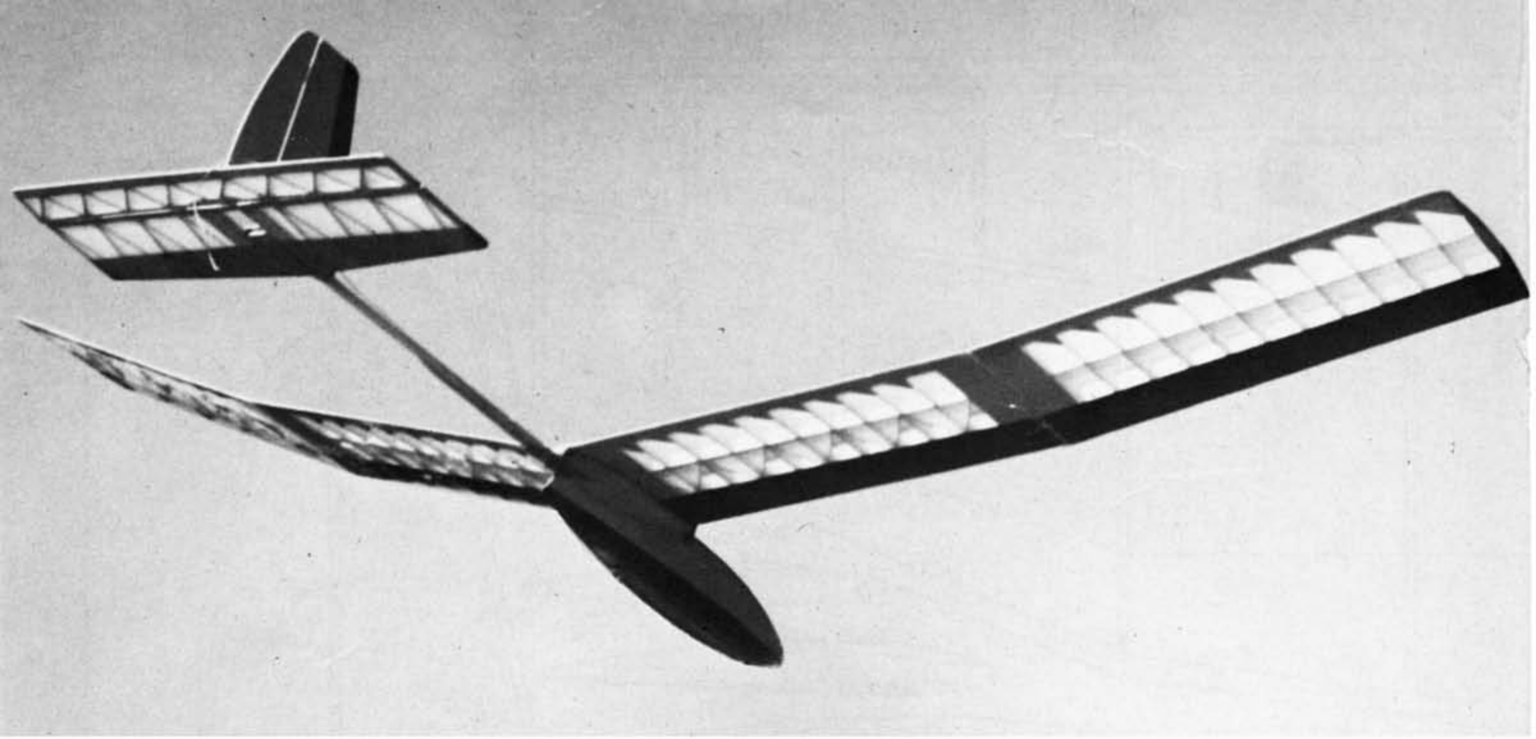


Some thoughts on soaring

When I dipt into the future far as human eye could see; Saw the vision of the world, and all the wonders that would be; . . . *Alfred, Lord Tennyson.*

by Jim Gray

What about the future of R/C soaring? Where is it going? . . . And how shall it get there? Can we, like Tennyson, dip into the future and predict the wonder that will be? Perhaps we can adopt an engineer's viewpoint and logically extrapolate from the curve of progress and discover . . . what?

