the AIAA/MIT/SSA second International 1974 symposium

THEORY OF FLIGHT FOR GLIDER PILOTS, Allen. Carefully described with no dependence on the use of mathematics

THEORY OF MODERN CROSS-COUNTRY GLIDING, Weinholtz. For those who wish to get the most in performance from their flight experience, equipment, themselves and each contest day

WEATHER FLYING, R. N. Buck. Based on forecasts, reports and in-flight observations

WHERE NO BIRDS FLY, Philip Wills. More on Wills' passionate devotion to motorless flight

WIND, SAND AND STARS, Antoine de Saint-Exupéry. Paperback. Flying with Air France's predecessor (Latecoere Company)

WINNING ON THE WIND, George Moffat. Paperback. If you want to excel in the sport, George has identified all the ingredients for you, along with lots of information

WISDOM OF THE SANDS, Antoine de Saint-Exupéry.

THE WRIGHT BROTHERS, Gibbs-Smith. A brief account by a qualified man with excellent photos

WRITTEN TEST GUIDE FOR GLIDER PILOTS, McKinnie.

YEARBOOK, The Soaring, Richard Miller. People, planes, production, places, performance, perspective 1965

Note: John Roby, 3703 Nassau, San Diego, California 92115, may be able to help with rare or out-of-print books on flying.

ACKNOWLEDGEMENTS

Creating and producing this book was a task shared by all the authors, whose gracious permission to use material they had written earlier is much appreciated. Several, including Derek Piggott (in England) along with George Worthington and Carl Herold (in California), made significant additions and clarifications to their original material. Special mention should also be made of Ed Byars and Bill Holbrook, who allowed me to edit and include some fine material from their book "SOARING CROSS COUNTRY" and from their Soaring Symposia. In England, Gillian Bryce-Smith (Editor of SAILPLANE AND GLIDING) kindly contacted those authors whose addresses I did not have, and obtained permission to use their writings. Doug and Lianna Lamont (SOARING) also provided important help and support at critical moments.

Most of the illustrations came from the original manuscripts or from the U.S. distributors of the sailplanes photographed, with the important exception of the lovely shots contributed by Dr. John Armitage of Boulder, Colorado. John sent a huge collection of truly exquisite photographs, representative of his skills and dedication to the sport. Such is his modesty that he referred to them as the 'junk box'–his 'junk box' is the unattainable dream of most soaring photographers.

Production is a tedious process, and the work of the primary typographer–the lovely Linda Guerrero–should not go unrecognized. She had to grapple with some very measy manuscript, and produced a clean final galley that required minimal corrections and changes. Where such changes were needed, they were due primarily to my illegible editing! She was ably supported by my production gurus at Graphic Production, Jane Cooney Hixenbaugh and Tom Bottman, who for reasons defying mortal comprehensive manage to tolerate my publisher's tantrums.

John Joss
Los Altos, California
December 1974

THERMALING
WAVES
LANDING
WEATHER
CROSS-COUNTRY
POLARS
SHIP CHOICE
REPAIRS
SAFETY
BADGES
TYPE CONVERSION
HUMOR
MOUNTAIN FLYING
RECORDS
SHIP PREPARATION
COMPETITION
BAROGRAPHS
EXPERTS' METHODS

JOHN JOSS, editor a
er of "ADVANCED S
and contributor of or
('Out of the Egg'), st
gliders in England in
the age of 17. He gai
badges in the primar
A writer and editor b
he has written and p
hundreds of articles
technology — includ
computers and elect
leading technical me
wide. He recently ed
published "WINNIN
Wind" by George Mo
the world's Open Cla
Champion. He lives i
Francisco area and f
Standard Class sailp
Western U.S. and occ
in England.