Soaring's Golden Age

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Introduction

George Moffat lies under the wing of his 22-meter prototype sailplane, the Nimbus. After a disastrous first day, he has bounced back and holds a small but significant lead over German Hans Werner Grosse in the 1970 World Gliding Championships at Marfa, Texas. Grosse approaches Moffat, and asks in broken English "How are we going to beat the Frenchmen?" Mercier, who is only a few points behind Grosse in third place overall. Moffat knows if he simply completes the task he has won the contest. Grosse is too worried about holding on and not focused on winning. A decade long quest is fulfilled.[1]

To most knowledgeable soaring pilots, especially those who fly competitively, two of the defining events of the modern soaring era were the 1969 US National Championship and 1970 World Championship, both held at Marfa, Texas. Rapid advances in technology following World War II and accelerating in the 1950s and 1960s led a group of young and talented engineers to design and build radical new gliders. These new, high performance gliders allowed pilots to further explore the limits of soaring flight. The contests at Marfa were a turning point that proved the future would be dominated by fiberglass sailplanes and pilots who understood how to make use of the new gliders' potential. By 1974, these new gliders and techniques had filtered down to a larger group of pilots and competition reached a new level of parity. Gliding was redefined during what could be called the sport's Golden Age.

Very little about gliding or soaring is included in mainstream aviation literature. A great modern work on aviation's beginnings is John D. Anderson Jr.'s Inventing Flight: The Wright Brothers and Their Predecessors. The majority of aviation experiments that were carried out in the period Anderson chronicles, from approximately 1804-1904, were conducted with unpowered aircraft. This was likely a result of the fact that an appropriate internal combustion engine was not available to aviation's pioneers

[1] Joseph C. Lincoln, *1970 World Championship.* (National Soaring Museum Archives, Elmira, New York., circa 1974) 133.

until the Wright Brothers designed and built their own in the winter of 1902-1903.[2] The Wright Brothers made their first experimental forays into aviation during 1900, 1901, and 1902 with a succession of three gliders. It was not gliding that the Wrights were pursuing, however, but the far bigger prize of the first powered flight. The gliders were a test bed used to research the best ways to control aircraft in preparation for eventually adding engines to their designs.[3] Save for 1911, when the Wright brothers returned to gliding for one season, research on unpowered flight was generally abandoned after 1904 when the Wrights made the first powered flight at Kitty Hawk, North Carolina, and this is the point at which Anderson's work ends. Another contemporary work, Roger E. Bilstein's Flight in America has but three pages devoted to gliders, and only as a prelude to the Wrights' eventual first powered flight. A book focused on aviation's pioneers, Robert Wohl's A Passion For Wings: Aviation and the Western Imagination, which covers the period 1908-1918, does not make a single mention of gliders. It is safe to say that gliding had never received the popular attention accorded to those like the Wright Brothers, Charles Lindbergh, Amelia Earhardt, and their kin who so fascinated the American public.

What little has been written about soaring generally takes one of three forms, most of which is primary. First person accounts of outstanding moments, such as contests and record flights, were often published in *Soaring Magazine* or in compilations such as John Joss' Soar America or Joseph Lincoln's On Quiet Wings. Other material that falls into this category is two-time World Champion George Moffat's writings, often first published in *Soaring Magazine* but then compiled and edited to form a more

[2] John D. Anderson Jr., Inventing Flight: The Wright Brothers and Their Predecessors (Baltimore: Johns Hopkins University Press, 2004), 150-151.
[3] *ibid*, 98-100.

continuous narrative in the 1974 book Winning on the Wind and the 2005 book Winning II. The second form of material is what one might call 'musings.' Soaring's most well-known 'muser' is Grenville Seibels, a long time pilot from South Carolina who wrote the series of books, A Gaggle of One, Pilots Choice, Turnpoints, and After All. Another well-known muser was Richard 'Dick' Wolters, who wrote Once Upon a Thermal. These works try to capture the views of the less serious pilot, one who flies for the fun of it and wonders how the top pilots of the soaring world are able to so convincingly beat them time and time again. The final group is the historical overview, such as Wings of Eagles: The Story of Soaring in America by Paul Schweitzer and Soaring Throughout the 20th Century by Bill Schweitzer. The Schweitzers wrote from the perspective of having owned the most successful American sailplane production company later forced to abandon that line and become a helicopter company by the German fiberglass revolution of the late 1960s and early 1970s. While they acknowledge the revolution that occurred, their writing longs for a bygone era of their youth when they built their first glider in a barn outside of New York City. This paper fills a void by presenting material that has never previously been combined in the form of an analytical narrative. It is meant to be both a story of soaring's Golden Age and analysis of why the age occured.

It is also interesting to note that toward the beginning of soaring's Golden Age, in 1966 and 1967, the sport received what could be called a 'perfect storm' of publicity from the mainstream press. The first article to appear was in the August 1966 issue of *Sports Illustrated* and was titled "The Long Ride Home." It was a chronicle of the 1966 National Championships held in Reno, Nevada. Next to appear was "Sailors of the Sky" in the January 1967 issue of *National Geographic*. It featured all levels and aspects of

the sport, from local clubs to racing at the national championship. An article entitled "The Sky is Their Limit" appeared in the April 1967 issue of *Reader's Digest*. It was written by Robert Buck, an airline pilot who would later become famous for writing North Star Over My Shoulder, a biography of his time as a TWA captain from aviation's early days in the 1930s to his retirement after flying the early 747 trans-Atlantic flights. Buck brought the art of silent flight down to a level the average American could understand. There is empirical evidence that these articles had much to do with the way the sport grew between 1966 and 1975. The membership of the Soaring Society of America increased from 6,000 to 13,800 in this period.[4]

If soaring reached a modern age at the turn of decade between the 1960s and 1970s, then George Moffat would be the age's defining persona. His 1974 book Winning on the Wind was a landmark in soaring literature that has not been eclipsed. Much of this work is material previously published in *Soaring Magazine* or other general aviation magazines later edited and reworked for book form. Moffat has become by far America's most well known and prolific glider pilot. While there were many players who contributed to gliding's revolution, and Moffat is certainly the first to claim his own place it in, it would only do him justice to say that his was a leading role. Moffat rose out of this seemingly chaotic period, time after time being in the right place, with the right equipment, at the right time. In the early 1960s he flew the Schreder HP-8 to three World Records. In 1966 he nearly missed a National Championship victory and in 1968 nearly missed a World Championship title, but these near misses showed he was the sport's rising talent. Finally, at the peak of soaring's Golden Age in Marfa, Texas, he claimed

[4] Paul A. Schweitzer, Wings Like Eagles: The Story of Soaring in the United States (Washington, Smithsonian Institution Press, 1989), 344.

two back-to-back victories. It was without a doubt the contests at Marfa in 1969 and 1970 that defined Moffat as a pilot and helped him define the sport.

In a paper authored for the consideration of Marfa as a National Soaring Landmark, Burt Compton, who as a teenager had crewed for his father in the 1969 Nationals and is now the proprietor of the gliding school at Marfa wrote, "Looking back, the 1969 Nationals at Marfa marked the beginning of modern sailplane racing, with the innovative 'glass' sailplanes which allowed the pilots to use aggressive racing strategies."[5] Moffat joined the sport just in time to take advantage of the advances in technology that Compton identified. Moffat agreed with Compton when he delivered the 2004 Ralph S. Barnaby Soaring Lecture, saying of Marfa in 1969 "What else was new? Practically everything."[6]

Moffat, with a background in boat racing, understood both the value of seconds in overall contest scores and of psychology in sports. He developed an entirely new concept of winning that led to one of the most dominating performances in World Championship history in 1974 at Waikerie, Australia, a contest that would be the last of the Golden Age as gliders and pilots reached a new level of parity. On the other side of the Atlantic, German Helmut Reichmann earned a PhD in cross country soaring and later published a revised version of his dissertation as Cross Country Soaring, a work which is still considered to be the one of the best on the subject today. Reichmann took a more mathematical approach than Moffat, painstakingly calculating the fastest way around the course for given conditions. Combined, these two men served as a model for the pilots who came after them.

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[5] Burt Compton, "The History of Soaring at Marfa, West Texas" (National Soaring Museum Archives Elmira, NY, 2006), 2.
[6] George Moffat, Jr., Winning II (Julian, PA: Knauff & Grove, Inc., 2005), 20.

Certainly the most important thing that was new in 1969 and 1970 were the gliders. In computing there is a concept called 'Moore's Law' which states that the power of computer processors will double every eighteen months in an exponential pattern. Soaring was following a sort of Moore's law that reached its apex at Marfa in 1969 and 1970. Building on preceding glider designs, two super-ships would dominate each of the contests. In 1969, those gliders were the Schleicher ASW-12 and Schempp-Hirth Cirrus. In 1970 the Schempp-Hirth Nimbus and Glasflugel Kestrel 604, both with spans over 22 meters, reached an entirely new plateau. Moffat would fly the Cirrus and then the Nimbus to victory. These ships were the result of the previous twenty years of development. In the 1950s, a group of Americans led the way by successfully implementing "laminar" or high-efficiency airfoils on gliders. In the 1960s, a group of Germans refined glider design by introducing the extensive use of composite construction, a technique the American's would fail to take up and therefore lose their technological lead.

There has yet to be a systematic exploration of the events that defined modern soaring. This paper is designed as a start to filling that void. Moffat wrote in the introduction to his 2004 memoir Winning II:

> In sum, this Golden Age of soaring has been an exciting time. It has been a great pleasure to have been present and to have participated in the creation of an era... This book is about soaring evolution and perhaps my own in a remarkable period – a Golden Age.[7]

It is time to do justice to this truly remarkable period, a Golden Age of soaring, and the men and machines that made it that way.

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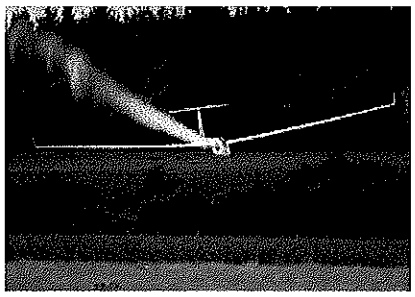
[7] Moffat, Winning II. 11.

Soaring Concepts

"Gliding is about finding your way about the invisible geography of the sky. Everything you need to know is there, but you have to learn weather, you have to learn navigation, you have to learn thermals, and you have to put it all together under a great deal of pressure."[8] *– George Moffat.*



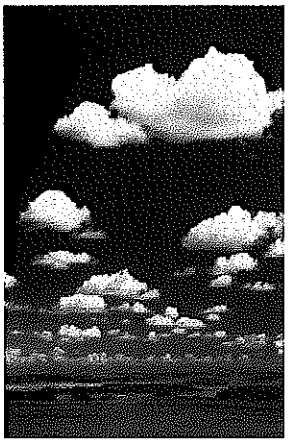
An LS4a Sailplane crosses the finish line at high speed dumping water ballast.

Soaring is a subset of aviation, often referred to as gliding. This is not hang gliding, a similar sport where pilots fly strapped to what essentially amount to glorified kites. Modern sailplanes typically have wingspans in of 15 meters or greater. They are constructed of composite materials, and can weigh over one thousand pounds fully loaded, including the pilot and water added to the wings as ballast. Soaring pilots often consider the sport to be the purest form of aviation in roughly the same manner as one might compare sailors to motor boaters. Once towed aloft, attached to a powered airplane by a rope of approximately two hundred feet, the glider pilot releases and is free to maneuver. Unfortunately, the glider is always descending, with the rate of descent correlated almost directly with airspeed. The pilot must get busy, and make use of the forces of nature found in the sky to avoid finding himself back on the ground. Luckily, the air mass in which the glider flies is also moving. The glider pilot's goal is to find air that is rising faster than the glider descends, and make use of it to regain altitude before gliding on. Once the proper techniques are learned, on a good day a pilot can fly a glider for hundreds of miles.

The rising air masses are all, in the end, created by the sun, but they can take several forms. The most common is the use of thermals, or rising columns of air

[8] A Fine Week of Soaring, dir. Juan Mandlebaum (Watertown, Mass.: Geovision Productions, Inc., 2004), DVD.

triggered by the sun heating the ground. Thermals are often marked by small cumulus clouds, creating a sort of map through the sky. The clouds are created when the rising air reaches its dew point, condensing to water vapor. Some days, however, the rising air never reaches its dew point, and the sky lacks cumulus clouds even though thermals are present. These days are referred to as 'blue days,' and the thermals are then called 'dry thermals.'[9] Luckily, a sensitive instrument known as a variometer is installed in most gliders. It indicates the speed at which the glider is either rising or sinking, helping the pilot to locate the areas of best lift.



Cumulus clouds for miles – a glider pilot's dream sky.

Upon entering a thermal, along with feeling a slight bump, the pilot will see the variometer indicate the air is rising. The variometer is compensated in a method known as the total energy method. Without compensation, the variometer would indicate lift when the pilot reduced speed quickly, converting the speed to altitude. After finding the thermal, the pilot will try to choose the optimum moment to bank steeply into a turn and begin to circle. If he waits too long, he will fly through the thermal and hit 'sink,' or descending air, on the other side. If he turns too quickly, however, his path will take him back out the same side of the thermal he entered. Typically after several turns and a few adjustments, the pilot will find himself 'centered' in the thermal, making use of its strongest parts. Throughout the climb he will continue make small adjustments to stay in the thermal's strongest part, known as the 'core.'[10] Typically, the stronger the thermal,

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[9] Helmut Reichmann, Cross Country Soaring (Streckensegelflug) Hannes Linke, trans. (Hobbs, New Mexico: Soaring Society of America, 1993) 4-5.
[10] *ibid*, 9-10.

the rougher it becomes. An extremely strong thermal may have so much energy it can toss the glider out of it if the pilot does not react quickly enough.

A glider flies the ridge near State College, Pennsylvania

Another form of lift is ridge lift, created by the deflection of wind against the sides of hills. Wind is a product of pressure differences in the earth's atmosphere that are typically created by uneven heating of the earth's surface by the sun. The pressure of an air mass varies inversely with its temperature. High-pressure areas will tend to flow towards lower pressures, and the result is what we know as wind. Ridge lift was used by soaring's pioneers in the 1920s and early 1930s before the discovery of thermal lift.[11] It was not until soaring's Golden Period in the late 1960s and early 1970s that ridge lift would be used to make long distance flights. A group of pioneering pilots including Karl Streideck and Bill Holbrook began to set records using the Appalachian Ridge System, which runs more or less continuously from New Jersey into Georgia. The advantage of ridge lift is that the glider can fly straight ahead for long periods of time more or less in a direct line towards the goal. Ridges generally have gaps, however, and these must be crossed by finding a thermal to climb in or using the most powerful form of lift, known as mountain wave.

[11] Reichmann, 2.

Wave lift results from wind that flows over mountains, and upon hitting the bottom of the lee, or downwind side, bounces back up many thousands of feet into the atmosphere. Waves are often marked by pearl shaped clouds known as lenticulars. Wave flying was first seriously explored in the Sierra Nevadas following World War II. Wave lift gets its name because of the wavelike pattern it makes hitting the ground and bouncing back up can continue for hundreds of miles beyond the terrain that created the lift. Each successive wave becomes slightly less powerful, but with proper technique it is possible to make long distance flights using each successive wave.[12] The United States Government funded the Bishop Wave Project to gather information about these strong currents in the name of airliner safety, as a number of military aircraft had been brought down in the mountainous terrain during the war. During the project a number of pilots made flights to extremely high altitudes, but wave lift was not truly explored as a source of energy for long distance cross country flights.[13] In the 1970's a group of pilots in New Zealand would begin to make use of the wave for long cross country flights. In the modern era, a majority of the world records that have been claimed resulted from flights making use of wave as the primary form of lift.

Lenticular clouds form over Hawaii

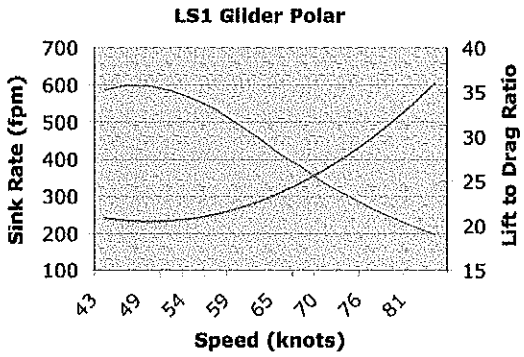
The shape of an airfoil often used on gliders.

There are a number of factors that influence glider performance, the most

[12] Reichmann, 33-35.
[13] National Soaring Museum, "National Landmark of Soaring Program – 12 – Sierra Wave Project, Bishop, California Airport," 15 June 2002. <http://www.soaringmuseum.org/landmark/nls12/nls12.html>.

