Highlights and Margin Notes in
Wolfgang Langewieshe's

Stick and Rudder: An Explanation of the Art of Flying
Chapter 12 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 IV: The Basic Maneuvers

Chapter 12: "The Turn"

Page No.	Highlighted Text (Langewiesche's words)	My margin notes
188	There are only four maneuvers that a pilot can execute in an airplane" the turn, straight and level flight, the glide, and the climb. All other maneuvers, however difficult, however intricate, however important they may be, are only variations of combinations of those four fundamentals	The four basics: climb, turn, descent and straight and level flight
	So-called "advanced" maneuvers, the chandelle, the lazy eight, the pylon eight, and so forth…are not at all important in themselves but are merely exercises by which to develop better mastery of those four fundamentals.	Pursuit of mastery of the four fundamentals
190	Almost all fatal flying accidents are caused by loss of control during a turn	Does the turn lead to the accident, or does the accident result in a turn before impact? If the turn develops into a spiral and the pilot does not recover, all is lost
	Flying is still quite an art	Art, or science? Or both?
	The turn-by-rudder idea	Langewiesche is getting redundant. He needed a good editor.
192	The rudder can *never* produce a turn. The only effect the rudder can ever produce is *yaw*, and the only effect it can ever stop is yaw…. Yaw is not a turn	Yet we level the wings in a stall, and stop the turn in a spin, with rudder…are these recoveries really in the *yaw* axis?
	(n/a)	Book or video idea: Stick and Rudder Exercises. 10 (or some number) flying exercises/lesson plans that teach the main lessons of *Stick and Rudder*.
195	A spin is nothing but a fancy stall; one side of the airplanes is stalled, the other is not, and therefore the airplane sinks down twisting.	But is this yaw, since we recover with rudder?
196	Once banked, the airplane seems to stay in the bank without having to be held in the bank by aileron! In fact, it wants to steepen its bank of its own accord and must be kept from doing so by a distinct and constant *opposite* aileron pressure.	The "overbanking tendency"
	Once turning, the airplane seems to keep on turning without much further need for the rudder! In fact, he may sometimes catch himself flying a *left* turn (especially a climbing turn) with slight *right* rudder.	
	During the turn he must hold back pressure on the stick to keep the nose from going down…when he wants to fly straight again, he can stop the turn only by using	To stop turning your need to command a turn in the opposite direction.

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	strong opposite stick and rudder.	
196	When the facts don't fit our ideas, we usually try to disregard the facts	Not just about turns!
197	So many pilots, when they make a turn, don't really know what they are doing.	
198	Most people will rather die than think. This book is written for the exceptions.	You can't reach the unreachables. You can, however, improve if you're reachable.
	An airplane is turned by laying it over on its side and lifting it around through back pressure on the stick.	At least steep turns
	Go up sometimes for a quarter hour and work your way gradually from steep turns toward shallow turns.	Finesse is harder
	Feeling things out for yourself in that order, you never come up against a point where your mind demands that there must be some other cause (such as the rudder) to account for your airplane's turning; it is all bank, plus back pressure on the stick.	
199	*An airplane turns because its wings shove it over sideways, and its tail makes it weathercock.*	Horizontal component of lift, and stability.
	This force is commonly called "lift", but the word "lift" suggests to many pilots (wrongly) a force that always acts straight up. Actually, what engineers call lift does not necessarily act straight up…it always acts perpendicular to the wing.	"Up" is relative to the airplane, not the horizon.
201	The tail, acting much like the tail feathers of an arrow, won't let it slide through the air sideways, but makes it swing around…into the Relative Wind.	
202	If you want a sharper turn, there is only one way to get it…more bank.	Or less speed works, too.
	This should be so firmly etched in a pilot's mind that he will remember it in an emergency…. In such an emergency there is always a tendency in the first place to hold the stick too far back, in a confused attempt to conserve altitude and "stretch" one's glide. This makes the airplane vulnerable to any further misuse of stick and rudder.	You don't rise to the challenge, you fall to the level of your training.
	Back pressure…is necessary only in order to get a good turn and to avoid a loss of altitude during the turn…. Coordination of back pressure and bank.	
203	What happens if the pilot simply banks the airplane without putting back pressure on the stick? …. The airplane sinks, and in sinking it noses down.	Spiral tendency.
	That's why back pressure must be held against the stick in every level turn…. By forcing the stick further back, we force the airplane to fly at higher Angle of Attack…. The bigger wing force is then adequate for the double job of holding the airplane up and shoving it over to the side.	
204	To get a perfect entry into the turn, the back pressure must be applied and gradually increased even as the airplane rolls into the bank; *at any one moment* the back pressure must be exactly right for the steepness of bank that the airplane has reached *at that moment*.	Timing of control inputs
	The nose appears noticeably higher, relative to the horizon, during a correctly flown steep turn than it appears in straight and level flight; this is because of the much higher Angle of Attack during the turn.	
205	If during any part of the turn the airplane slips, the reason is almost certainly lack of wing force, that is, lack of sufficient back pressure. The rudder should be left alone until an increase in back pressure has been tried.	This is backwards from what we're taught—that it's active rudder inputs, not elevator, that is required for coordinated flight.
	Instead of adjusting the back pressure to the bank, the pilot may also do the opposite, change the bank so as to fit the amount of back pressure he chooses to hold.	Regardless, the inputs change G load in a level turn.
206	Turning ability depends on three factors. By far the most important is speed…. If you fly twice as fast, you need, at any given angle of bank, four times the room.	
207	If you fly twice as fast you need (at any given bank) twice as much time to accomplish a given change of direction.	