Let's take what is known and use it as our launching device on a journey into the future, examine the new developments along the way, and discover the unknown. Even in the "Age of Aquarius" the crystal ball is sometimes clouded with cumulus.

To begin at the beginning, we ought to come to terms with terms and try to define what might represent the ideal for most sailplaners. I'd like to suggest the term *soarability;* meaning the ability to sustain soaring flight as long as we wish, at any time, in any weather and in any place of our choosing. Soarability is the ultimate achievement of that ideal, and the goal to which our trip into the future is directed. Soarability implies an interface between the sailplane, the atmosphere, the radio control system and the pilot. The radio and the plane are the "hardware" while the atmosphere and the pilot are the "software" which we shall consider separately before bringing them all together into an integrated whole.

The Sailplane

Ideally, the sailplane is easily and completely portable—not just transportable. It must have great survivability and be maneuverable, yet stable. First, if you can't take it with you, you won't be able to fly it when you get there. If you can't fold, bend, stow, pack and carry it in the smallest practicable container, stuff it into a "beetle" carry it on board an airliner, carry it under your arm, or sling it on a bike or back pack, then it's not portable! So far, one of the best ready-made sailplanes in the portable category is the "Hobie Hawk" which qualifies because of the ingenuity of its container. Among scratch built sailplanes I would suggest the "Wild Blue," a 100″span sailplane designed by Don McGovern (July, 1974 FM) and fitted into a suitcase only 25½″x18½″x5½″, with room for a transmitter, hi-start and a couple of tee shirts to spare! Recently, Frank Zaic has come up with a new kit, designed along similar lines—"The Scout." These developments will show the way to complete and total portability and a guarantee that wherever you wish to fly, you can carry the means with you in safety, convenience, comfort and peace of mind.

Survivability is obvious; your sailplane ought to be able to withstand the normal rigors of flying, crashes, ham-handed but well-meaning help, vicious winches, turbulence, trees and power lines, rain and snow and heat and cold. It's got to be tough, durable and strong. The new plastics may someday provide a complete answer, particularly the new ASA plastic of the type used in the vacuum-formed "Rubber Ducky." Much simpler for the average builder and almost as indestructible is a built-up plywood fuselage and rubber-band-in-place wing; yes, you've guessed it: The "Floater!" Also the "Scout." There is ample evidence that such a structure will survive the twists, impacts and punctures of rugged use. Foam wing cores covered with light plywood sheet, say 1/64″ thick, will provide the same toughness and durability that we seek, yet remain light and simple. A great deal of effort is going to have to be put into radio equipment, particularly the airborne flight pack components, to render it impregnable and insensitive to high impact loads. On top of all these requirements should be an added one of water resistance, if not a completely waterproof structure! Some of the best lift available anywhere exists ahead of rain squalls.