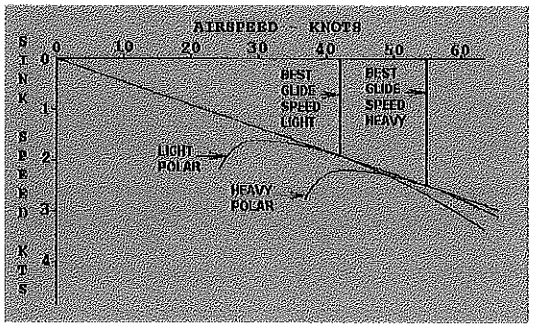
important of which is the airfoil, or shape of the gliders wing. At the beginning of the Golden Period, gliders began to make extensive use "laminar" or high efficiency airfoils that had been developed by the National Advisor Committee on Aeronautics, or NACA, during the Second World War. Gliders develop lift due to a law called Bernoulli's Principal, which states that as the velocity of a fluid increases, its pressure decreases. Airfoils are positively cambered, meaning the distance over the top of the wing is longer than the distance over the bottom of the wing. This means that as air travels over the wing, the velocity of the air on top is greater than that on bottom. The glider is essentially pulled into the lower pressure above the wing.

The efficiency of the airfoil is a major contributor to the efficiency of the glider, which is generally measured by a number known as the lift to drag ratio, or L/D. L/D is the distance a glider can travel forward in relation to the distance is travels downward.



A L/D of 40:1 (pronounced forty to one) indicates that a glider can travel 40 feet forward for every one foot down. The best L/D typically occurs at a speed of 45 to 60 knots. Flying slower than best L/D speed may lead the glider to sink more slowly, but the L/D drops because the distance traveled is less. Flying faster than best L/D causes the distance traveled in a time period to increase, but the increased sink rate leads to a lower L/D. A glider's performance is displayed in a graph known as a polar. The curve with its apex, or point where the line tangent to the curve equals zero, at the bottom of the graph shows sink rate at various speeds, while the curve with its apex at the top of the graph

shows L/D. A sample polar curve for an LS1 sailplane, a type typical of the late 1960s and 1970s, is presented above.

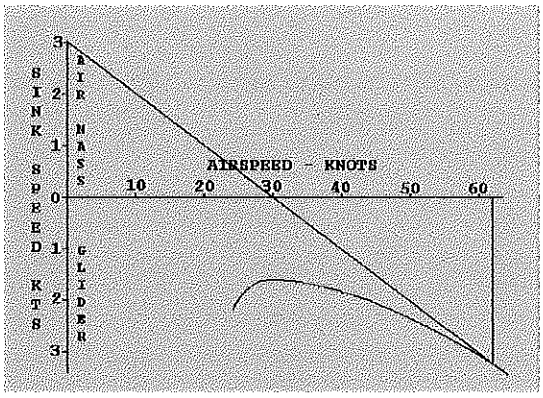


Knowing the glider's polar curve is only the first part in determining its performance. The curve moves based on wing loading, which is the area of the wing divided by the total weight of the glider. The glider's polar is then adjusted using what is known as the square root of the wing loading method. The result of increasing wing loading is that the glider's minimum sink rate increases, but the speed at which best L/D occurs also increases. This means the glider can fly faster throughout the speed range above maximum L/D while still achieving the same distance. Unfortunately, because the minimum sink rate is higher, it cannot climb as fast, so the conditions must be strong for increased wing loadings to pay off.[14] A sample L/D graph with a glider at two different wing loadings is presented above. By the mid 1960s, designers were increasingly emphasizing the use of water ballast to vary wing loadings. In strong conditions, the pilot could carry several hundred pounds of water. If conditions weakened, the water could be dumped, returning the glider to a lower wing loading and allowing better progress.

In 1948, Paul MacCready, a glider pilot and graduate student at California Institute of Technology, determined how to calculate the appropriate speed to fly based on expected thermal strengths. The MacCready theory involves finding the tangent line that goes from the expected climb rate through an inverted sink rate polar. The point where the tangent line crosses the x-axis is the expected average cross-country speed for

[14] Reichmann, 134-136.

the given rate of climb. A graphical representation is presented here. In the 1960s and early 1970s, glider pilots saw the MacCready theory as a golden rule to follow, but they would later reassess MacCready's underlying assumptions and determine that there are many cases where pilots should fly slower than the theory would call for. Iterations of this theory allow the pilot to calculate the appropriate wing loading and how fast to fly if the glider is traveling through lift or sink. Modern electronic instruments, first introduced around 1974, handle all these tasks with little to no input from the pilot.



Soaring competition is often difficult for the general public to understand because of its many complexities and the fact that for most of the day the competitors will be far away from spectators who remain on the ground. In soaring's Golden Period, there were generally two accepted classes of competition gliders, the Open Class and Standard Class. The Open Class was the unlimited class, and one could fly essentially anything. The wingspan of Standard Class gliders was limited to 15 meters, or 49.2 feet. Initially, the gliders could not have a retractable gear, flaps, which are devices at the rear of the glider's wing that make it more efficient, or water ballast.[15] The Standard Class gradually evolved in the period, with retractable gear allowed by 1970, water ballast by 1972, and for a short time, including the 1974 World Championships, flaps. In 1978, flapped and non-flapped 15 meter sailplanes were finally split into two different classes. The United States did not hold its first Standard Class National until 1970. At Marfa in

[15] Nick Goodhart et. al., "Panel: Standard Class – Present and Future," Soaring Symposia, 20-21 February, 1970. <http://www.betsybyars.com/guy/soaring_symposia/70-stand.html>.

1969, a majority of the top pilots would fly open class gliders, as pilots for the US Team in both the Open and Standard Class would be selected from the overall best placings in the contest.[16]

In the Golden Period, pilots flew both speed and distance tasks in competition. Speed tasks required the pilots to fly to pre-selected turn points, then return to the home field in as little time as possible. Distance tasks called for pilots to fly as many miles as possible, with no time limit. The speed tasks typically took the pilots around four hours to complete, not including the time spent after launch waiting to start the task at an opportune time. The pilot would not want to start the task immediately because to achieve the highest speed required flying course during the hours when conditions would be the strongest. This minimized the time spent circling in thermals to climb when the glider was not making forward progress on course.

Distance tasks often kept pilots in the air for over nine hours and could cover over 500 miles. Distance tasks were originally all of the 'free distance,' or straight out variety, with distance measured in a straight line from the airport to landing point. This became a problem as glider performance and therefore distances achieved continued to increase. Distances of 400 miles became common by the mid 1960s, necessitating retrieves that could put over 1000 miles on a car's odometer. To try to cut down on the number of driving miles, a variation of the distance task called distance in a prescribed area, or 'cats cradle,' was introduced. An oval of approximately one hundred by two hundred miles was laid out by six to eight turnpoints, with the home airfield more or less in the center. The pilots could claim any of the turnpoints as well as use the home airport as a turning

[16] Joseph C. Lincoln, "The 1969 US National Soaring Championships," Soaring (September 1969): 22-23.

point. The pilot attempted to fly as many segments between the turnpoints as possible with the only other rule being a pilot could not retrace a segment just flown.

By Marfa in 1969 the verification system used to ensure the completion of tasks was finally improving. When speed tasks were first adopted, observers with binoculars were sent to different turnpoints record which gliders made it around. This required the competitors to fly low enough over the turn point for letters painted on the bottom of the wing and sides of the tail, known as a competition ID, to be observed. If the ground observers somehow missed one of the gliders, the pilot would receive no credit for the task. A later technique was to send out ground crews to the turnpoints with large tarps. The ground crews would vary the pattern of the tarps throughout the day. The pilot would observe and record the pattern and time he rounded the turnpoint. Some pilots, however, had better eyes than others, and could see the tarps from farther away, giving them a significant advantage.[17] In addition, at contest sites such as Marfa where the pilots would reach altitudes in excess of 10,000 feet of the ground, the tarps became difficult to see. The pilot often had to descend to a lower altitude, losing valuable time. By 1969, the use of cameras to record the turnpoints had been developed. Each pilot had to take a picture from the same position relative to the turnpoint, ensuring that all pilots flew the same distance. It placed the onus on the pilots to perform the correct procedure, reducing errors that had previously caused problems.[18]

Throughout the course of a task, pilots make innumerable decisions. The predominant form of lift at Marfa was thermals, although ridge lift could often be found on the windward side of mountains and would be used to avoid a landing if a pilot

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[17] George Moffat Jr., Winning on the Wind (Los Altos, California: The Soaring Press, 1974) 169.
[18] Nick Goodhart et. al., "Panel: How to Practice to Improve Contest Performance," Soaring Symposia, 20-21 February 1970. <http://www.betsybyars.com/guy/soaring_symposia/70-how.html>.

became low. Sometimes, thermals are numerous, yet each thermal is of a different shape and strength. Speed and distance are both achieved when the glider is flying straight ahead, rather than circling. By climbing in the strongest thermals, a pilot can minimize the time spent circling, resulting in higher achieved speeds and longer distances.[19] Thermals often organize themselves in lines, referred to by glider pilots as 'streets.' Locating one these streets might allow a pilot to fly straight ahead for fifty miles or more without turning. On the other hand, if too much energy and moisture is sent skyward, then the clouds can overdevelop and turn into thunderstorms, blocking a pilot's course and forcing him to land far away from home in horrific conditions of wind, rain, and hail. The pilot who makes best use of this energy is able the fly the course fastest, often to the amazement of his fellow competitors, who found nothing but difficult struggle.

Yet, for all the pilots experience on a given day, a spectator would witness only the fleet of gliders towed into the air, followed by high speed finishes several hours later during speed tasks, as pilots burned off excess energy and dive for the finish line as fast as safely possible. In 1969 and 1970, they would have also witnessed the pilots starting speed tasks by diving at high speed towards an imaginary line in the air, some 3000 feet of the ground, known as the gate, to record a start time for their task. Today however, even this element of entertainment is gone, as the introduction of GPS flight recorders has allowed an entire flight to be logged and analyzed by computer once the pilot has landed. The hours spent out on course, solitary except for the few other glider pilots on course, will forever be lost to the outside observer. Yet over a ten-day period, one pilot will put together the winning combination, make better decisions than the rest, and

[19] Reichmann, 23-25.

become a champion. In 1969 and 1970, after a decade of development as a glider pilot, George Moffat would emerge as that champion.

The American Connection

The Raspet Flight Research Laboratory, established in 1948 under the guidance of Dr. August Raspet, became a world-class flight research and development facility for sailplanes and powered aircraft, utilizing unconventional methods. It was here that pioneering drag reduction and suction boundary layer research was accomplished, propelling the United States to the world leadership in sailplane design in the late 1950s. Dick Johnson's RJ-5 sailplane pointed the way with its glide ratio of 40:1. Inspiring a wide range of individuals, this facility acted as a catalyst for sailplane designers and builders the world over.[20] – *National Soaring Museum*

The first sign that soaring following World War II would be far different than the sport prior took place on 5 August 1951, when Dick Johnson flew his RJ-5 sailplane to a new World Free Distance record of 535 miles. Introducing him at the 2006 National Soaring Museum History Symposia, Museum Director Peter Smith said, "If there is a pilot who has gone beyond fame to become an icon, that man would be Dick Johnson."[21] Johnson combined three traits of which many of the top pilots had one or two. He was a consummate pilot, his stick and rudder ability questioned by no one. He had the competitive drive necessary to win and break records at the highest levels. Finally, he was a brilliant engineer, over the course of several years turning the RJ-5 from a 30:1 prototype into the first glider to have a recorded 40:1 L/D, something that seemed out of the realm of possibility before he achieved it.[22]

Johnson had been an active member of the gliding community since before the war. He taught himself to fly in 1938 in a Northrup primary glider that he bought along with his brother and another friend for $75 from "someone who had purportedly lost it in

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[20] National Soaring Museum, "National Landmark of Soaring Program – 13- Raspet Flight Research Laboratory, Mississippi State University, Starkville, Mississippi," 1 November 2003. <http://www.soaringmuseum.org/landmark/nls13/nls13.html>.
[21] Richard Johnson, "The RJ-5 Sailplane," (National Soaring Museum Archives, Elmira, New York, 2006), DVD.
[22] *ibid.*

a poker game," implying that it may not have been legal for the Johnson boys to own it. Johnson went on to remark, "it's a good thing my mother didn't know what I was doing."[23] He also served as a civilian flight instructor in the US Army Air Corps glider program, where he was instrumental in developing the program used to train Army glider pilots.

Johnson said that the RJ-5 was the first of what came to be called the 'lead sleds,' or a glider with a wing loading over five pounds per square foot that had previously been considered impossible to soar effectively except in the strongest conditions. When Johnson showed up at the 1951 National Championships in Elmira, New York, he recalled that:

> One of the local pundits came up to me and said 'Johnson, what's the wing loading on that glider.' That was Steve Bennis, he was flying a Kirby Kite I believe and he was a really good pilot. In weak conditions he would be tough to beat. I told him 'Well, I'm afraid its five pounds per square foot,' and he [sic] gauffed and said 'Then I don't have to worry about you then.[24]

Johnson would go on to win the contest, making an unprecedented flight from Elmira all the way to Virginia.

The principal designer of the RJ-5 was Harland Ross, who was the R in RJ with the J standing for Johnson. Ross had built the Zanonia sailplane before the war that had gone on to win several National Championships. Johnson placed an order for what would become the RJ-5 in 1948 after he had been working for Pan American Airlines for several years. He said he "figured he could afford to spend $4,000 and get a new sailplane."[25] Integral to the design of the RJ-5 was the use of laminar airfoils that had

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[23] Johnson, "The RJ-5 Sailplane."
[24] *ibid.*
[25] *ibid.*

been developed by the National Advisory Committee on Aeronautics, or NACA, during the war. Originally, the plan even called for the glider to have water ballast tanks in the wings, a feature that would not become popular on gliders until the mid 1960s. Johnson remarked that the idea was "awfully advanced for the time."[26] Unfortunately it was not carried out, otherwise the glider may have still been the highest performing glider in the world well into the 1960s.

Johnson and Ross learned of the existence of slow-speed laminar airfoils from Dick Lyon, a glider pilot who had worked extensively on their testing.[27] Laminar flow is essentially a scientific term for smooth flow. The farther back the flow of air over the wing remains laminar, the smaller the amount of drag will be created. On the airfoil chosen for the RJ-5, the flow remained laminar to approximately 30% mean aerodynamic chord, or MAC. While not great compared to today's sailplanes, it was revolutionary at the time, with Johnson remarking "without that airfoil, that sailplane never would have had as good a life as it did.[28] Using the laminar airfoil was also a big risk, however. Many aerodynamic experts of the time did not believe that a laminar airfoil would work on a sailplane because it essentially operates in two regimes; cruise, when the glider flies fast and climb, when it slows down to circle. To optimize an airfoil to be effective in both aspects was considered exceedingly difficult. Dr. Gus Raspet of Mississippi State was one of the few researchers who believed that it could be done effectively. Johnson took his advice in what turned out to be a far-sighted move toward the future of sailplane technology.[29]

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[26] Johnson, "The RJ-5 Sailplane."
[27] *ibid.*
[28] *ibid.*
[29] *ibid.*

The original timeframe for delivery of the glider was one year, but this slipped due to Ross' overloaded schedule for building the glider, running a flying service, and raising a family. Johnson agreed to accept the glider as 85% completed and pay Ross a proportional amount, although Johnson remarked that the glider was "far less than 85% complete. It didn't even have controls yet!"[30] Johnson brought the glider to Mississippi State University, where Dr. Raspet was doing research on low speed aerodynamics. Johnson made a number of changes to Ross' original design, including shortening the ailerons and adding wingtip spoilers, to help the glider roll into turns faster, and reducing the size of the tail section.[31]

The glider's first flight occurred on July 23, 1950. Dr. Raspet was anxious to get test results about the gliders L/D, but these came back somewhat disappointing with a maximum L/D of only 30:1. Johnson had a month before the National Championships at Grand Prairie, Texas, to improve the glider. The flaps had been piano hinged at the top of the wing, and left a large gap in the bottom. A wing produces lift by having a lower pressure on its upper surface than its lower surface. If there are any gaps between a wing and the controls, the higher pressure air from the lower surface can bleed onto the upper surface, disrupting lift creation and creating drag. Johnson chose to lock the flaps in place and cover up the gap, which yielded an L/D of 33.3:1.[32] It was good enough to win the 1950 Nationals, although at least part of the credit must be given to Johnson's superior piloting abilities.

