Highlights and Margin Notes in
Wolfgang Langewieshe's

Stick and Rudder: An Explanation of the Art of Flying
Chapter 10 Notes

Perhaps my notes and observations will inspire you to buy your own copy and learn from this classic…or to take the copy you already own off the shelf and revisit its great lessons, just as I am doing again now.

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Continuing my notes on Wolfgang Langewiesche's essential classic, ***Stick and Rudder***:

Part III: The Controls

Chapter 10: "The Ailerons"

Page No.	Highlighted Text (Langewiesche's words)	My margin notes
163	When the Wright Brothers invented the airplane, the thing they really invented [was] the aileron. All the other elements of the airplane were then already in existence.	Actually, wing warping to accomplish the same thing.
	The aileron was created new and was the one thing that made it possible to combine all those other elements into a flyable machine…. "lateral control".	
	Aileron or wing warping…works on the same principle" by increasing the Angle of Attack on one wing tip and decreasing the Angle of Attack on the other wing tip, you get more lift on one side of your airplane and less lift on the other side, and your airplane banks or unbanks at your will.	Downward aileron = higher AoA; upward aileron = lower AoA
164	If you ever break your neck in an airplane, your ailerons will probably have much to do with it.	Need to keep ailerons neutral at high angles of attack and initially in stall recovery.
	The aileron has two inherent faults. The more serious [is] the *adverse yaw effect*.	
	The downward-deflected aileron (the one that is set to lift its wing) projects deeply down into the airstream and will cause, along with much additional lift, much additional drag; while the upward-deflected aileron (one that is set to depress its wing)…has, along with very little lift, very little drag.	Differential ailerons
165	With the differential lifts of the two wings tend to roll the airplane…but at the same time the unequal drag…tends to yaw it [the other direction]…the real reason why the airplane had a rudder.	Adverse yaw
	The rudder is merely a device by which the pilot counteracts the adverse yaw.	
	Misuse of the rudder is a factor in almost all accidents…adverse yaw effect gives rise to a whole string of consequences.	Stall/spin
	The wrong-way yaw can actually also produce a wrong-way roll.	One reason why you level the wings with rudder.
	Because of this yawing, the left wing tip has temporarily less forward speed and less wind, and hence also less lift…the yawing gives the right wing tip more speed, more wind, and more lift.	
166	Under come conditions, an aileron that is set to lift a drooping wing may actually stall that wing and drop it viciously.	Snap roll: one wing stalls while the other is developing near its maximum lift.
168	By using the ailerons sharply to raise one wing, [the	Danger of deflecting aileron during stalls and

	pilot] will do to that *one* wing exactly the thing which holding the stick further back would have done to *both* wings…it will stall.	recovery.
	On many airplanes today, those two inherent faults of the aileron have been reduced almost to the vanishing point.	A 1940s statement—and yet, we still have the stall/spin problem today.
169	One important improvement…"wash-out," a twist of the wing that makes the wing tip ride always at a flatter Angle of Attack than the wing root.	The inner wing generates most of the lift, and is designed to stall first. When it stalls the ailerons remain effective and well away from their critical angle of attack even when deflected…or so it is designed.
	Another way of getting the same results is a slot in the leading edge of each wing, near the tips…slots in the leading edge of the wingtip will make the aileron on the trailing edge of that same wing tip much safer and much more effective in slow flight.	Slots were something of a fad in 1930s design, for example the automatic slats/slots of deHavilland Tiger Moths and the Globe Swift. It appears washout won out and slots/slats never really caught on in light airplanes.
170	Another important improvement…on the *transmission* between the aileron and the pilot's stick. This is known as *differential aileron*.	Yes, washout and differential ailerons won out over slots.
	When the pilot moves the stick, say, to the right, the aileron on the *left* wing is deflected downward only comparatively little. Deflecting an aileron upward can't do much harm; it is the downward deflection that causes our troubles—adverse yaw and wing-tip stalling.	
	Finally, the *control surface* itself has also been improved…. Hinging causes the leading edge of the aileron to protrude…down into the slipstream. This lip acts as a drag. This drag partly balances the drag which at the same moment is being caused by the other aileron…. The offset hinge equalizes the drags of the two wing tips and reduces the adverse yaw effect.	
171	When an airplane is stalled, it becomes laterally unstable, that is, it wants to drop off over one wing or the other…but in stall practice, the student is told that this is wrong, he must neve ruse the ailerons while stalled…in most ships the ailerons are quite nicely effective even in the stall…[but] the ailerons are effective only because he is using a good deal of rudder at the same time.	So aileron use is OK as long as the recovery is done as a continuously coordinated maneuver.
172	Observe the adverse yaw is in taxiing against the wind; the ship will tend to turn right if the stick is held to the left, and vice versa. This is especially noticeable when taxiing a seaplane and is an important trick in seaplane handling.	Not nearly as obvious in tricycle gear airplanes.
	It may be best to assume for a moment that all these improvements [to aileron design] had not been made…never use ailerons without diligently supporting them by rudder.	Coordination at all times…except when you *want* to be uncoordinated (a slip or crosswind landing).
173	Rudder action must become more and more lively the more [the airplane is] slowed.	Control authority changes with indicated speed and AoA
174	In a steep turn the airplane flies at a high Angle of Attack—the pilot holds a lot of back pressure on the stick. The higher the Angle of Attack of the airplane, the mmore pronounced is the adverse yaw effect. Banking out of fast, low Angle of Attack flight into the turn, there is not much yaw and hence little need for rudder. Unbanking out of slow, high Angle of Attack flight, there is much yaw and hence much need for rudder.	Changing rudder needs as speed and AoA change
174-175	Even the modern airplane needs more rudder coming out of a steep turn that going into one. If a steep turn goes sour, there is only one safe way to recover in a hurry—get the stick forward first, put on top rudder then, and last of all, and *gently*, use your aileron…. Stick forward!	Assumes a spin, not a spiral, when a spiral is really a steep turn "gone sour". In the case of a stall, PUSH. In the case of a spiral, roll level in coordinated maneuver, then PUSH once the lift vector is vertical.
175	The only certain way to regain control surely and promptly, to maintain control under all conditions, is to get the stick forward.	2018 note: PUSH and HOLD PUSH = stick forward HOLD = Wings level with rudder and coordinated aileron

I'll add chapter highlights and notes until we reach the end of the book. If you're impatient—and I hope you are—you won't wait for my musings, but instead will secure your own copy of *Stick and Rudder* now. Beyond simply reading its words, you'll truly analyze, criticize, mark up and understand Langewiesche's teachings to, as Adler suggests, **make this book your own**.

I look forward to your comments on these notes and the larger work. Please send your thoughts to me at mastery.flight.training@cox.net. Thank you.

Pursue *Mastery of Flight.*

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