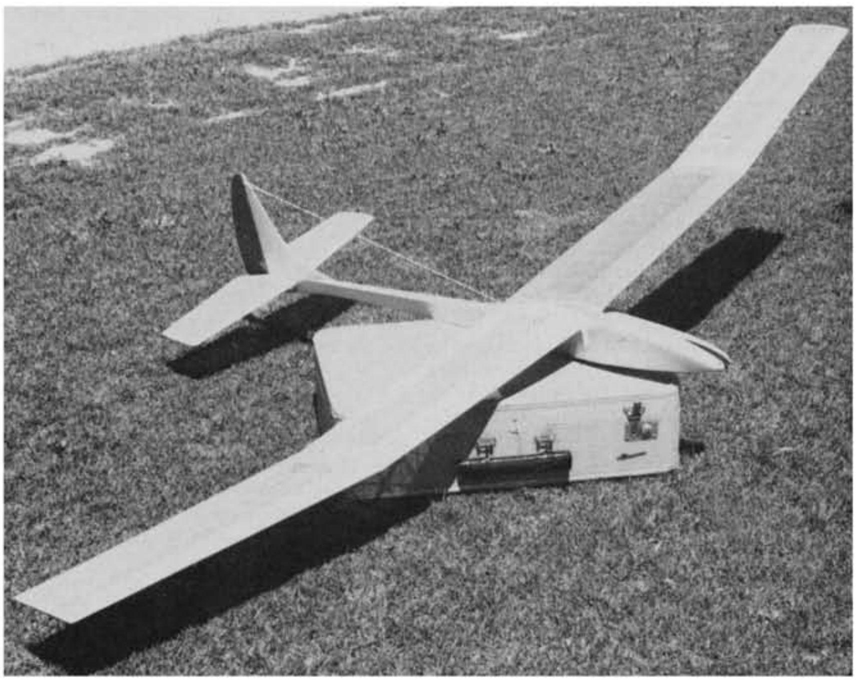
Maneuverability and stability seem to be contradictory terms because design features that promote one often detract from the other. There is a fine line between maneuverability, neutral stability and dynamic instability. A design compromise would not necessarily be a beginner's sailplane; for example, a "T-2" or "Todi" possess good maneuverability and adequate stability with some other advantages thrown in for good measure. The sailplane of the future should be able to handle gusts and turbulence with ease, yet allow some degree of "hands off" soaring. It is probable that a nice blend of these factors could be achieved with a wing of limited span, say something between 72" and 100", for low inertia and fast roll response. Ailerons or flaperons will provide fast rolls and have the benefit of doubling as flaps when needed. The yaw axis maneuverability can also be made better than adequate by provision of generous tail arm length and rudder-fin areas. Another good feature of the latter design is that pitch stability will be insured if a generous area stabilizer is employed. More about this later. Stab-elevator and fin-rudder could very easily be made all-moving in the latest fashion, thus insuring ample control movement to initiate attitude changes.

One of the major disadvantages of most sailplanes is that they are not stable in pitch when strong lift is encountered. Most will pitch nose up, and this is not desirable because it often causes the pilot to overcompensate, it disturbs the trim and is inefficient. What is desirable is a design that will react to lift by rising "flat," that is, ballooning. The cause of pitch-up in lift is the sudden angle of attack increase provided by a thermal which has considerable vertical component of flow compared to the horizontal velocity of flight. In most airfoils of the flat-bottomed or undercambered variety an increase in angle of attack causes an abrupt center of pressure change toward the leading edge. What is needed is an airfoil that possesses a stable center of pressure (little movement) over a wide range of attack angles. Fortunately such airfoils exist: they are often used in flying wing or tailless aircraft, and are known as reflexed airfoils. Since our machine of the future is not (necessarily) tailless, perhaps an airfoil from the 23012 or 2R12 families would be a good choice. To the best of my knowledge the only sailplanes using either of these airfoils are the "Rubber Ducky" and Jerry Krainock's world distance record holder. The 2R12 is slightly semi-symmetrical and therefore has excellent penetration ability. Although it may not be a top thermal airfoil, remember the sailplane has flaperons which should compensate for the lack to some degree. This choice of airfoil, moreover, is an excellent bet for slope soaring and should be considered quite seriously.

Ideal soarability also implies that the ship should be launchable and landable in the smallest possible space within reason. Let's call it the smallest practicable space. For example, it could be *hand* launchable a technique that has recently been widely demonstrated in (where else) California! This is not a hand launch into a slope breeze, but a hand launch into a thermal duration flight. The "Pierce Arrow" and "Drifter" appear to lend themselves well to this form of launch; that is, they are relatively small and light. Since landing is fully as important as take-off, a near-vertical descent is much to be desired. This means that flaps and spoilers ought to be fitted, working in such a manner that spoilers are deployed only after flaps have descended about 30 degrees or so. This also prevents deployment of spoilers when ailerons are used. Both the "Challenger" and "Maestro" use this system with good success and I've witnessed parachute-like landings by both. Linkage is also fairly simple, although initial construction is a bit more difficult. Worth it, in my opinion, for maximizing soarability.