Johnson spent the winter of 1950/1951 back in Mississippi continuing to improve the glider. He made the glider's nose and canopy more pointed and removed the wingtip

[30] Johnson, "The RJ-5 Sailplane."
[31] *ibid.*
[32] *ibid.*

spoilers, which he felt added little to the control of the glider and also had drag producing gaps similar to the flaps he had sealed the previous year. Johnson also created templates to check the wing's profile whereby he discovered that the wing did not keep its proper shape behind the rear spar. Johnson used fabric and dope to bring the wing back to its the proper profile. These changes brought the L/D up to 38:1, which was good enough for Johnson to repeat as National Champion, this time flying out of Elmira, New York, where no one expected his high wing loading glider to do well.[33]

With the glider reaching world record shape, Johnson took it to Odessa, Texas, to make an attempt at the world distance record of 465 miles that had been held for thirteen years by Russian Olga Kleptakova. Late July and early August is typically considered record season in West Texas. The air dries out and a strong tailwind begins to blow from the South allowing long flights into Kansas and Nebraska. Johnson made his first long flight on July 27, but the air was too moist. While the lift was good the moisture caused large cumulonimbus clouds to form that later developed into thunder storms, forcing him to make numerous detours. This reduced his speed and overall distance, although he still landed in Johnson, Kansas 403 miles from Odessa. Johnson wrote that:

> Of course I was happy with this flight, but it was to exceed the 465 miles International Distance Record that I was there – especially since the Russian girl had made it from a tow to some twenty-three thousand feet of altitude. This we did not feel was entirely sporting.[34]

The following week did not produce record weather, and Johnson acted as tow pilot for those who were trying to make shorter distance flights. August 3 proved to be a good day, but Johnson was serving as crew that day for another pilot who made a flight of 348

[33] Johnson, "The RJ-5 Sailplane."
[34] Richard Johnson, "We Break 500," Soaring (September/October 1951): 4.

miles. This necessitated spending July 4 getting back to Odessa, with Johnson remarking:

> That day, the 4th, was a very good soaring day. The cloud base was higher, a decent tailwind prevailed, and the dust devils [columns of dust blown upwards by strong thermals] were in sight everywhere. There was little doubt in my mind that my sailplane could have exceeded the 465 miles that day and for awhile I regretted having left my post at Odessa.[35]

As so often happens in soaring, fate would once again play its hand. Had Johnson flown that day, he would have missed the 5th, which turned out to be the best day of the year.

Johnson took off at 10:29, making slow progress for the first hour until he finally climbed to 9000 feet, high enough to really get going. He found the flight remarkably easy for the next few hours, and had only one close call with landing out around 2:30 near Armarillo, Texas. A little after 4 he crossed the Texas-Oklahoma border at the top of the Texas panhandle, some 365 miles out, and had enough altitude to glide the final 100 miles for the record. From this point on, he flew cautiously, but still landed 545 miles out, easily claiming the record. The distance was slightly handicapped by the fact that Johnson incurred a ten-mile distance penalty. He had not lost any altitude after releasing from tow because he had released into a thermal. Without losing altitude, he did not put a 'notch' in his barograph, the instrument that records altitude. This meant that it looked like Johnson had remained on tow several thousand feet higher than he actually had been. The record was reduced as 535 miles, still an amazing feat beating the previous record handily.[36] That record stood for twelve years until succeeded by Al Parker in a Sisu 1A.

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[35] Johnson, "We Break 500," 4.
[36] *ibid*, 5-6.

The final test for Johnson and the RJ-5 would be to see how the glider did compared to those of the world's top pilots in the 1952 World Championships at Madrid, Spain. The contest was a mixed bag. Johnson badly damaged his glider on the first day, requiring him to spend the next two contest days repairing it. He finally got it into the air and on the final day won in dominant fashion over a crop of mostly prewar gliders. In an interview at the 1970 World Championships, where Johnson would serve as team captain, Joe Lincoln asked him about the RJ-5, "And it had also, I understand, a very great influence on European development, particularly going toward laminar flow aircraft, subsequently?" Johnson replied:

> Apparently. They were probably going to head that way anyway, but this – apparently the aircraft did help confirm that it would work and there were advantages to it, and they did start swinging over almost completely to laminar airfoils after that.[37]

The RJ-5 really was a seminal ship in the history of glider design. Although not well understood, it would go on to inspire the gliders that most fly today. Americans would have two other designers who would also help shape the gliders that would eventually fly at Marfa. They were Len Niemi, who designed the Sisu, and Dick Schreder, who designed the HP series of gliders.

The Sisu was probably the dominant sailplane in American competition during the 1960s. It represented the peak of construction before the introduction of fiberglass around 1965. The Sisu was a direct descendant of Johnson's RJ-5, with National Air and Space Museum curator Russell Lee writing that:

> Inspiration to design and build the Sisu dates to 1951 when Richard Johnson flew the RJ-5 sailplane 881 km (547 miles). This world distance record generated publicity that broadcast the superiority of laminar-flow

[37] Joseph C. Lincoln, *Dick Johnson* (National Soaring Museum Archives, Elmira, New York, circa June 1970) 3.

> airfoils similar to those first employed on the World War II P-51 Mustang (see NASM collection) but with one crucial difference. Where the Mustang airfoil performed best at high speeds, the RJ-5 wing used a laminar-flow profile tailored specifically to operate most efficiently at low speeds. Harlan Ross had built this wing and Richard Johnson refined it, under guidance from Dr. August Raspet at the Mississippi State University. The success of the RJ-5 marked the beginning of a fundamental shift in the design philosophy of high-performance sailplanes.[38]

The Sisu was developed by Niemi, who named it after a Finnish word that has no exact English translation, but roughly means the strength, backbone, and courage of the Finnish people. Niemi left no detail untouched, sacrificing nothing in the quest for performance. Lee wrote that:

> The wingtips leaned ahead of the inner wing sections to insure that the ailerons, hinged just inboard of each wingtip, continued to bite the air and provide the pilot control during a stall. Washout, twisting the wingtips to reduce slightly their angle of attack and lower their stall speed, is a much more common technique but Neimi eschewed it. Twisting the wings, however slightly, would have generated unacceptable drag.[39]

Niemi set up the Arlington Aircraft Company to manufacture the glider, but costs soon exceeded revenues and he was forced to sell the project to Philip Baugh, a retired Air Force officer and entrepreneur who finished ten gliders and sold them at well below his cost. Al Parker, a successful Texas rancher and financier, bought a Sisu in August 1963 for $9,700. Just over one year later, he made his unprecedented flight from just north of Odessa, Texas to Kimball, Nebraska. According to Lee, breaking the 1000km barrier was an important psychological hurdle for soaring pilots of the time.[40]

The third important American designer of the 1950s and 1960s was Richard "Dick" Schreder. Schreder developed an interest in building model airplanes as a young

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[38] Russell Lee, "Arlington Sisu 1A," Smithsonian National Air and Space Museum, 2000. <http://www.nasm.si.edu/research/aero/aircraft/arlington.htm>.
[39] *ibid.*
[40] *ibid.*

child. His father was anything but supportive of the hobby, not seeing any value in the balsa and paper models that Schreder constructed. Nonetheless, he continued to pursue his passion, eventually designing a full sized glider at the age of twelve. This venture was an unmitigated disaster, with the glider crashing at the bottom of the hill from which Schreder had attempted to launch. It was not until four years later that he finally got airborne, after purchasing a factory built primary glider from a man skipping town because he had not paid his bills.[41]

Schreder's interest in soaring was rekindled following World War II where he had served as a Naval Officer and sunk a German submarine flying a PBM-3 airplane.[42] Schreder competed in his first nationals in 1956 in a Schweizer 1-23, considered to be one of the highest performing gliders of the time. At the end of the contest, however, he decided that he could do one better. Irv Prue, himself a successful glider designer in the 1950's, later recalled:

> In 1956, my friend Lyle Maxie was flying his sailplane, the Jenny Mae, in the Grand Prairie Nationals. I had not known of Dick Schreder except in a casual way, but on the morning after the '56 nationals, I went down to the contest field to take pictures of the Jenny Mae in which Lyle Maxie had won the contest. As I drove up, here was Dick measuring the Jenny Mae with a tape measurer. I think he was surprised to see me. He came up to my open windowed car door and said, 'Next year, I'm going to have a glider like this one.' Those were the first words Dick ever said to me.[43]

So began Schreder's career as a sailplane designer, which would result in a series of designs over the next twenty years, several of which would win nationals and one of which would win the bronze medal in the 1963 World Championships.

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[41] Karen Schreder-Barbara, 10,000 Feet and Climbing (Self Published, 2003) 1-9.
[42] *ibid*, 42.
[43] *ibid*, 105.

Schreder's first design was the HP-7, which had a number of early problems. The flaps did not come down far enough for him to make effective landings. He had decided to use rollers instead of a single main wheel for landing, but the rollers became jammed with small pebbles. Even so, he still placed 4th in the 1957 Nationals in Elmira. Unfortunately, the glider was destroyed when a close friend of Schreder's was at the controls after flying through a cloud and spinning out of control. After a period of mourning, Schreder decided that he could and should build an even better glider, one that would become one of his three great designs, the HP-8.[44]

Schreder combined many of the qualities of Johnson, being both an outstanding pilot and engineer. But Schreder was also very different, eschewing the testing and refining of designs that Johnson favored. Schreder had a special way of finishing his gliders. It usually happened just a few days before the National Championship for that year. He would show up having flown the glider once or twice, and go on to achieve superior results because the combination of glider and pilot were just that much better than anything else flying. Well known glider pilot Sterling Starr recalled that:

> I first met Dick and flew with him during the 1958 National at Bishop, California. He had his HP-8, which he had just finished a few days before. In fact, we were not sure it was really 'finished.' But it was an impressive glider, which clearly was superior to most anything else around.[45]

Rudy Mozer, a long time dealer for Alexander Schleicher, a West German glider producer, said that "[i]n that era, a National Soaring Contest was not complete if Dick did not show up on the last practice day, still working on perfecting his latest sailplane

[44] Schreder Barbara, 111-114.
[45] *ibid*, 115.

design."[46] Schreder's major contributions to glider design were to ambitiously increase the wing loading of gliders and later the 90 degree landing flap, which he considered far simpler than the spoilers coming out of the tops of the wings found on most gliders. Schreder's flap system had the advantage of adding additional camber to the wing when deployed, increasing the amount of lift allowing for slow landings while also creating enough drag to reduce the L/D of the glider. Spoilers are essentially slats that pop out of the center of the wing. While they create lots of drag to help bring the glider down, they also reduce the amount of lift produced, increasing the speed at which the glider stalls and forcing pilots to use higher approach speeds.

Schreder's dislike for spoilers was born on the practice day for the 1958 Nationals. After flying through a strong thermal, his spoilers were sucked open so hard that they jammed in the wing skins. Schreder was forced to make an emergency landing 40 feet short of the runway, and spent the entire night fixing the damage and creating new stops for the spoilers so the whole episode wouldn't happen again.[47] Schreder would later fly the HP-8 in the 1960 World Championships in Cologne, Germany. In a memorable flight, he accidentally landed across the border separating East and West Germany, creating an international incident. But what was truly important for the history of soaring was his realization that the commercially available sailplanes in Europe were far better than those in America. From then on, Schreder would design his gliders to be available in kit form.[48]

Schreder came closer to winning a World Championship in an American glider than anyone before or after him, flying his HP-11 in 1963 at Junin, Argentina. Schreder

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[46] Schreder-Barbara, 175.
[47] *ibid*, 116
[48] *ibid*, 122.

had realized that the HP-8 was simply too heavy, so he trimmed back the wing loading to make an 'all-weather' glider. True to form, Schreder would have a problem with his glider when during the first practice day his rudder pedals came unwelded. Another problem facing competitors was that no one was allowed to make retrieves by trailer on the road, as few competitors had cars. For most retrieves, the fields were large enough to get an airplane in to tow out. On the first contest day, however, Schreder landed in a field so small he had to be towed out by helicopter. On the second to last day, he landed in a swamp over 400 miles from the home airport at Junin. His glider was pulled out of the swamp by horse and he used a small dirt road as a runway.[49] Schreder finished in third place behind the two Polish pilots, Edward Makula and Jerzy Popiel. The Polish pilots were heavily subsidized by their government, and had months to practice team flying techniques that proved to be extremely valuable in the wild Argentinean conditions.[50]

Seven of Schreder's gliders, the HP-10, HP-11, HP-12, HP-14, RS-15 and HP-18 eventually found their way into kit production. Despite strong demand for his kits, Schreder never turned a profit on selling glider and eventually trailer kits. He was the owner of a successful drafting instruments company and financed the deficits from aircraft production out of his own finances.[51] Without Schreder's ships pilots like Moffat would never have been able to learn the techniques of high performance soaring that would lead them to future success. Schreder's use of flaps would also be copied in many European designs.

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[49] Schreder Barbara, 147-153.
[50] Omneya T. Foz, "The 1963 World Soaring Championships," Soaring (March 1963) 12.
[51] Schreder Barbara, 163.

Unfortunately for the Sisu, HPs and other American sailplanes, an important revolution in sailplane design was on the horizon. Using fiberglass, the Germans were able to create compound shapes that are difficult if not impossible to duplicate with traditional metal construction. Lee wrote:

> The end of the nineteen-sixties also marked an end to the Sisu's dominant position in world competition glider flying. 'As one decade ends and another begins,' quipped 'Soaring,' the all-metal Sisu finds itself fighting on against mounting odds-a tin soldier in an increasingly hostile world of fiberglass, where the prevailing language is German." With sustained and ample support from the West German government, researchers and technicians at major universities had begun to design and build motorless aircraft from fiberglass. These sailplanes claimed the lead in competition soaring by 1970 and as the new millennium dawned, skilled pilots soaring these aircraft remain the best in the world.[52]

By 1969, pilots would find that the new breed of 17 plus meter fiberglass sailplanes simply outclassed the rest of the field. American producers would never be able to emulate the success of the Germans who built an insurmountable lead in the technology required to produce modern sailplanes. If the period 1966-1974 was a Golden Age for soaring, then the period from 1950-1965 was a Golden Age for American sailplanes. Without the innovation of Ross, Johnson, Raspet, and Niemi, German designers would not have been able to improve on the American's concepts in fiberglass and take sailplane design to a whole new level.

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[52] Lee.

The Education of George Moffat

"There are three elements to success in soaring – or just about any other high-stress endeavor. They are talent, skill and the mastery of emotions. Talent is usually the least of these. It provides a jump-start but will amount to little if the other two are unattained. Skill requires time, discipline, and plenty of practice. The skills are vital, but I'll let you in on a secret: most of the top-level competitors have all the skills needed to win. Who does win? The person with the emotional control – the emotional strength, flexibility, responsiveness, and resiliency – to let their talents and skills do their thing unimpeded."[53] *– George Moffat*

Before he began flying, Moffat had been a world champion in the International-14 class sailing dinghy, regarded as requiring one of the highest skill levels of any class. With perhaps the exception of three-time world champion Helmut Reichmann, no other pilot has had the long-term impact on the sport of soaring as Moffat. Moffat and Reichmann were contemporaries, and Reichmann would incidentally win two of his World Championship titles during the same years as Moffat, 1970 and 1974, but flying in the Standard Class, rather than Open Class. Moffat dedicated more than ten years of his life to achieve success in a sport for which there are no financial rewards and little fame or publicity can be expected; where only a pilot's fellow competitors can truly understand the brilliance that one must demonstrate not only to complete the task at hand, but to fly faster or longer than the rest of the field.

Moffat seriously took up gliding in France during 1959, when he joined a local, government sponsored glider club. Typical of his generation, he had been fascinated with aviation far before he had opportunity to explore it first hand, writing in Winning on the Wind:

> Soaring didn't really start for me in Chevenay, 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 the

[53] Moffat, Winning II, 83.

> pictures of the then fabulous Minamoa, reading accounts by the great Philip Wills, becoming utterly entranced with the idea of silent flight.[54]

Compared to the Cirrus that Moffat would fly in 1969 and the Nimbus that he would fly in 1970, highly refined composite machines, the all wooden Minamoa was like a Model T compared to a Mustang. Moffat recalled in Winning on the Wind watching in awe in 1959 as many time French National Champion Camille Labar finished a 440km task, a seemingly impossible distance at the time.[55] Only ten years later, the course distance for the speed tasks at Marfa during the 1969 Nationals would average over 400km, and pilots routinely exceeded 600km on the distance tasks.[56] Moffat's built upon his early experiences in France following his return to the United States, and by 1966, he would firmly establish himself as one of the top pilots in the country. Moffat refined competition flying to an art form that few would be able to match.

Recalling his experience in France, Moffat wanted the reader to believe that he was preordained for greatness. In an early flight, Moffat attempted something no one else ever had. The first major milestone for a glider after flying solo is completing the requirements for the Federation Aviation International (FAI) Silver Badge. To become a 'Silver' pilot, one must complete three 'legs,' including staying in the air for 5 hours, climbing 1000m from a low point in a flight, and flying 50km cross-country. It is this third requirement that is perceived to be the most difficult, because the pilot must 'cut the apron string' and venture away from familiar territory, risking a landing in a farmer's field should another thermal not be forthcoming. At the time, the amount of money gliding clubs in France received as a subsidy from the government was based on how

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[54] Moffat, Winning on the Wind, 131.
[55] *ibid,* 133.
[56] Lincoln, "The 1969 US National Soaring Championships," 22-23.

many badge legs the clubs pilots completed in a given year, so naturally, Moffat was encouraged to complete his Silver Badge as soon as possible.[57]

After completing his duration and altitude gain legs, Moffat set out for the distance attempt. In modern gliders, with L/D's typically in the mid forties, flying 50km is fairly easy. All that is required is to climb to the top of an average thermal about 2km above the ground and set off for the goal. Moffat, on the other hand, would be flying an Emouchet with an open cockpit and an L/D of approximately 12:1. Moffat wrote of the Emouchet:

> The single seater to which I was introduced was no Breugeut [the highest performing glider in the world at the time]. The Emouchet was a sturdy French version of the famous Grunau Baby-the dernier cri 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.[58]

His goal was the cathedral town Reims, France. Once off tow, he found good lift to 5,500 feet. After about an hour Moffat had made good distance. A few minutes scanning the horizon and he finally spotted the Reims Cathedral, which allowed him to easily find the glider field for which he was looking.

After landing and having his paperwork signed, Moffat became anxious. He had a date with a girl in Paris that evening, and if it took too long for a trailer to come from his club, he would not make it in time. Instead of waiting, he decided to fly back. Unfortunately, by the time he got a tow back into the air, conditions had weakened. In addition, on the trip to Reims, he had a five knot tailwind pushing him towards the goal. Now, he was fighting that same wind on the trip home. A little after six in the evening,

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[57] Moffat, Winning on the Wind, 135.
[58] *ibid,* 133.

he was forced to land in a farmer's field, and call for a retrieve with the trailer that he had tried to avoid.

After about an hour, one of the instructors showed up with the trailer. He was furious, as he believed that Moffat had only made a flight of seven kilometers after being airborne for most of the day. After Moffat presented his signed paperwork, however, the instructor burst out "Il a fait la retour," or "He has made the return." Never before had a pilot attempted to fly back from his Silver Distance flight.[59] While his date may have inspired his choices on that particular day, the flight was characteristic of Moffat's personality. He would approach competition flying with the attitude that you win by trying harder, an attitude that would propel him to continually improve his flying in order to beat the rest of the field.

Moffat developed a theory of competition he called 'low loss soaring,' or the idea of winning by not losing. In introducing low loss soaring as a concept at the 1969 Soaring Symposia, he said:

> It seems to me that very few sailplane pilots properly appreciate how long a second is and how fast seconds add up. I guess perhaps it's because I used to race boats a lot that I got very aware of this... Just to dramatize what I'm talking about, last year in Poland I lost third place by 20 seconds and second place by 55 seconds. Now let's say that a circle takes most of us about 20 seconds to fly--that is one circle during eight days of contest flying, mind you. I was one circle out of third place and three circles out of second place.[60]

The contest in Poland involved over thirty hours of flying, yet in all that time, just one minute separated Moffat from second place. It was for this reason that he would look to save every second possible. Beyond that, Moffat refused to give up points easily earned.

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[59] Moffat, Winning on the Wind, 141-142.
[60] George Moffat Jr. "Low Loss Flying," Soaring Symposia, March 8-9, 1969. <http://www.betsybyars.com/guy/soaring_symposia/lowloss.html>.

In "The Sunship Game," a movie about the 1969 National Championships at Marfa, fellow competitor Gleb Derujinski says "I was 300 feet off the ground so I just dumped it in. Its [sic] kind of silly, you know. 300 feet gives you three miles, fourteen points maybe." Moffat then replies "I've lost national championships by nine points, though."[61] In Marfa during the 1969 Nationals, the proper choice of glider would allow Moffat to make up many points over his closest competitor.

In soaring, the scoring system is based on 1000 points. Fly ninety-nine percent as fast as the winner and you get 990 points. Most pilots would be happy with 990 points, but Moffat, with his extensive background in sailboat racing, had a different concept of scoring. In a regatta, the winner gets one point, the second place finisher two points, and so on, with the lowest score at the end of a series of races winning. Such a scoring system puts a much higher emphasis on the importance of place in the field rather than scoring relative to the winner. Should you place fifth only a few seconds behind the winner in soaring, you will score highly. In a regatta, you receive fully five times as many points as the winner, a bad thing in this case. The sailor is, therefore, very much aware of the value of a second, since those seconds could well make a difference in his placement and thus have a major impact on his score. It was a concept that Moffat brought with him to soaring competition. While it was not necessary for Moffat to win every day in soaring competition, he still realized that by saving seconds over the course of a flight he could move up many positions.

Moffat also realized that most pilots at the top of the sport had fundamentally the same skill level when it came to the actual flying of the glider. In introducing low loss soaring as a concept at the 1969 Soaring Symposia, he said:

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[61] The Sunship Game. dir. Robert Drew (New York: Robert Drew & Associates, 1970), DVD.

> How about by doing something dramatically better, thermalling or high speed cruise or something of that sort? That's out, too. There isn't anybody who is demonstrably, materially, better than any of the best other people today; and if you don't think so, take a look at the point scores again. In Poland, for example, with the best in the world flying, there was an easily catchable difference of points among the first five pilots in both the standard and open classes. One more day could have easily made an upset. The points were very close.[62]

There were a number of little things on each flight that every pilot could do, but most pilots felt were not worth the effort. These were the areas where Moffat tried to make up time on the other pilots. They were all part of Moffat's psychological advantage; the way he approached being the best.

Moffat had plenty of advice about how to save seconds. Many pilots would not go through the start gate at the maximum height and the glider's redline (or top safe) speed, then pull up to gain extra altitude. Next, pilots spent too much time in thermals. They tend to weaken in strength as they get higher. Spending time climbing in the weak part of the thermal was wasted time. Heading for the wrong thermal because you saw a number of ships nearby was a waste of time – they were probably circling in weak lift. Climbing too high to make a final glide for home was a waste of time – Moffat trusted his slide wheel flight computer. "What does this add up to?" all the aforementioned factors on a typical contest day, asked Moffat. "It adds up to 2070 seconds which is 34-1/2 minutes."[63]

Finally, Moffat believed, at least at the time just prior to the 1969 National Championships, that all the ships were fairly close in performance. That contest, however, showed how far the best of the fiberglass ships had advanced beyond what was previously available. Before that seminal moment he said:

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[62] Moffat, "Low Loss Flying."
[63] *ibid.*

> You can't have equipment that completely outclasses anybody else--for instance Dick Johnson in the Fifties with the RJ-5--just a whole new departure, no other ship was in the same league... Well, number one is out, there really are no ships currently available that will significantly outperform any other ships. So you have a Phoebus C, I have a Cirrus, or you have a Diamant 18. They are all pretty much in the same bag. Poland, among other places, made this very clear indeed.[64]

The World Championships in Poland likely proved that for the most part, the ships were similar. In 1970, Moffat's prototype Nimbus would clearly outclass most of the field, save for Walter Neubert in the other giant 22-meter glider, the Kestrel 604, and play a major role in his victory. By 1974, however, when all the top pilots had access to similar fiberglass ships, Moffat would be proven right about no equipment outclassing the rest of the field. In this context low loss soaring would become even more important.

Even though the ships were not as equal as Moffat presupposed prior to 1969, the concept of low-loss soaring was still important because even the best ships had only an eight to ten percent advantage over the next few. As Moffat would show, this advantage was easily eroded. First, by paying attention to the 'little details,' on the glider, such as seals on the ailerons, improving the dive brake fit, etc., one could make small gains in performance. Prior to the 1968 World Championships, Moffat and A.J. Smith made a number of small improvements to their gliders. He states that:

> My guess is from making comparison flights before and after with one of the Swiss Elfes (Bloch's), was that perhaps, we gained two to three percent from doing this. We modified A.J.'s ship to match mine so the two ships were, at least supposedly, very much alike. Two to three percent. Well, that worked out at about 30 minutes saved in an eight day contest.[65]

What was even more important, however, was the devastating psychological effect the Americans' improved gliders had on the rest of the field. Many of the pilots had been

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[64] Moffat, "Low Loss Flying."
[65] *ibid.*

provided with lower performance Foka 4's from the Polish Aero Club, with the Polish team already flying a newer Foka 5 model.

In the late 1950s and early 1960s, when there were a few gliders that simply outclassed the rest of the field, pilots could win by making the right 'big picture' decisions, such going east towards clouds instead of flying north out into a blue sky and uncertain lift. A few hundred feet too low at the start or staying in a thermal for a few extra turns didn't matter as much as the fact that the pilot had a top glider. In fact, when gliders of lower performance were common, those few hundred feet gained at the top of the thermal might have made the difference between making it to the next thermal or landing out. Even as late as 1970, having the best glider would make a big difference, as Moffat would be able to bail himself out of a poor first day using the superior performance of the Nimbus. Moffat and others began to recognize, however, that those days would soon be coming to an end. Even the Standard Class gliders of 1970 were far better performers than had been Johson's RJ-5. Pilots could afford to take more risks in search of better lift. Low loss soaring proved to be a valuable asset for Moffat throughout his career. While he was a brilliant pilot and made the right 'big picture' decisions, he still made up many points on other great tacticians by doing all the 'little things' right. It was the winning psychology that other top pilots too often lacked.

Marfa Overview

> *"My all time favorite [contest site] is Marfa, Texas. As with any contest, our first and sometimes only stop (we carried a cooler packed with food and two Tupperware containers for barf and pee) after leaving Bryan, Ohio, and arriving in Marfa, was the airport... and I use that term loosely. Upon seeing the facility for the first time, even our most minimal expectations were dashed... I surmised even the removal of a single nail could surely bring the edifice crashing down around us."*[66] *– Dick Schreder's daughter Karen.*

Marfa is located in the northwest portion of the state, where the border between Mexico and the United States still runs on land before it heading into the Gulf of Mexico. It is right in the middle of the Davis Mountains. The terrain looks forbidding from the ground, and in many ways, even more so from the air. Like most gliding sites, often located at airports built during the Second World War far from large cities, the town is small even today, with 2,121 residents according to the 2000 census. In her report to *Soaring Magazine* following the 1967 nationals, the first major contest held at Marfa, Sylvia Colton wrote:

> Marfa, like many another old town of the Southwest, is a composite of adobe and modern glass-fronted buildings. It is a western style cattle town with a smattering of small industry and a single stoplight to divide it either way you happen to go through.[67]

The arrival of over seventy pilots and their crews created quite a buzz in the local community. Local merchants enticed weary travelers with signs such as "Good grief, no motor!"[68]

The history of aviation at Marfa began in 1911 when daredevil pilot Cal Rodgers landed for fuel on his transcontinental flight across in the USA in a Wright EX biplane. Rodgers was following the route of the Southern Pacific Railroad as a train loaded with

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[66] Schreder-Barbara, 95-96.
[67] Sylvia Colton, "34th National Soaring Championship," Soaring (September 1967) 10.
[68] *ibid*, 10.

many spare parts followed behind him. In 1919, the US Army began dispatching biplanes to patrol the Rio Grande river border with Mexico. They were often on the lookout for smugglers and bandits, and activity that continues today with a US Border Patrol aviation unit still based as Marfa Airport.[69]

The year of 1942 brought big changes for aviation in Marfa, as the Marfa Army Air Field was built outside the city adjacent to what is now interstate highway 90. The base was used to train Army Air Corps pilots, navigators, and bombardiers. Fritz Kahl, who would become one of the major proponents and organizers of soaring at Marfa, was one of the flight instructors assigned to the base during the war. Deciding that he liked Texas far better than his home state of Iowa, he stayed and set up a flying operation.[70] Kahl was Mayor of Marfa in 2001 when Burt Compton established Marfa Gliders, the new full time gliding operation at the Presidio County Airport.[71]

Al Parker organized the first soaring camp in West Texas at Odessa in 1959. Red Wright, who would later become another sponsor of gliding in West Texas, went along with Al Hoffman in a war surplus TG-3 training glider.[72] In the early 1960s, a number of soaring camps were held. In 1962 notable national pilot Ben Greene and Neil Armstrong, an enthusiastic glider pilot who would later become famous for being the first man to land on the moon, spent several weeks at Marfa. It was with this group that George Moffat first visited Marfa with Dick Schreder's record-breaking HP-8 to attempt the 100km and 300km triangle speed records.[73] Red Wright, who would later be described

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[69] Compton, 1.
[70] Compton, 1.
[71] Compton, 2.
[72] Joseph C. Lincoln, *Red Wright* (National Soaring Museum Archives, Elmira, New York circa June 1969) 20.
[73] Compton, 1.

by Fritz Kahl as the "sort of grand-daddy of soaring in Marfa," later explained how the trip happened:

> In 1962 Ben Greene and other soaring pilots around the country showed up at Odessa. We decided to come down to Marfa and try out conditions here. We were aware of this old field here and knowing the country, we concluded that this ought to be a nice place to soar, so about twelve of us just bundled up and came down for a week to try it out.[74]

Wright was described as "well over six feet, 230 pounds." He had served in the Army Air Corps beginning in November 1942 and flown the extremely dangerous route over the Burma hump to resupply Chinese troops fighting the Japanese in Manchuria.

West Texas' potential for great flights would be further explored when Moffat returned in August 1964 and flew out of Odessa to a better result than he had achieved in Marfa during 1962. He writes in Winning on the Wind:

> The first time I ever heard of the 300-km triangle record, back in the summer of 1959 when I was first starting to fly seriously in the elderly Olympias and AV-36's of L'Aero Club Gaston Caudron, it was an astronomical 77km/h, a speed that completely passed my comprehension of possibility. The first time I flew a 300-km triangle, still in France, it took me a hard working six and a half hours.[75]

Within ten years, that speed record would have been more than doubled. A look at just how drastic the changes in soaring at this time were will begin to reveal why. In 1964, a pilot could still wake up one morning, put the glider together, attempt a record, and have a pretty good shot of completing it. On August 6, 1964, Ben Greene, Wally Scott, Red Wright, and Moffat were all camped at Marfa, with the initial idea of setting a goal and return record. Moffat wrote that the day "didn't look particularly promising" and Scott, who proceeded with the record attempt, took off at 10:15 but found himself back on the ground by lunchtime. Moffat "thought about [his] 7.85 pound wing loading," a fairly

[74] Lincoln, *Red Wright.*
[75] Moffat, Winning on the Wind, 161.

heavy glider for the time, "and stayed put." When cumulus clouds started popping at 1:30, Moffat "got out a piece of paper and wearily wrote out a 300-km triangle declaration. The others had writer's cramp by this time, and didn't bother. They agreed to come along for the ride, however – after all, what's a 300-km triangle in Odessa, Texas?"[76] Moffat started the task just after 2:30, and had a hard time getting going. With the start gate system, it was imperative that a pilot get a good climb immediately following the start. In the modern GPS system, pilots start several thousand feet higher, and have a longer time to find that first good thermal. Forced to work several weak thermals before getting a good climb, Moffat's speed was slow and the others, starting after him, caught up. Conditions improved, however, and Moffat flew home to a new World Record.[77]

If the turn of the decade was Soaring's Golden Period, then the early to mid-1960s were the 'glory days.' No one knew exactly where the limits were or how far the technology would advance. Each flight contained an element that was exciting and new. Pilots like Moffat flew around courses and speeds that had been unimaginable just five years earlier. Those who were participating realized that they were on the verge of a whole new era. The outstanding speed and distance flights being made at the Marfa and Odessa camps caused the SSA to look to West Texas to stage national competitions. At the time, there were two airports in Marfa. The first was owned by Kahl, who would serve as Contest Manager in 1967, 1969, and 1970. It was from his airport that the very successful Marfa Soaring camps were held. The Soaring Society of America would stage the later contests at Marfa at the larger Presidio County airport. It has three large

[76] Moffat, Winning on the Wind, 161.
[77] *ibid*, 163.

runways that would prove more than adequate to handle the contests involving seventy-plus sailplanes. At the time, a large World War II hanger still stood, offering competitors and crew an oasis from the relentless sun with which they contested for most of the day.[78]

Part of what makes Marfa so special is the mountains that can serve as both a blessing and a curse as pilots attempt to make their way across the Texas landscape. Thermals often form earlier in the mountains than they do over the plains, because the mountain's sides form a more direct angle with the sun for a majority of the day. This increased sun intensity typically leads to increased thermal strengths. Unfortunately, it is also possible for the thermals to become strong enough to push too much moisture into the air causing the clouds to 'overdevelop' or block out sun from hitting the ground. Without direct sunlight on the ground, thermals are less likely to form. In this case, pilots fly cautiously, hoping to stay in the air until the clouds begin to dissipate and sun begins to hit the ground again. Sometimes, this can happen several times over the course of a day, in an action known as 'cycling.' In more extreme cases, however, the overdeveloped clouds will take on a life of their own. Once enough energy is in the sky, clouds may begin create their own energy in a reaction that continually feeds itself, eventually leading to violent thunderstorms with extreme updrafts and downdrafts that often contain heavy rain and hail. At Marfa, nearby Mt. Livermore would often cause thunderstorms late in the day, creating numerous difficult decisions for the pilots as they returned from long tasks.

In a 1969 interview with Joe Lincoln, Red Wright explained how contests got started at Marfa:

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[78] Schreder Barbara, 95-96.

> After the [1965 Nationals] we came down here and had a soaring camp. That is when the townspeople wanted to know if they could host a contest. We urged them to not try for the Nationals first off, but to host a Regional, so they bid for the Regionals and got it in 1966, which was a successful contest and was run by Marshall Claybourn. So Marfa gained a bit of confidence in their ability, and we told them they were well qualified and able to handle a National Contest, so we urged them to bid for the 1967 contest and they got it. I flew in that contest. I'd just as soon forget about my placement in that one, too.[79]

Another important part of the Marfa mystique is the Robert Drew movie "The Sunship Game," filmed at the 1969 Nationals. The movie follows Moffat and fellow competitor Gleb Derujinski, a photographer from Manhattan who flew with Moffat out of the Wurtsburo, NY airport. Between "The Sunship Game", Joseph Lincoln's contest report of some 25 pages which constituted a majority of the September 1969 *Soaring Magazine*, Moffat's chapter on the contest in Winning on the Wind, and his discussion of the 1969 contest at the February 1970 Soaring Symposium, the 1969 Nationals is probably one of the best recorded contests in the history of soaring.