Flight duration is an important factor in soarability and depends on launch altitude, rate of sink of the sailplane and the presence—or absence—of rising air along the flight path. All else being equal, a good launch is always the beginning of a good flight. Stability in the launch phase, high C_l, light weight and low wing loading are important. Much can be done by proper c.g. location and tow hook location. Perhaps one of the best-climbing sailplanes is the "Pierce Arrow" which possesses the desired features in abundance. Changes in wind will have to be easily compensated for, so there is no hard and fast rule for C.G. and hook placement. Broad wings of low aspect ratio seem to be superior to thin, high aspect ratio wings and the modern trend in the Pokey 808, Aquila, Pierce Paragon and others seem to bear out this analysis.

Putting these features all together should show us what our soarable sailplane should approach in the ideal: A span of 72" to 100", low aspect ratio wings of relatively great area (meaning wide chord), strip flaperons with "Honker"—simple linkages coordinate with spoilers. Polyhedral insures stability without severe drag penalty, and the airfoil is a semi-symmetrical family with slight reflex and zero moment coefficient about the quarter-chord point at all reasonable angles of attack. The fuselage has a long tail arm. The all-moving stabilizer/elevator and fin/rudder insure excellent pitch and yaw control. Construction is plywood and foam, and configuration is pod and boom with rubber band secured wings. The spoilers are pulled up by the downwardly moving flaps through a simple thread or string linkage. The tail configuration will be your choice. While I like T-tails, they have some disadvantages—particularly the whiplash effect on hard landings—which cause damage to the fuselage and fin. As far as I know V-tails are okay but the only "experts" on these are Lee Renaud and a few others. Conventional tails are adequate and simple, and have the advantage of easy disassembly and storage in the box. The fuselage separates at the aft end of the pod, and the wing separates into a center-section and two outer panels. The tow hook is adjustable, and there is room for ballast and weightshift.



Don McGovern's "Wild Blue" soarer will disassemble and fit into the suitcase for easy transportation. Zaic's "Scout" **(opposite)** is a stubby contrast to the conventional long-wingers.

The Atmosphere

The medium in which our super machine is to fly remains one of the most discussed and least understood of the four ingredients of soarability. We know little about the fine structure of the atmosphere, or its micrometeorology. We can't see thermals or sink or turbulence and we don't know anything about dynamic soaring. Being a purist at heart, it will be difficult to make this admission, but since we lack knowledge of all these things, we must have a substitute; yes, a thermal sniffer! If you are going to achieve maximum soarability, you need all the help you can get, even if it is artificial.

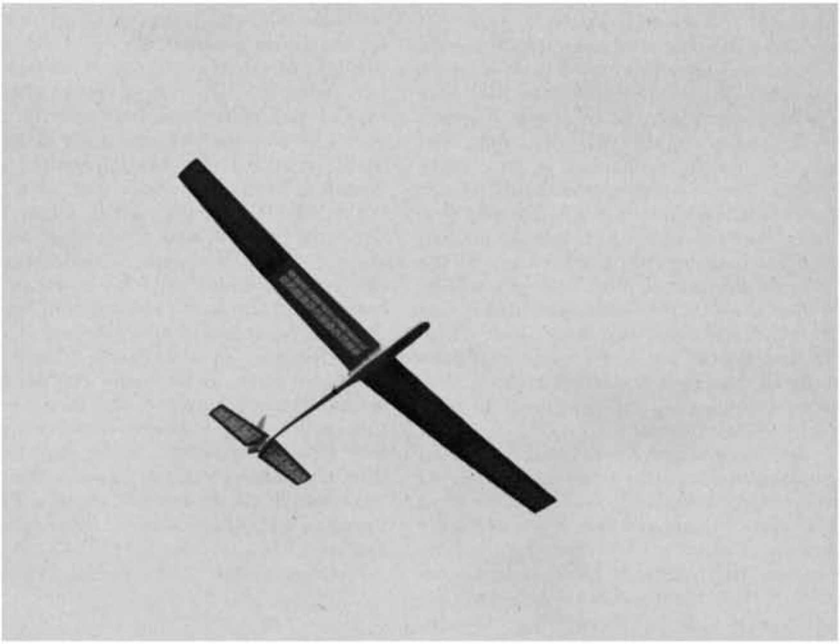
Naturally, the more familiar we become with any given flying site, the better we can "work" it under a variety of conditions, and this is good. But we'll want to fly in any place of our choosing, so a sniffer is a must. I suggest a new approach to thermal detection and utilization. It seems to me that someone ought to build a sniffer based on Maynard Hill's electrostatic field detector. Changes of altitude would be sensed as field voltage changes which would drive an oscillator in the downlink transmitter audio system. There are other ways, but that should be a start.