[79] Lincoln, *Red Wright.*

Fiberglass' Early Years: Reno 1966, Marfa 1967, Poland 1968

The 1966 U.S. National Championships in Reno, Nevada would mark the introduction of fiberglass sailplanes in competition on the North American continent. The construction techniques of the gliders competing in Reno varied across the board, from the primarily wooden Austrias, one of which was flown by Moffat to second place, to traditional American metal construction in the form of the Sisu's and Dick Schreder's new HP-14, to the new fiberglass Libelles flown by Graham Thompson and Carroll Klein. Judging from future directions of sailplane design, one would have expected the Libelles to fly away from the field. Rudy Mozer later remarked that:

> To most opinions, the western pilots [including Thompson and Carroll] with the exotic new German hardware ranked as the favorites, especially since the weather in Reno offered a very tricky mix of thermal flying, wave flying and even ridge soaring, all stuff that the westerners were more familiar with.[80]

The Libelles, however, were able only to stay relatively close to the other leaders, finally coming in third and sixth, respectively. Later research would show that the Libelles suffered from a number of design issues, primarily caused by use of early laminar airfoils. When corrected, the Libelles remained competitive in the 15 meter class well into the 1980s.[81]

Following on the success of his previous designs, Schreder knew that he could do better. The early HP's had been at their best in strong conditions. With his latest design, Schreder hoped to build a more versatile ship, stating that:

> At the conclusion of the 1965 Nationals, I drew up a design for a competition sailplane which would perform equally well in weak and strong conditions. I used to believe that high wing loadings of 7 to 7½

[80] Schreder-Barbara, 176.
[81] Wil Schueman, "Sailplane Modifications," Soaring Symposia, February 12-13 1972. <http://www.betsybyars.com/guy/soaring_symposia/72-modif.html>.

> pounds were the answer, but bitter experience of going down just once during a contest, on that weak day or weak period, wipes out all the advantages of the lead sled.[82]

For the HP-14, Schreder had only advanced his design by a single generation, far less than the breakthroughs that were soon to be made in fiberglass. His daughter later wrote, however, that the HP-14 did include "the best features of all previous HP-series sailplanes as well as others improvements that seemed to be dictated by current trends."[83]

Reno was probably the ideal area for a trial of all the latest designs. Pilots were forced to use the whole day. Moffat wrote that:

> An added feature was the ability to get away as early as 10:30 in the morning and fly until very late in the evening. On most of the distance tasks, the leaders landed more because of darkness rather than lack of lift. The result of this meteorological largesse was that the winners generally flew for ten hours on distance days.[84]

When considering this, it is important to realize that "getting away" at 10:30 does not mean that a lead sled like the HP-8 could have stayed up in such conditions. Schreder had shown great foresight to design an all weather ship, despite heading to Reno, where according to Moffat "everyone grew used to seeing 1000 [feet per minute] on the clock [the rate of climb on the variometer], and most of us found quite a bit more on many occasions."[85] Such a rate of climb is extremely good, with 3-400 feet per minute being more typical of contests in the eastern portion of the United States or Europe.

The contest was won by Schreder in the HP-14, despite the fact that it had been finished only days before the contest and was far from top form. Schreder nearly lost the contest, with *Soaring Magazine* recounting that "the last day of the contest was a bit of a

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[82] Schreder-Barbara, 175.
[83] *ibid*, 171.
[84] Moffat, Winning on the Wind, 167.
[85] *Ibid*, 166-167.

cliff-hanger. Moffat was dogging Dick in second with only a few points separating them." While making his run for the start gate on the final day, Schreder hit a huge gust that registered four negative G's in the cockpit and sent his thermos through the plexiglass canopy. *Soaring Magazine* said that:

> For some time he proceeded on course fearing to land lest he relinquish his lead to Moffat, but finally returned and made lash-up repairs with cardboard and masking tape. It seemed the delay would cost him the meet, especially when Moffat came whistling back with the early arrivals. But instead of landing with the others, Moffat circled the area weighing the advisability of a second round should Schreder appear to have made good time.[86]

A slight delay would not cost Schreder the contest however. He had built up a large enough lead even with the morning's excitement; Moffat remarked that Schreder won the contest "by the largest margin in years."[87]

In 1967, many pilots descended on Marfa unsure what to expect. A number of pilots arrived at least a week before the contest, including such well known names as Paul Bickle and Rudy Mozer. Bickle was an aeronautical engineer by training, and was employed at Edwards Air Force Base in the flight testing department. He had done some of the pioneering work on laminar airfoils. Mozer was a well known pilot from Bloomfield Hills, Michigan, where he was involved in manufacturing. He was flying the new Schleicher ASW-12, designed by Gerhard Waibel. Mozer also served as US agent for the Schleicher company.

Marfa in '67 was a clear indication that glider design was heading more and more towards fiberglass. The number of fiberglass ships increased dramatically, including the Libelle 301 and BS-1 from Glasflugel, the Diamant 16.5 that had been developed by the

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[86] Sylvia Colton and Douglas Lamont, "The Historic 33rd Nationals," Soaring (August 1966), 24.
[87] Moffat, Winning on the Wind, 165.

Swiss Institute of Technology, and the ASW-12 from Alexander Schleicher, one of the first glider manufacturers with a heritage dating back to the 1920s. Yet for all the advances, AJ Smith was still able to win in a seven year old Sisu.

The early fiberglass ships were in many ways still compromises. The BS-1 weighed in at over 1000 pounds empty, close to double that of the average wooden or metal glider flying at the time. No better story can be told about it than that of Rheinhold Stuhr, a German flying in the contest as a guest, who blew out his tire landing in a field quite a distance from the road. The field was so rough the trailer could not be brought in. Stuhr was forced to carry the glider out of the field. He hoisted the root of each wing, weighing over two hundred pounds a piece, on his shoulder and marched out. Paul Bickle, who had landed on a nearby road and was helping out, recalled that Stuhr was so strong "He took that 1,000 foot stomp like a Sunday walk."[88] After the wings, *Soaring Magazine* recounted:

> There was a real race to see who would get the BS-1 drag chute and other assorted light items for the fuselage still remained. At length Stuhr hoisted the nose up on his shoulder while Paul [Bickle], and five other stalwarts who had lost in the drag chute lottery, strung themselves out along the length of the fiberglass hull. Whenever Rheinhold stepped into a hole, which he did often enough in his rapid progress over the dark ground, the impact reverberated down the length of the fuselage, causing each man in turn to buckle at the knees.[89]

Weight was only one issue with which the pilots had to contest. The ASW-12 was equipped with only a tail chute to aid in landing. George Moffat would later decide against purchasing one because while it was the highest performing ship of the time, one bad landing could destroy it. Moffat had his own problems with his new Diamant 16.5.

[88] Colton and Lamont, 23.
[89] Colton and Lamont, 24.

The ship was so new the total energy system did not work and it lacked water ballast until half way through the contest.

After Schreder's 1966 win in the HP-14 and Smith's 1967 win in the Sisu, it is likely the Americans felt that their metal designs had no real disadvantage when compared to the latest German fiberglass. They were able to deceive themselves in this way because most of the 'top' American pilots, those who had previously been selected to a US Team, such as Johnson, Schreder, and Smith, were flying metal designs. One truism of sailplane racing is that the ship doesn't make the pilot, but rather the pilot makes the ship. Ross Breigleb, flying a wooden BG-12B that was designed before 1960 and certainly no world-winner, managed to finish 8th.[90]

The Americans were content with what their metal designs and watched with what might be considered arrogance the revolution that was happening across the Atlantic. Even as late as 1970, Dick Schreder explained at the Soaring Symposia:

> There is always a question -- which is better? -- fiberglass or metal. I think that they both have their place and should be used where they work the best. One of the reasons the Europeans went to fiberglass, principally in Germany, was because they developed the fiberglass technology ahead of everyone else. They also had a very great reluctance to go to metal because they simply didn't have the technicians or the people who were familiar with metal. They have, therefore, led the world with fiberglass ships.[91]

He went on to say that: "I think that the trend in the future will be away from fiberglass. It will still be used, but I think we will go more to metal. My reason for saying this is

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[90] Colton and Lamont, 20-21.

[91] Richard Schreder, "A Synopsis of Design –Present and Future," Soaring Symposia, 8-9 March 1969 <http://www.betsybyars.com/guy/soaring_symposia/70-synop.html>.

that the prices of sailplanes are getting very high."[92] Schreder believed that metal construction offered considerable cost savings. He remarked:

> I have toured all the plants in Germany and watched them build ships from fiberglass and, contrary to most opinions, the man-hours required to build the fiberglass ship are generally higher than those required to build a metal ship. Bolkow (which, in my opinion, has the best control and the best methods of all the plants I was) claimed that in building the Phoebus, they required 900 man-hours for each ship. At our rates of pay, 900 man-hours results in prohibitive cost figures. I think it is out of the question to build fiberglass ships in the United States.[93]

With the American metal ships continuing to do well in contests and the perception of fiberglass construction as time-consuming and perhaps even wasteful, no progress was made on the creation of "next-generation" sailplanes on the North American continent after 1966. The HP-14 was the last of the truly competitive American designs, and even then, the ship did well at least in part because of the capabilities of its pilot.

Another of the reasons that fiberglass was disdained in America was that pilots did not yet really understand how to make use of the performance that the new ships offered. As glider performance increased, the pilots blindly followed the advice of their MacCready rings and flew the gliders faster and faster. This also meant that the gliders sunk through the air just as fast. MacCready theory is predicated on the idea that there is a specific speed to fly for the expected climb rate in the next thermal following the glide. It also assumes that the pilot will be able to find a thermal of that strength, in ignorance of the fact that the pilot has a limited amount of altitude to expend before he finds himself on the ground. When asked about his flying strategy, Dick Schreder once stated: "Well, I fly 120 miles per hour until I'm down to 2000-3000 feet above the ground, then I slow

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[92] Schreder
[93] *ibid.*

down and look for a thermal."[94] Flying faster certainly led to fast speeds in "record like" conditions, where every thermal was a boomer and there was no trouble finding the next one. Over the course of a contest, however, there will be weak areas on a task, and days filled with weak conditions. Even if the lift is a relatively strong 400-500 feet per minute up, it made little sense to barrel along at 80 knots when cloud base was only 2000 feet above the ground. The chance of finding the next 400-500 foot per minute thermal would be greatly diminished by the decreased range of action possessed by the pilot who flew at such a speed.

After a somewhat disappointing showing in the 1965 World Championships held at South Cerney, England, the American team was looking forward to a productive meet at Lezno, Poland in 1968. It seemed clear at the outset that the foreign pilots were at a disadvantage to the Poles, who were on their home soil. The Polish pilots had flown consistently to the top of the score sheets since 1960. Ake Petterson, a Swede who flew in every World Championship from 1970-1999, remarked, "Soaring started as an individual sport. Strong teamwork was necessary to support the pilots before and after the flight, but in the air, the pilot was on his own, fighting the elements and his fellow competitors."[95] The Poles, however, learned to bring a team element into the air. Under the leadership of team coaches Tadeusz Rejniak and Josef Dankowski and with government sponsorship, they pioneered a tactic often called 'pair flying,' but which I will refer to as team flying for simplicity. Petterson explained:

> In the 1960 [World Gliding Championship] in Cologne, Germany, the Polish team entered a new generation of sailplanes, the open class Zefir and the standard class Foka. These new sailplanes were greatly admired,

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[94] Schreder-Barbara, 119.
[95] Ake Petterson, "Team Flying and Gaggles in Soaring Championships," October 2001 <http://www.fai.org/gliding/documents/teamandgaggles.pdf>, 1.

> and so were the new team-flying tactics of the two Open Class pilots Edward Makula and Jerzy Popiel. They flew close together and communicated closely. When the standard and Open Class shared the same task, the Standard Class pilot Adam Witek joined his Open Class comrades and flew with them. At that time, use of [a] radio was prohibited in the Standard Class, but the excellent co-operation within the team enabled Witek to take part in the team flying anyway.[96]

By exchanging information, the team flying allowed the pilots to have knowledge of multiple parts of the course. The Poles went on to make good use of team flying in England in 1965, where chancy weather once again made team flying an outstanding tactic. Jan Wroblewski was able to win the open class in a standard class Foka and his team mate Franciszek Kepka took third place. Only German Rolf Spanig, flying the prototype D-36, came between them. Petterson wrote that "the forerunner of the new generation of [fiberglass] gliders managed only second, despite the superior performance of this next generation sailplane."[97]

The D-36 was designed by Gerhard Waibel, one of a trio of German glider designers also including Wolf Lemke and Klaus Holinghaus. As members of the Akafleig Darmstadt, a university sponsored flying club, they had made the first effective use of composites in glider construction when they designed and built in the D-36 in their spare time. While the D-36 was clearly superior to anything else flying at the time, it was also handicapped in several ways. First, to speed construction, the glider had been built using the "male mold" process. Fiberglass was laid up on top of molds that were the exact shape of the desired pieces. This produced the smoothest results on the inside of the parts rather than the outside. For laminar flow to exist, Dick Johnson estimates that the waviness of the surface must not exceed .004 inches. In the female mold process, a

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[96] Petterson, 1.
[97] *ibid*, 1.

male mold is created, then a secondary "female mold" is pulled from the male molds. When the flight articles are laid up in a female mold, the outer surface faces the mold, resulting in much more consistent production. Secondly, the wings were extremely bendable, resulting in less than desirable flight characteristics. *Soaring Magazine* reported that at the 1965 World Championships:

> The most sensational ship entered was undoubtedly the D-36 designed and built at Darmstadt University. In flight, the extremely flexible fiberglass wings curve upwards to an astonishing extent. However, when landing, the wings do not seem to deflect downwards to an embarrassing extent. As the contest proceeded, this formidable entry became known as "Old Gummi Flugel" (rubber wing). The radius of the leading edge is tiny, about inch. This means that the wing is efficient only at one angle of attack, two degrees. The flaps are used to ensure that the angle of attack is the same at all speeds.[98]

With all the bending and twisting of the wing, however, the glider was not always able to stay in its 2 degree "laminar bucket" where the wing was most efficient. Holinghaus later chose to use a much less sensitive airfoil on his Cirrus design because of his experiences with the D-36.[99]

After university, each member of the famous D-36 trio went to work in glider design and construction. The three would design most of the World Championship winning gliders from 1970 to the present. Waibel ended up at Alexander Schleicher Gmbh., where he worked until his retirement in 2005, dedicating himself to developing safer, crash-worthy cockpits after about 1990. Lemke helped found Rolladen-Schneider, where he designed the LS series of gliders, the first of which, the LS-1, would win the 1970 Standard Class World Championships at Marfa. The most successful, both in terms of World Championship wins as well as financially, would be Holinghaus, who went to

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[98] Harold Drew, "World Soaring Championships," Soaring (August 1965) 7-8.
[99] Joseph C. Lincoln, *Klaus Holinghaus* (National Soaring Museum Archives, Elmira, New York, circa June 1970), 4.

work for Schempp-Hirth, becoming CEO in 1972 and sole owner in 1977. Holinghaus' gliders went on to win more World Championships than those by any other designer. He also became one of the world's top pilots, winning three European Championships and nearly winning several World Championships before his untimely death in 1994.

By 1968, there were a much larger number of high performance sailplanes available. The top six finishers in the Open class would fly a fiberglass glider, and a new Standard Class version of the Libelle, known as the 201, would finish second and fifth in the standings. The only ship that kept fiberglass from showing complete dominance was the Elfe S-3s, two of which were flown by Moffat and Smith. The S-3s were built primarily of wood, a seeming throwback to a previous era. Their performance, however, was almost equivalent to the fiberglass designs flying in the contest. After several months of preparation, Moffat stated that he felt his and Smith's S-3s were equal to anything else flying.[100]

The disappointment in Poland was certainly the performance of the Poles themselves. Petterson wrote:

> The 1968 WGC went to Poland. National pride demanded victory, but this time the Polish machine did not work out. No other country had yet mastered team flying, but the wooden Polish gliders were now surpassed by German made [fiberglass] in the hands of Austrian Harro Wodl, winning the Open class in a Cirrus, and Swiss-crafted wood, an Elfe flown by American AJ Smith, both of them individualists by all means.[101]

Whether it was the pressure of being on their home turf or the fact that they were flying gliders of somewhat less performance than the Americans and Western Europeans, only Edward Makula managed to crack the top ten for an eighth place finish in the Standard Class.

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[100] Moffat, Winning on the Wind, 46.
[101] Petterson, 2.