I think we are all going to do a great deal of night flying. Texas and California have shown the way. Strange, unexpected and interesting lift phenomena are found after dark. True, all diurnal thermal sources—in theory—are super suckers after dark, like real downers. But what about ponds, woods and other sources that are supposed to give off heat at night? Sure, it would take courage to penetrate out over woods or a pond, but how will you know what's there unless you try. That's one reason for making the sailplane waterproof. Who will prove or disprove the popular belief?

I've seen some interesting flights made in turbulence; albatrosses soaring in wake turbulence behind a ship's superstructure. A highly-loaded structure resists being tossed about by turbulence because of its inertia, like a balloon versus a bowling ball —both being the same size. Somehow, the bird manages to "rectify" turbulence and turn it into usable lift. In the future we will learn how to use turbulence for lift, and the knowledge of how to do so is beginning even now. Lift around the leading edge of rain and snow squalls is tremendous, and we could soar in it if we had the courage and waterproof equipment. Now I'm not suggesting that you fly in thunderstorms. A successor to Ben Franklin tried the kite and key bit and was electrocuted!

There is plentiful lift along sea breeze "fronts" where land and sea air masses converge. Along these convergence zones you will find clouds parallel to the shore which give a strong clue about active thermals in the area.

One of the active and fascinating subjects for exploration is dynamic soaring, but I don't know where to begin. Maybe you can help the future a bit. As steady wind flows over the ground or sea, the air closest to the surface loses velocity by friction effects. The air only a few feet above is moving faster, and the air at thirty or forty feet is moving still faster. The velocity gradient is used by sea gulls and other water birds like albatrosses, gannets and the like. Such a gradient is usually more pronounced in stable, laminar flow where little or no vertical motion is present. Somehow the birds can exchange potential energy and kinetic energy while flying up and down through these gradients. Maybe Mark Smith who has done so much gull-like flying near the coast could shed some light on this theory. Is it fact or fiction?



The Pilot and the Radio

It is obvious that good radio equipment is needed, and perhaps it is equally obvious that a good pilot is needed to maximize performance. In the case of radio, I suggest that reliability far outweighs sophistication. "Class D Pattern" radio definitely is not needed, but the gear must be comfortable in the hands of the pilot, must have long range and must not fail—ever. How many ruined flights would you guess could be laid at the doorstep of radio failure? Use good quality equipment, keep it tuned and maintain your batteries in the best manner you can learn according to the latest charge-discharge techniques. Ultimately, new equipment will supplant the old and it will be as different from present gear as today's is different from the escapement and tube equipment of the 1950's.

The last, but not least of the ingredients is the pilot—perhaps the greatest unknown of all. That's you, friend, the guy who gets it all together and makes it go. Your state of mind and body are very important. You can't be tired and nervous or in a bad frame of mind and expect to do well. You should be relaxed, confident and happy; at peace with yourself and others. How is the eyesight; need glasses? Checkup? How is your ability to concentrate after a long flight, when your ship is very high and far away, or at dusk? Have you developed a "feel" for your sailplane in its natural environment? Are your nerves and muscles connected by the electronic link of your radio to the sailplane? I can't describe it, but I've seen it operate in others: the pilot who detects the slightest subliminal impression of lift or movement and automatically makes the right correction—just enough. I've seen him work one off the deck when anyone else would have landed; I've seen him find a non-existent thermal and work it out of sight. He is a unified or integral "one" with his plane, the air and himself. He has practiced long and diligently, and his health and mood are tops.

Someday you and I, too, will get it all together. You'll be out there, alone, and staying up. All your OFB's will be asking each other: "How does he do it? There just isn't any lift out there!" Inside, you'll kind of smile to yourself and know how it feels to have achieved soarability.

Whether in competition or just soaring for fun, the sport will probably have to adapt to the pressures and problems of contemporary transportation and R/C flying environments.