The American Open Class pilots, Johnson and Schreder, flew fairly well in Poland, coming in eight and 21st out of 48, respectively. It was Smith and Moffat flying in the Standard Class, however, who would really shine. Both flew consistently well until two days before the final scheduled day, when Smith lost a 150 point lead to Belgian Henri Stouffs. With rain in the forecast for the next two days, it looked unlikely that Smith would be able to make up the points . The final day, June 22nd, proved flyable after all. A front had just recently passed, however, making conditions difficult. Smith later recalled:

> The weather that morning was cycling... Only one event with value occurred in all this. Dr. Kuettner stopped by... He really broke through my preoccupation when he said 'its cycling, isn't it?' It was a good moment. I flew the goal race that day completely on the observations made while we stood there.[102]

At the 1969 Soaring Symposia, Smith further explained:

> As I got into the starting altitudes, approximately 3,000 feet, it was in very, very weak weather. There was no chance for me to make that good kind of start. At least, not at that time. Because of my position in the standings, if I didn't make that kind of start, I probably had no chance of winning the competition. So I stayed around the field for nearly an hour until the next good wave came through.[103]

In order to catch the good wave of weather, Smith was forced to fly 30 miles away from the field and then back to 'ride the wave' through the course. Stouffs landed out, failing to complete the task and finishing in 5th place overall. Moffat finished a close 4th place, less than 150 points behind Smith. Had it not been for Moffat's extremely poor showing on the first contest day, where he was almost three hundred points behind Smith, he likely would have won the contest.

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[102] AJ Smith, Letter to Joseph Lincoln. 5 January, 1975. National Soaring Museum Archives, Elmira, New York.

[103] AJ Smith, "The Philosophy of Winning," Soaring Symposia, 8-9 March 1969 <http://www.betsybyars.com/guy/soaring_symposia/69-phil.html>.

Between 1966 and 1968, the use of fiberglass construction became far more prevalent than it had been in years passed. Pilots began to win in the new ships once they learned to make the best use of the newfound performance. Technique also began to grow in importance at this time. While the ships weren't yet equivalent, they performance gap had begun to close, placing more emphasis on pilot ability rather than simply having the right glider as during the 1950s and early 1960s. The new gliders also allowed pilots to expand the envelope of the conditions they flew in, leading to a better understanding of the dynamics that allowed soaring flight. Only a few years earlier, a pilot such as A.J. Smith would have been unable to fly those crucial 60 miles to make a good start because the performance of the glider would have been inadequate.

Even though the fiberglass gliders began to perform credibly, it was still not clear that they had a significant advantage over other forms of construction. Wood and metal gliders continued to do well through 1968, with A.J. Smith's first, Moffat's fourth, and Dick Johnson's eighth place finish in his HP-13M in the World Championships seemingly confirming that designs of this type still had significant potential. The truth was, however, that designers had yet to make full use of fiberglass' capabilities. Once they did, the world of competitive soaring would be changed forever.

Marfa 1969

"Mr. Moffat rose and walked up toward the stage. His graying tousled hair was like a shock of wheat lying in the sun. After a few words, Marshall Claybourn gave him the du Pont Trophy, the highest competitive honor of the Soaring Society of America. As the champion moved over behind the microphone, pilots and crew members down on the main floor began to stand up – just a few in the beginning, then more and more of them in cascading wave until every person in the room was on his feet. Then the applause began, and for a long, long moment everyone in the hall honored the man who had won the championship against the most formidable competition ever assembled in the United States."[104] *– Joseph Lincoln*

The 1969 National Championships was the last time a single title was awarded in the United States. Thereafter, the Standard Class would be separated from the Open Class. Never before had such an impressive array of sailplanes and pilots been assembled on the North American continent. By careful sailplane selection, a well thought out strategy, and a bout of good luck, George Moffat would emerge the winner. The potential of the new fiberglass sailplanes would be far more clearly demonstrated that in previous contests. Moffat summed up what he expected from the competition at Marfa in 1969 as follows:

> When I arrived in Marfa, a week before the 1969 U.S. National Championship races, it was a sobering experience. Although I had flown in larger contests, and against practically all the serious pilots at one time or another, I had never competed against so many top-notch pilots, flying such outstanding ships.[105]

Nearly every top US pilot would be flying at Marfa, including all four members of the 1968 US Team, Moffat, Smith, Schreder, and Johnson, who jointly had made the best showing at the Internationals since Paul McCready's 1958 first place performance. Besides nearly every top American pilot, the field included world-class competitors such

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[104] Joseph Lincoln, "The 36th Annual U.S. National Soaring Championships," Soaring (September, 1969): 31.
[105] Moffat, Winning on the Wind, 171.

as Henri Stouffs of Belgium, who had been just one day away from winning the 1968 World Championships, Austria's Haro Wodl, who won the 1968 World Title in the Open Class, and Poland's Jan Wroblewski, who had won the 1965 World Championship in the Standard Class and would later go on to take a second title in 1972.

Looking back, Moffat was right about the ships as well. Burt Compton later wrote:

> For the first time, the majority of the ships entered were the new German fiberglass sailplanes, including the Libelle, Kestrel, Phoebus, Open Cirrus, and ASW-12. 40 to 1 glide ratios were now achievable in production sailplanes.[106]

Moffat's real concern, however, was Texan Wally Scott. Not only was he intimately familiar with the contest terrain, he would also be flying the ASW-12, the latest in a series of "super-ships," each seeming to make the previous obsolete overnight. A significant success factor in the contest would certainly be the gliders, as the Open Class had almost no rules. Joe Lincoln wrote in his *Soaring Magazine* article:

> It had been five years since I had last been at a national soaring contest, but in that short half decade a revolution has been wrought in competition sailplanes. McCook in 1964 was not very kind to the sailplanes with heavy wing loading. Dick Johnson won the contest with his Skylark 4, and experts might have debated as to whether he could also have won the contest with an aging 1-23D. At that time, the Austria was a very modern ship, and Schweizer Aircraft had a pair of their earliest 2-32's in the competition.[107]

In 1969, the ships that Lincoln mentioned were either sparse, with three Standard Austrias (the best of which finished in 20th place) and a single 1-23, or non-existent, including the Skylark and 2-32. In just five years, a previous generation of gliders had become completely outdated.

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[106] Compton, 2.
[107] Lincoln, "The 36th Annual U.S. National Soaring Championships," 14.

In "The Sunship Game" Moffat remarks in commentary immediately preceding the first contest day:

> The real threat here is the ASW-12. I had one on order, but decided against it, because of the danger of nothing but a tail chute to slow you down. One landing in the yucca plants could really tear that ship up. Wally Scott is taking the gamble, hoping he will always be able to land on airports. That could cost him on the distance days, when he may have to turn back with hundreds of feet of altitude.[108]

The ASW-12, designed by Waibel, had first flown at Marfa in 1967, when Rudy Mozer, who was the representative for the '12's manufacturer, Schleicher, totaled it trying to bring it to a stop on a country road.

Instead of the ASW-12, Moffat chose the Holinghaus designed Cirrus, which was clearly the second highest performing ship in the contest. In one of the more memorable scenes of "The Sunship Game" Moffat cuts off the last few inches of his Cirrus' wingtip in order to glue on an extension of approximately two feet with the assistance of his wife, Suzanne. In the voiceover, Moffat informs the viewer that his fellow competitor and friend, Gleb Derujinski, has done the same to his Cirrus. They then rename the glider the "Cirrus-B." The Cirrus had more conventional spoilers, slats of approximately three feet in length that pop out from the center of the glider's wing, to aid in landing. The spoilers both reduce the amount of lift the glider creates, by stopping the air from flowing all the way to the trailing edge of the wing, as well as create drag due to their resistance as the glider flies through the air. The mechanical linkages of the spoilers are almost foolproof. They can be opened to their maximum extension for the highest rate of descent, then closed again in a matter of seconds. With the tail chute, the pilot only has one chance to make a landing. Once deployed, assuming it opens properly, the chute is in full effect.

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[108] The Sunship Game

The chute may not open at all, and even if it does, should the pilot need to jettison it, there is no second chance.

Moffat judged the Cirrus to be the most flexible of the gliders flown at Marfa in 1969. An important factor in glider design is wing loading, or the total weight of the glider including pilot divided by the area of the wing. At this time, pilots and designers first began to experiment with using water ballast in the wings to add weight and increase wing loading if conditions warranted. Moffat was able to adjust the Cirrus' wing loading by taking off with 240 pounds of water ballast in the wings, then dumping the water if conditions weakened. The ASW-12's "dry" wing loading without ballast was slightly heavier than the Cirrus, while the Cirrus could achieve a higher wing loading when "wet." Moffat judged that he gained many miles on Scott at the end of the distance days when, after dumping his water, he was able to stay aloft in the weakest of thermals, slowing drifting downwind.

As the gliders wingspans got longer in the late 60s and early 70s, they became less responsive, and the pilots had to relearn technique, making adjustments much earlier as the gliders took longer to roll in and out of turns. Gliders suffer from a phenomenon known as adverse yaw. The glider banks left and right by using ailerons, which change the shape of the wing. One aileron goes down, increasing lift on that side of the wing, while the other goes up, decreasing the lift. The aileron that goes down and increases lift also increases drag, slowing the progress of that side of the wing. To compensate for this, aircraft are fitted with rudders on the tail, which slews the nose right or left. The pilot must use the appropriate amount of each control to establish a coordinated turn. Reminiscing on this era in the 2002 movie "A Fine Week of Soaring," Moffat recalls:

> It took a lot of strength to fly those things. The wings were so long it took forever to get them into a turn because of the adverse yaw. Eventually, we figured out to start with opposite aileron for a few seconds, then return to normal aileron. That got you into the turn twice as fast, but it was a little unnerving while you learned.[109]

The final super-glider at Marfa in 1969 was the South African BJ-4. It had the innovative feature of fowler flaps. Traditional flaps simply move up and down to keep the gliders angle of attack at an optimum position. Fowler flaps actually extend from the wing, increasing its surface area, and decreasing wing loading. Lower wing loading allows the glider to climb better. In the cruise, the flaps retract, resulting in higher wing loading and better lift to drag ratios at high speeds. Such a feature would seem to be the perfect compromise, but the BJ-4 had difficulties at Marfa as well. Its flap system was too complicated for the sometimes tricky Marfa conditions. Jackson would finish only a mediocre 14th place. With three of the highest performing gliders ever built flying in strong West Texas conditions, the stage was set for the first of the super-ship showdowns that would occur at Marfa.

The first contest day for the 1969 Nationals was June 24. Competition director Marshall Claybourn called a 262.5 mile speed task around two turnpoints, Van Horn and Fort Stockton. Eighty-three sailplanes were poised along four launch lines ready to take to the air. With up to ten days in a national championship, the contest cannot be won on the first day. A major mistake, however, could lose it. When describing the difficulty facing the competitors, Joe Lincoln wrote, "Much of the terrain is unlandable-closely strewn yucca, but here and there you see good open spots. A number of the open areas, however, have drainage channels - depth unknown, impossible to judge from altitude."[110]

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[109] A Fine Week of Soaring

[110] Lincoln, "The 36th Annual U.S. National Soaring Championsips," 7.

One landing across such a ditch could tear the landing gear from a glider, putting the pilot out of the contest.

The day turned out to be far more difficult than forecast. The first problem was the winds, which according to Lincoln reached one and half times as high as was predicted.[111] The movie "The Sunship Game" shows a cutaway from Derujinski's cockpit, with a wall of dust blowing towards him. He remarks "that's the last thing you want to see. That wall of dust indicates strong winds blowing directly at you."[112] The second problem was a voracious amount of sink, or descending air, in the vicinity of Marfa. The eventual winner of the day, Moffat remarked:

> I went on and sank in the downwash behind the mountains this side of Alpine. Things got bad enough that Marfa went out of sight behind the last hills. Finally, I got so low that I ridge soared. My glide angle [lift to drag ratio] in the sink went down to 9 to 1![113]

In still air, Moffat likely would have achieved more like 30 to 1. 1968 World Champion AJ Smith commented "Boy, what a workout. I don't think that there will be 40 percent finishers." He had found the going extremely difficult, remarking "I had to come in at maximum glide angle. I took at least half an hour too long. It was a complete disaster."[114]

When the scores were tallied, Moffat had come in first at 64.8 mph. Even he was not satisfied, however, remarking about the sink he hit coming home to Marfa, "That last mistake cost me about six miles per hour in overall speed." The biggest story of the day was the fact that 1968 National Champion Ben Greene landed out six and one half miles from Marfa, finishing 50th for the day. One way to take yourself out of a National

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[111] Lincoln, "The 36th Annual U.S. National Soaring Championships," 7.
[112] The Sunship Game
[113] Lincoln, "The 36th Annual U.S. National Soaring Championships," 8-9.
[114] *ibid,* 9.

Championship is to fail to complete a task that the other top pilots all do, and this was the fate that befell Greene. Perhaps part of the problem was the glider Greene had brought with him to Marfa, the new 17m Kestrel designed by Eugene Hanle of Glasflugel. Greene had his own ASW-12 sitting at home highly prepared, but perhaps, like Moffat, believed it too inflexible to make a good contest ship. In Winning on the Wind, Moffat remarks "I thought the Kestrel's climbing abilities to be less than I had anticipated, especially in weak weather."[115] He provides further analysis in a speech at the 1970 Soaring Symposia, held between the 1969 US Nationals and 1970 World Championships, commenting:

> The Kestrel looked very potent on the drawing board and would have been unbeatable if the finished product had weighed in at the projected 463 pounds. Unfortunately the ship actually weighs 578, stripped, according to Ben Greene's weight and balance. This, combined with late delivery and no water ballast tanks until the fifth day, pretty well washed up the Kestrel's chances. The Kestrels at Marfa were easy to out-climb if neither of us had water, which may have had something to do with the fact that only once did a Kestrel ever do much on a distance day.[116]

For Greene, winning would now be impossible and the failure to make that last six miles would cost Greene a spot on the 1970 Team.

If the first day cost Greene the contest, then the second day would nearly do the same to Moffat. The task was a 240 mile triangle. Moffat took four starts before he finally got going at five after three in the afternoon. Even then, he was unable to find good lift to set off on course, and it was not until ten before four that he got high enough to leave the vicinity of Marfa, figuring that it was too late to make it around the course.[117] Scott won the day with an outstanding speed of 58.3 miles per hour to take the overall

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[115] Moffat, Winning on the Wind, 171.
[116] George Moffat Jr., "Marfa – 1969 and 1970," Soaring Symposia, 20-21 February 1970 <http://www.betsybyars.com/guy/soaring_symposia/70-marfa.html>.
[117] Moffat, Winning on the Wind, 174.

contest lead. Also doing well were a number of pilots flying Hanle's Glasflugel Libelle, including Rudy Alleman and Bud Mears. The Libelle seemed slightly handicapped, however, in the fact that its span was only 15m, while the Cirrus' and ASW-12 were both over 17m. Allenman said following one contest day:

> After the final turnpoint, you looked out on a big gap, 40 or 50 miles beyond a couple of clouds near McCamey, to what looked like Fort Stockton and was actually Alpine. That's where the high performance ships have an advantage over mine.[118]

Lincoln wrote following the second day "No real trends had been established yet, except that Scott and the ASW-12 were going to be tougher than anticipated and that there were an awful lot of good pilots around who seemed capable of winning."[119]

The third day was a shorter speed task, a 155-mile goal and return. Wally Scott once again won, making his daily scores 2-1-1, and proving his ASW-12 had a big advantage on just about everyone in the speed tasks. The real test, however, occurred in the coming days, when Contest Director Marshall Claybourn mixed up the action with a few distance tasks. No one knew just how handicapped the ASW-12 would be against the more flexible Libelles and Cirruses. For good measure, some unexpected weather phenomena would also be thrown in.

For the fourth day, the task was the venerable free distance task. For Moffat, distance tasks were an anathema from a bygone era. When asked his opinion of distance tasks at the 1969 Soaring Symposia, Moffat said "It's a very bad task in my opinion for national competition. The purpose of a competition is to measure ability of the pilot. You

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[118] Lincoln, "The 36th Annual U.S. National Soaring Championships," 15.
[119] *ibid*, 12.

cannot measure ability of pilots if they're not doing fundamentally the same thing."[120]

A.J. Smith explained:

> The cat's cradle is a return to the marathon and walkathon of the 1930s. The only time I like to have a gambling situation, as George puts it, is when I'm far behind. Then the gambling, the element of luck with a distance task becomes very great and I think my chances improve.[121]

The top pilots all seemed to believe that the distance tasks hurt their chances at winning. In Marfa, however, Scott was able to dominate the speed tasks with his higher performance ASW-12. Moffat would have to make up points on the distance days he so despised, yet for which his Cirrus was well suited. Between them, they would win seven of eight contest days.[122]

The free distance day turned out to be everything the top pilots accused it of being. A front, typically impassable for sailplanes, lay to the 200 miles to the north, leaving seemingly the only option for long flights to the east. Moffat and Scott carefully followed the weatherman's advice, with Moffat making the best distance of those who flew the easterly path at 374 miles. He wrote:

> Imagine my shock on calling in to learn of five flights of over 500 miles, with many more in the 400s. Those who had never heard that crossing fronts is impossible in the southwest, or has merely taken the line of least resistance and drifted downwind, had found a hole in the supposedly uncrossable front and poured through.[123]

The best flight was made by Poland's Jan Wroblewski, who set down 527.5 miles from Marfa. The flight nearly equaled Dick Johnson's 1952 World Record, and was made on

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[120] Richard Schreder et. al., "Answers to Questions from Participants," Soaring Symposia, 8-9 March 1969. <http://www.betsybyars.com/guy/soaring_symposia/69-qa.html>.
[121] *ibid.*
[122] Lincoln, "The 36th Annual U.S. National Soaring Championships," 7.
[123] Moffat, Winning on the Wind, 174.

a less than ideal day in an HP-14, borrowed from Dick Schreder and now outclassed in the speed tasks by the likes of the Cirrus and ASW-12. *Soaring Magazine* reported:

> 'Fantastic... fantastic...' Fritz Kahl kept saying that night after hearing about Jan Wroblewski's flight to Freedom, Oklahoma, the longest of the meet, 527.5 miles. 'He's really gonna be their boy now. They'll give him a great big Red Star.' On that day the pilots flew 27,958 miles, the distance around the earth at the equator, plus 300 miles.[124]

Moffat wasn't completely upset with the performance, however. He later wrote "I closed up almost 80 points on Wally at a cost of only $120 for gas, motels, etc. – fairly cheap as far as free distance goes."[125]

Moffat and Scott traded victories over the next three days, with Moffat taking the two cat's cradle distance tasks and Scott winning the speed day placed in between. Moffat had posted much larger margins over Scott in his victories, however, and entered the final day with an 80 point lead. Watching "The Sunship Game," it is easy to see the tension on the pilot's faces as they wait for Marshall Claybourne to announce the final task. As he does, a clamor erupts throughout the room. Marfa to McCamey to Van Horn and return – the longest speed task in the history of competitive soaring. You can hear a pilot in the background exclaim "You've got to be kidding me." The camera pans to Scott, whose grin is as wide as his face. He knows he's been handed the task he needs to win. Moffat is heard as a voiceover "Just perfect. The longest speed task in the history of soaring. It gives Wally every advantage. It's so long its like a distance task, except he gets to land at a nice safe airport."[126]

Moffat's strategy for the final day was simple. He would try to follow Scott for as long as possible, "that way I know he's not out there racking up miles on me," Moffat

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[124] Lincoln, "The 36th Annual U.S. National Soaring Championships," 24.
[125] Moffat, Winning on the Wind, 174.
[126] The Sunship Game

said. It didn't take long before Scott used the superior performance of his ASW-12 to pull away, however. But as Moffat approached the final turnpoint, captured on his in cockpit camera, he saw another glider circling in the distance. "Seven Romeo [Scott's call sign], Wally Scott," Moffat exclaims "with 80 miles to go, we're exactly even."[127] The pilots faced a choice to fly directly home to Marfa through a blue sky that might contain lift or detour to the east to follow a cloud street. Scott chose to fly directly towards Marfa knowing, as he would later tell Moffat, he had to do something different to gain the necessary points to win.[128] Moffat detoured for the clouds and was the first pilot home to win the day and the contest. He made the correct choice in both glider and tactics to win the most competitive National Championship ever staged on American soil.

The 1969 Nationals were the last before the Soaring Society of America belatedly staged separate nationals for the Open and Standard Classes in the following year. With 82 gliders entered, it was also the largest national championship ever held. Future contests were restricted to 65 gliders in the name of safety. Moffat won the contest through a combination of skill and foresight, correctly recognizing that the Cirrus was a sort of Swiss Army Knife of gliders, capable of performing many tasks with equal ability. He wrote following the contest "Winning is a combination of ship, skill, and luck. I had incorporated two out of the three several times before; this time, finally, all three fell together."[129] With his high placing in both Poland and Marfa, Moffat became one of the favorites to win the world title the following year.

The long tasks in strong soaring conditions during the championship clearly showed the advantage that fiberglass construction would provide. Moffat and Scott

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[127] The Sunship Game
[128] Moffat, Winning on the Wind, 177.
[129] *ibid*, 177.

outclassed the field in their highly tuned, 18-meter plus machines. While Jan Wroblewski and Harro Wodl were able to finish eight and tenth, respectively, they still trailed in the overall standings by over 800 points. Equally important is that they made up around 300 points on Moffat and Scott on the free distance day, when their lack of knowledge of West Texas conditions caused them to find the magic hole in the front that allowed for flights of over 480 miles for each. While the American designers would continue to pursue metal construction for the next several years, the Europeans at this point almost abandoned it. It was the passing of an era.

Marfa 1970

"I drop the gear 15 miles out to increase the sink, but even then have to resort to the tail chute to get across the finish. I radio to the gate, 'Double-X, one mile out,' and get a cheerful reply 'Welcome back, World Champion,' for a reply. I have won the day and the contest."[130] *– George Moffat*

The 1970 World Championship's be the end of one era and the beginning of another. The Open Class would be far less competitive than in previous years, as only a few pilots flying the latest, highly modified gliders would have a chance of winning. The Standard Class, on the other hand, would show the new parity that was emerging as designers found optimal solutions to glider construction within a limited rule. Moffat would be bailed out of a poor showing on the first day because of his superior glider, then go on to show just how dominant a pilot he was. Only four years later, such an event would be improbably at best, but more likely an impossibility. 1970 was also the year that the young Helmut Reichmann emerged from obscurity to dominate the Standard Class, even though his glider had no advantage over any of the others. By 1974, this parity would also emerge in the Open Class, leading to a new era in gliding competition, a true racing age.

The 1970 US Team was announced as George Moffat and Wally Scott in the Open Class, and AJ Smith and Rudy Alleman. All except Alleman had World Championship experience and between them they would have a huge advantage because of their years of experience in West Texas. The biggest problem for Moffat was securing a ship to fly. Moffat still had his Cirrus, but its weakness in speed tasks had been clearly shown in 1969. In the final analysis of ships, Moffat, speaking at the 1970 Soaring

[130] Moffat, Winning on the Wind, 186.

Symposia, held in February 1970 between the 1969 Nationals and 1970 Worlds, remarked:

> One of the recurrent cries that one hears in sailplane flying, or at least one that I have heard -- and sometimes joined in making in the last 10 years -- is that ship X has completely outdated every ship now flying, and the open class is now dead save for the very rich. The RJ-5 was probably the first ship X, the HP-8 was another, the Sisu a third. The ASW-12 is only the last of a long line.[131]

It was well known that there would be two prototype superships available for the Marfa contest. The first was the Glasflugel 604, a development of the Kestrel 401 that Ben Greene and others had flown at Marfa in 1969. Moffat hoped to fly Holinghaus' latest creation, the Nimbus, but numerous problems awaited. Moffat explains: "My guess is that the Open Class should be won by Klaus Holinghaus' Nimbus, a ship of 72 foot span, 850 pounds weight, and an aspect ratio of 31. The measured best L/D comes in at a hair under 50."[132] Moffat had first seen the Nimbus in the winter of 1968 when he was in Germany on a sabbatical preparing for the 1968 World Championships in Poland. Holinghaus had only recently joined Schempp Hirth and worked on the Nimbus in a loft above the Schempp Hirth factory between the hours of 6pm and 2am after the regular work day.

Following the Poland Worlds, Moffat helped pry the giant center section of the three piece wing from the mold.[133] The following year he heard about the performance of the glider from Holinghaus in Marfa. Moffat explains:

> Klaus was there, crewing for Georgio Orsi of Italy who was flying the prototype Standard Cirrus, so I got to hear a good deal about the wonderful performance of the big Nimbus. This made me a bit wistful since it was obvious the new ship would go to the German team for the

[131] Moffat, "Marfa – 1969 and 1970."
[132] *ibid.*
[133] Moffat, Winning II, 156.

> Worlds. My crew chief, Ralph Boehm, never one to be daunted by the obvious, tried the direct approach. Klaus looked tempted, but the German team would have to come first.[134]

Luckily for Moffat, fate had a strange way of playing itself out. Walter Neubert chose to fly Hanle's 22 meter Kestrel 604, as he had been a long time Glasflugel pilot. That left Hans Werner Grosse as the other German team Open Class pilot. He showed up at the Schempp Hirth factory in late November to try out the Nimbus. Holinghaus later recalled to Joe Lincoln at Marfa in 1970 that the flaps, which also served as the primary landing control mechanism, were inoperable because the handle in the cockpit was broken. Grosse decided to take the ship for a flight anyway, believing he could land the glider with the tail parachute as he had been flying an ASW-12 for the past season where the parachute was his only means of landing control. When he set up on final approach to the airport, the Nimbus' tail chute failed to deploy. He was forced to make a circle over the end of the runway, nearly destroying the glider. His temperament did not lend itself to such incidents and he rejected the glider.[135]

Holinghaus wrote Moffat around Christmas 1969 to offer him the glider. Unfortunately, it could not leave Germany until several weeks before the contest, so it would have to be air freighted over. In previous years, the US Air Force had brought the American gliders overseas, but due to the war in Vietnam, such assistance could not be found for 1970. Moffat departed for the 1970 Soaring Symposia unsure how he would get the glider over. He explained in a talk titled 'Marfa 1969 & 1970:'

> At the moment, I don't know who will be flying the ship, I am supposed to but since the SSA does not plan to give any aid to team pilots this year on the understandable grounds that they must spend every cent on running the contest itself, and since the military doesn't seem interested in flying the

[134] *ibid*, 157.
[135] Lincoln, *Klaus Holinghaus*, 4-5.

> Nimbus over and back, and since the price of having it flown commercially will be $2500 to $3000, which combined with insurance and normal contest expenses will bring the total to about $5000, I rather doubt that I will be able to fly it unless we can get help from some airline or other source. Any suggestions will be most acceptable.[136]

Luckily, help would quickly arrive. Joe Lincoln approached Moffat and offered to pay to have the Nimbus shipped over and back. His offer was to no avail, however, as no airline was willing to handle the glider due to its size. Holinghaus finally found a vessel that could take the glider over by sea. According to Moffat, the ship 'took the scenic route' and arrived over ten days later than scheduled, only twenty days before the contest.[137] As soon as the glider was unloaded, it was impounded by customs. Moffat recalled:

> The bird in the hand turned out to be still in the bush, a thicket called Customs. My import broker sadly told me that due to some technicalities in the paperwork the glider could not be brought into the country for a brief period. A frantic afternoon at the brokerage poring over Webster's Unabridged sized tomes of Customs law followed. Finally, I, the least legal mind of the decade, came upon a hopeful sentence on a dusty page. Legal heads huddled. Multi-syllabic words flew, brows gradually unfurrowed, calls were made to Customs and finally, grudgingly, agreement was reached.[138]

By the beginning of the contest, Moffat had only managed to put fifteen hours on the glider. He stated that flying it at least 150 hours would have allowed him to make the best use of its performance.[139]

Looking to repeat his 1968 victory, AJ Smith was clearly the favorite in the Standard Class. Smith was flying Lemke's new LS-1 and only Wally Scott in the Open Class had more experience at Marfa. After winning two of the three practice tasks, Smith's psyche was to be dealt a cruel blow immediately preceding the contest. When

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[136] Moffat, "Marfa – 1969 and 1970."
[137] Moffat, Winning II, 158-159.
[138] *ibid.*
[139] Moffat, Winning on the Wind, 192.

the official registrations were posted, Belgian Henri Stouffs registered his glider as an LS1-g (the author currently owns the LS1-'g' flown by Stouffs at Marfa. It is currently undergoing a complete restoration to return it to its Marfa condition). Smith had an LS1-c, which he correctly believed to be the latest model. Smith was heard to inquire from several other teams if they knew anything about Stouffs' glider, but got no satisfactory answers. After the opening ceremonies, Smith enquired directly of Stouffs, who replied "Well, you can see that it's the same sailplane – same fuselage, same tail, same wings – well, yes, the airfoil is just a bit different – but that can't really make any difference, can it?" Of course, the airfoil is the most important part of the gliders performance. It took Smith several days to realize he had been very skillfully taken for a ride – days he flew poorly and otherwise may have repeated as World Champion.[140]

The first contest day turned into an unmitigated disaster for the Americans. Called as a cat's cradle distance task, logic said they should have excelled with their experience in using the long Texas soaring days. Unfortunately, they did so well that they ended up 'ahead of the weather.' While trying to cross a mountain range near Ardoin, they were consistently forced back because the clouds had not yet risen above the mountain peaks. The Germans, arriving an hour later, found the weather much improved and were able to cross and make flights exceeding 300 miles. Moffat and Scott were forced to land with flights of 178 and 188 miles, respectively. Smith and Alleman in the Standard Class did even worse. Moffat later wrote:

> The low point department in that contest was pretty well cornered by the first day. It was without question the most nightmarish flight I have ever made. The best altitude of the day was 3300 feet and the whole last two hours was below 2000, much of the time over unlandable terrain.[141]

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[140] Reichmann, 69.
[141] Moffat, Winning on the Wind, 190.

Moffat noted that "Hans Werner Grosse told me later that they never would have tried [to get through the mountains] if they had known what the terrain was like."[142] The Germans decision to fly over such territory had its consequences. Walter Neubert, flying the 22 meter Kestrel, had yet to be heard from when the pilots went to bed that evening.

Neubert had landed far from the main roads or lines of communication. After securing his glider, he walked to a farmhouse he had seen about a mile away, only to find it locked and abandoned. Not willing to break in to use the telephone, he returned to his glider to spend the night, vainly hoping his crew would find him. He was finally rescued the next morning after being spotted by one of the tow planes sent out to search for him. The glider did not arrive back at the field until after 3pm, however, and Neubert managed a flight of only 3.5 miles and 14 points. Moffat later wrote:

> Many pilots, among them Neubert and 1968 World Champion Wodl, gave up many points by charging into unlandable and unretrievable country with too little thought as to the difficulties of being ready to fly the next day. The U.S. team gave up valuable distance on this day to stay near main roads and ensure retrieves in time for the next day's flight.[143]

Reichmann questioned the first day's task, even though he had been one of the better performers. The weatherman had stated that the weather would be unstable, the worst sort of conditions for the pilots to have to choose their own course – a sort of lottery task similar to what Moffat and Smith so abhorred.[144] Neubert's final score trailed Moffat by 641 points – had he only completed the course on the second day, he could have won the contest.

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[142] Moffat, Winning on the Wind, 190.
[143] *ibid*, 190-191.
[144] Joseph C. Lincoln, *Helmut Reichmann: Impressions During the World Championships* (National Soaring Museum Archives, Elmira New York, circa June 1970) 6.

After the second day, Moffat could certainly feel better about his chances. He completed the task in a respectable 8th place. With Neubert making a flight of only a few miles, Moffat was the only 'supership' pilot to be in contention. He would still have more work to do, however, as he was more than 400 points behind the leaders Grosse of Germany and Camille Labar of France – the pilot Moffat had so admired when he took up gliding in France in 1959. Moffat would only improve his performance, however, winning the next three days in succession and five of the final seven. The last two thirds of the contest were certainly a dominating performance, despite the fact that he was so sick on the fourth and fifth days, June 25 and 26, that he could hardly stand up.[145]

Scott was taken out of contention on the third day, June 24th. A freak thunderstorm grew up over Marfa, pouring rain around the field and cutting off thermal convection. Scott had not been able to make a start before being forced back to the airport. Late in the day, he was finally able to get through the gate and make a flight of 10.5 miles good for 27 points. Had Scott completed this the task on this day, it is almost certain he would have been among the top three and may have had a chance of displacing Moffat as champion.

Meanwhile, in the Standard Class, Reichmann was showing that he was clearly at the top of the field. Like Moffat, he would win five of the nine contest days. He was never in the dire position of Moffat, however, with his lowest cumulative placing being 6th after the first day. He assumed the overall lead on the third day and never relinquished it, winning the contest by over 400 points, an impressive margin. Like Moffat, Reichmann was a school teacher, but he was a product of the German soaring

[145] George Moffat Jr., Letter to Joseph Lincoln. November 11, 1974. National Soaring Museum Archives, Elmira, New York.

system rather than an individualist like Moffat. He had grown up around sailplanes, winning the 1966 German Junior Nationals at a time when America had no contest pilots who would qualify as Juniors under the age of 25.

The new long winged gliders with L/D's over 50 radically changed the options pilots could consider to complete a task. Several contest days stand out where Moffat was given a clear edge by flying the Nimbus. Coming home on the second day, a storm had cut off Moffat's and Scott's path. Moffat agreed to make a long glide into dead air with his superior performance glider once the storm cleared, but he was too early and lift had not yet redeveloped. Only the Nimbus' L/D saved him, as he was able to fly back out of a series of hills, clearing each one by 50 to 100 feet, and finally found lift in a valley to save his flight.[146] On the 6th day, a cat's cradle distance task, Moffat gained almost 2000 feet on Scott as they drifted downwind at the end of the day. Had Moffat been able to clear one last mountain range, he would have been able to add another 40 miles to his 482-mile flight.[147]

Two notable pilots showed up at Marfa to see the advances that were being made in soaring technology. The most well known and by far the biggest hit among the visiting pilots and crews was astronaut Neil Armstrong, who less than a year before had become the first man to land on the moon. Armstrong was a notable glider pilot who held a Diamond Badge, the top gliding award of the FAI, aviation's international governing body and had been among the pioneers of Soaring at Marfa while still and Air Force test pilot. The contest bulletin reported that "Yesterday [June 26] another sailplane was airborne over Marfa. Its fin number RR could not be found on the entry list, but its

[146] Joseph C. Lincoln, "With the U.S. Team at Marfa," Soaring (September 1970): 17.
[147] Moffat, Winning on the Wind, 184.

pilot was enjoying the thermals like everyone else. Welcome, Neil Armstrong." Armstrong spoke at the morning briefing on June 27, showing a warmth of hospitality. He stated "I am here as a representative of the President and it is a privilege to meet the world's finest pilots." and "To the winners of this contest, I offer my congratulations, and to the others who will end up down the list, where I do, you have me as a friend. In my future visits to different countries, I hope to see something of your gliding and meet you on your own ground."[148]

Another famous pilot who was able to look back and adequately sum up the changes in competition between an earlier era and the Marfa World Championships was Paul MacCready, Jr. MacCready is known by all soaring pilots, even if not personally, because of the 'MacCready ring,' a simple way to calculate the speed a pilot should fly between thermals based on his expected climb in the next thermal. MacCready's biographer Paul Ciotti said of the discovery:

> Prior to the invention of the speed ring, determining the best speed to fly was a slow, iterative process. The advantage of the speed ring was that it allowed the pilot to determine the best speed, in MacCready's words, 'virtually without thought,' thus allowing the pilot to concentrate on strategy or evidence of lift, such as evolving clouds, circling hawks and vultures, smoke, dust and surface winds.[149]

MacCready was the first American to win a World Soaring Championship, taking home the gold after the 1956 contest at St. Yan, France.

MacCready said his strategy had been "to do moderately well on each day" rather than trying to win a day and risk not completing the task. He did so well, winning three of the first five days, that he could have not flown on the final day and been assured of

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[148] Anne Welch. "Marfa Bulletin #11," Soaring Society of America, 27 June 1970, 1.
[149] Paul Ciotti, More With Less: Paul MacCready and the Dream of Efficient Flight (San Francisco: Encounter Books, 2002) 33.

victory, the first and only time this has happened in world championship level competition.[150] He flew the day anyway, but barely made it out alive. He was nearly killed by the violent conditions in the French Alps when his glider was brought down to within feet of the mountains. Indeed, his teammate Bill Ivans, attempting to follow MacCready's route, crashed on a mountainside and broke his back.[151] His final flight at that contest was also the last of his competitive career, with Ciotti writing:

> That was MacCready's last sailplane contest. He knew it wasn't his flying skill that got him home alive. It was pure luck – what he called 'fate's coin flip.' After that he never flew competitively again. Life was too short to risk for mere glory.[152]

Therefore, MacCready would only be a spectator at Marfa, but his insights offered a valuable glimpse into the changes that had occurred.

Lincoln interviewed MacCready on July 3. When asked about what the biggest change was, MacCready said:

> It looks to me like the big difference is in the sailplanes. The organization of contests is all done –for the International Contest – seems to be done magnificently every place... but the big difference is the sailplanes which are – the poorest performance sailplane in this contest is significantly better than the best sailplane that was in operation in various contests that I was flying. The difference between them is really that great.[153]

MacCready believed that in previous contests, luck had played a far bigger factor in winning. He noted that Wally Scott, who had otherwise flown magnificently, caught a bad break on June 24 by taking off at the wrong time. Had this not happened, MacCready was certain that Scott would have been much higher up the standings. MacCready said, "Luck always has a lot to do with what happens at a contest. It's been

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[150] Ciotti, 33.
[151] *ibid*, 37.
[152] *ibid*, 37.
[153] Joseph C. Lincoln, *Paul MacCready* (National Soaring Museum Archives, Elmira, New York circa June 1970) 1.

eliminated a little bit, not much, but a little bit by having a bunch of contest days – like this time there will be eight contest days."[154] MacCready was certain that luck had played a big role in his world title. He said of his victory:

> In France was the time when the coin landed heads up six times in a row, or however many days there were, as far as I was concerned. Just by luck I didn't have a bad day, although on several days there were parts of the flights when I was in quite a predicament. Just a few seconds one way or another would have made me land short, but it happened to work out that I didn't.[155]

What made the two contests separated by thirteen years different was that MacCready felt the ability level of the pilots had increased along with the technical ability of the ships. He said:

> Now you probably have a better chance of really coming up with a top pilot in a contest, whereas a decade ago, or two decades ago, there were a lot more flips of the coin as to which one was going to win. The one who was going to win still had to do rather well, but maybe it was more important as to which one of the competitors fell down on a day. They almost all did on one day or another of a contest.[156]

Two other factors that had also changed to help reduce the role that luck played in the contest were the task calling and weather, which was primarily a feature of the contest site. With the exception of the first day at Marfa, conditions were fairly consistent. This meant that on the distance days there really was not a 'right' direction to go. The tasks had also switched to be primarily speed, rather than distance based, meaning that everyone was flying on primarily the same course. MacCready said:

> From what I've seen of this contest, it has nice Texas soaring weather, and when you go through a prescribed course, luck has a little less involvement on how the contest goes. Back in the old days there were more free days in contests – that's way, way back – that's practically all they had – and then the scores varied all over the place. Now a day like

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[154] Lincoln, *Paul MacCready*, 2.
[155] *ibid*, 3.
[156] *ibid*, 3.

> today you can be pretty sure that there will be a bunch of pilots pretty close to the top. Nobody is going to get 300 points more than the second person on a day like today.[157]

Indeed, the biggest point spread between first and second place in 1970 was 65 points. The quality of both gliders and competition had improved to the point where it was far more likely that the best pilot would win.

This level of parity at Marfa was best displayed in the Standard Class. With far more restrictions than the Open Class, there were four gliders, the Standard Cirrus, LS1, ASW-15, and Standard Libelle that displayed relatively equal levels of performance. Even the Poles were able to be competitive in their highly refined wooden Kobra 15 sailplanes although they also realized that the game was up. The Polish aircraft industry rushed to build the first generation of fiberglass Jantar sailplanes before the 1972 World Championships. Moffat said that because of the parity "the Standard Class, which I think probably this time, and certainly the next time, will be the sportier of the two to win."[158] Just two weeks later, Moffat would fly his new Standard Cirrus in the 1970 Standard Class Nationals in Elmira, New York winning seven of the eight contest days, and make future plans to concentrate on the smaller gliders.

Marfa in 1970 clearly showed that the way of the future of the Open Class would be bigger, heavier fiberglass sailplanes. Moffat was lucky to escape a poor first day by using his intimate knowledge of the contest area and the superior performance of the Nimbus. It seemed obvious in 1970 to many pilots that the Open Class was on its last legs as a truly competitive institution. At the 1970 Soaring Symposia, Moffat said:

> I would anticipate a gradual falling off of interest in favor of the smaller, lighter, and more competitive Standard Class, as has already happened in

[157] Lincoln, *Paul MacCready*, 3-4.
[158] Lincoln, "With the U.S. Team at Marfa," 35.

> Europe. Perhaps in 10 years the competitive soaring scene will much resemble the power plane Unlimited racing scene of today where a Darryl Greenmayer completely dominates the competition. Can we envision A.J. Smith, Al Parker, and five or six other devotees of the ultimate - damn the expense - fighting it out in their 200 footers while the real competition takes place in the Standard Class? Probably.[159]

The demise of the Open Class was greatly exaggerated however, as a new generation of Open Class sailplanes would also bring parity to that class. By the 1974 World Championships, the new Nimbus II and ASW-17 would be available in abundance. Designers had realized that the Nimbus and 604 were simply too big, too complicated, and too expensive for the majority of pilots. Some, like Holinghaus and Waibel, did what anyone with a decent commercial instinct would and tapered back to 20-meter spans. Hanle continued to sell the 604, essentially unmodified, although only 11 were ever produced. The Open Class goes on even today, with these early gliders successors the Nimbus-4 and ASW-22 as the sailplanes of choice. In contrast to the other classes, however, the Open Class Nationals attract 10-15 pilots, where the Standard and 15-Meter classes often fill up to the limit of 65 with more on the waiting list.

Marfa would be the last great experiment in soaring competition until the introduction of GPS technology in the early 1990s. The distance tasks, with their lottery-like nature, would soon come to an end in favor of all speed tasks. The parity of the new sailplanes would emphasize Moffat's tactics of winning by not losing. In a period of ten years, the sport had completely changed. The sense of adventure of Johnson and Parker's early distance flights, of Moffat's speed records, of the earlier contests where what was possible was redefined would be gone. In its place, soaring competition would become

[159] Moffat, "Marfa – 1969 and 1970."

more institutionalized. It became a matter of long-term practice and preparation. Soaring traded in romance for speed and technology. A new era had begun.

Aftermath: The Modern Soaring Era

"For the generation of competition pilots who came of age in the 70s and 80s, George Moffat's ground breaking book, Winning on the Wind, assumed totemic status. Revealed therein were this two-time World Champions secrets for exhaustive ship preparation, contest strategy, and most important, winning by not losing."[160] *– Doug Jacobs, 1985 World Champion 15-Meter Class.*

In the introduction to Moffat's Winning II, famed soaring author Michael 'Platypus' Bird considers the changes in soaring during the 1960s and 1970s when borrowing from the words of 1952 World Champion Phillip Wills, who wrote the introduction to Moffat's first book, Winning on the Wind. Wills once said that his favorite part of soaring was "to tiptoe off in the first elfin whiff of rising air." Bird placed Moffat apart from this earlier generation, stating:

> *Elfin whiffs* do not crop up much in George Moffat's writings, which embraced with gusto the new era of plastic gliders and the inevitable rule-changes that their astonishing performance brought about. Philip's nostalgic lament for a past that could never return, adjointed to George's modern, hard-edged advice on how to win, seems therefore one of the strangest partnerships in gliding literature – but it reminded us how dramatically the whole spirit of contest flying had changed in just a few years between the early and late 1960's.[161]

The 1960s brought an end to the entrepreneurial spirit that had characterized earlier generations of glider pilots. The advances in design and technology began to institutionalize the sport – only those with extensive resources were able to harness the potential of new materials that led the breakthroughs at the end of the decade. The Schreders of the sport would never reclaim the leadership in design that they had held for the previous fifteen years.

The 1970s brought in a period of stable change in soaring. The gliders continued to improve, but at a more deliberate pace. 'Moore's law' was replaced by incremental

[160] Moffat, Winning II, Rear Cover.
[161] *ibid*, 12.

improvements, hence flying a glider a few years old certainly did not stop one from being competitive. This author was able to keep up with Moffat and Jacobs, flying the latest in high performance sailplanes less than five years old in 35 year old LS1-'g' during a series of training flights in 2004, on one day even besting them both (he would like to think it was skill, but he probably just caught a lucky break).

Distance tasks were replaced with pilot selected tasks, where the pilots were given a minimum amount of time to remain on course and round as many turnpoints as possible, but could still return home after the minimum time elapsed. The tasks also began to become shorter, especially after 1972 when the gasoline crisis hit America. Previously, the crews chased pilots around the course, and if they landed out, the glider could be disassembled, returned to the home airport, and reassembled for another launch and try at the course. After the end of the distance tasks, chasing the pilot became far less important. The rules eventually specified that if a pilot landed away from the home airport, he was not allowed another attempt.

While the gliders became marginally better, the techniques that pilots used have come a long way on two fronts. At first, the new gliders were flown in the same way that the old ones had been, with increases in performance leading to increases in cruising speed. Eventually, it was determined that this was suboptimal. In a recent e-mail, 1985 Doug Jacobs wrote to me that he agreed the changes in gliders had been less than breakthrough, but:

> On the piloting front, however, I think there's been more progress, particularly in racing. If you read contest reports of the 70's/80's era, there's still a lot of technique being talked about that we'd now view as suboptimal, particularly inter-thermal speeds, thermal selection and the like.[162]

[162] Douglas Jacobs, "Re: Gliding Paper for Comment," E-Mail to Kevin Christner, 3 April 2007.

The first hint of this revolution came at the 1972 Soaring Symposia, the last that would be held before the SSA took over organization of these events and turned them in to full fledged conventions designed for pilots of all skill levels, rather than the racing elite. Wil Schueman, who had done the pioneering to modify Glasflugel Libelle and get the most of its potential, spoke on the issue of MacCready speeds. MacCready speed assumes perfect knowledge, that whatever thermal strength you set the ring for is the strength of thermal you will find. Weather conditions, on the other hand, are variable. The probability of guessing the future thermal strength is not high. Beyond this, MacCready assumes that you have unlimited altitude, and will not be forced to take a thermal of weaker strength when low to the ground to decrease the probability of landing out.

Schueman found both of these assumptions required revisiting. He calculated that the price you paid for flying slower than optimal MacCready speed was minimal, perhaps on the order of 5% to 10% depending on what part of the speed range you were in. The additional distance you gained by flying slower at a higher L/D could be significant, however. It might allow you to use a stronger thermal rather than accepting a weaker one when desperate and low to the ground. Using stronger thermals and located by the increased range a pilot had when flying slower could often result in a higher average speed.[163] It was a revolutionary idea for the time. Later this theory would be expanded to include the use of water ballast. Rather than adding the water and flying a lot faster, many pilots have expounded flying only marginally faster, using the increased L/D the water ballast provides at marginally faster speeds to have longer to search for the strongest thermals. Average cruising speeds today are not much faster than they were

[163] Wil Schueman, "The Price You Pay for MacCready Speeds," Soaring Symposia, 12-13 February 1972 <http://www.betsybyars.com/guy/soaring_symposia/72price.html>.

thirty years ago, and may not have increased at all.[164] The average speeds have increased, however, because of the decreased need to regain altitude due to the increased performance of the gliders in the cruise.

In a 1975 letter to Joe Lincoln, after describing his winning flight in the 1968 World Championships, AJ Smith wrote of the phenomena he encountered on that day:

> All this is just more indication of the current nature of competition soaring. Mostly we don't have enough solid information to support what we're trying to do. We have to operate on obscure relationships. Sometimes they work out good. Surprisingly often if you work at it. Often enough for those people who don't even know they exist. But because we're operating in this only slightly enlightened fashion all the old methods, routines, and task types hang on in competition. And some still believe in their supposedly unique ability. And others seem mystified and charmed by all the mentality displayed. It'll take time, but we'll learn.[165]

Smith was right and wrong at the same time. In the past 30 years, a lot has learned a lot about soaring, but not nearly enough to say that it has been conquered. The sky is never the same two days in a row – if it was, the sport would be reduced to one of a plethora of other pursuits, where the competitors know well in advance what to expect. That's what makes gliding special and keeps pilots coming back year after year. There is still a lot more to learn before Smith's prediction will become true. We will get there some day, but it will not be any time soon.

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[164] Jacobs.
[165] Smith, Letter to Joseph Lincoln.

A Personal Statement

Looking back, the events of Marfa are intensely fascinating to anyone with an appreciation for gliding. I first started flying gliders a little over seven years ago at the age of fourteen. I still vividly remember reading accounts of the Marfa contests as a young boy that left me utterly fascinated with soaring flight. While I have been flying gliders for only eight years, it is safe to say that I have been in love with aviation far longer. At age two, my parents took me to an air show, where I was able to sit in the cockpit of a plane for the first time. My mother has told me many times I was never as happy before and have not been a happy since. While I'd like to think this isn't completely true there is at least some reason to it as I am never as happy as I am in the cockpit.

The author at the controls – age two.

The author after a flight in a Glasflugel 304c sailplane – age 19.

When considering what I wanted to study for senior research project, I thought about soaring but was unsure what I was getting myself into. There is very little secondary literature on soaring history and virtually no serious research that seeks explanation for the events of the past. I realized that I would be embarking on an untrodden path. I was fortunate to be able to

attend the 2006 Soaring History Symposia at the National Soaring Museum in Elmira, New York last May Museum Director Peter Smith expressed support for my project, which made me feel somewhat more comfortable. I was able to attend a presentation by and interview Richard 'Dick' Johnson, who will become important to the Marfa story. These sessions opened up a completely new line of thought as they allowed me to truly understand the effect American sailplane designers had on the overall history of soaring. I decided to proceed with a project on gliding heavily based on primary research and addressing issues that had not been seriously considered by historians in the past, instead of a more typical senior project based on a well developed historiography on a subject that I was not truly passionate about.

I returned to the National Soaring Museum in December to access the museum archives. There I stumbled upon a gold mine when I found the notes of Joseph Lincoln, who had written a number of articles for *Soaring Magazine* including the accounts that would consume an entire issue of both the 1969 National and 1970 World Championships at Marfa. They contained first hand interviews with the most influential figures at the contest that also yielded a wealth of background material. Without them, I likely would not have been able to complete this project in the form it has taken. I also found a very interesting manuscript that Lincoln was developing at the time of his death. It was a minute by minute, blow by blow account of the 1970 World Championships. While extremely interesting to me, the general public would probably be bored. The manuscript inspired me to complete this project. I hope to continue to develop it further over the next few years, and create a defining work on soaring's Golden Age.

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