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	For any given angle of bank, the G load on the pilot is the same, regardless of the speed, power, weight, wing loading, or size of the ship….	Only if altitude is held constant.
208	When flying at high Angle of Attack, the long narrow gliderlike wing has less drag than the short, stubby wing of the same area.	“The impossible turn” and “sailplanes can do it” argument debunked.
	You simply cannot roll an airplane into a bank instantaneously, because the wings themselves resist any attempt to roll the airplane fast. This is called the *lateral damping effect* of the wings.	
	This effect is of course the stronger the longer the wing; because, the farther out the wing tips are, the more actual up or down travel they must do for any given rolling motion of the ship; and hence, the bigger is the resisting force…. That is one reason why in the old days pursuits were biplanes or even triplanes; it made them quicker to roll into a turn.	
211	Everything that is true of the turn, of the curving of the flight path sideways, is true also of the pull-out from the dive, the flare-out from the glide, the pull-up into a loop—in short, of any curving of the flight path upward. An upturn of that kind is in most respects simply a turn of zero bank. It is subject to all the laws of the turn.	You can “turn” about any of the three axes. A “turn” is a change in orientation along any one or more axes.
	You can stall with your nose down in too sharp and upward turn just as you can stall, with your nose on or below the horizon, in too tight a sideward turn.	Turns on any axis affect angle of attack, and therefore have the potential of creating a stall.
212	*For the same laws that govern the sideward turn also govern the upward turn in regard to the time and the room needed to turn.*	
214	An arrangement by which the throttle can’t be closed unless the wheels are down….	Interesting. Was this in military types?
	The difference between piloting a heavily wing-loaded and piloting a lightly wing-loaded airplane, especially on landing…wing loading 6 pounds per square foot [vs.] 24 pounds per square foot….	
215	…the heavy fast ship makes all turns, for a given G load, four times as wide! And that goes not only for turns left and right, but also for upward turns, particularly the flare-out for landing…. You would have to *start flaring out four times as high, and four times as far away!*	It takes more force and distance to flare a heavily wing-loaded airplane.
	The pilot of the faster ship needs twice the time and *must begin his flare-out twice as many seconds before the actual landing as the slow ship pilot must.*	“Being behind the airplane” during transition training may be a result of a change in the airplane’s wing loading, not its speed! This could explain the difficulty of moving *down* in airplane performance as moving up, because in the lighter wing-loaded airplane you have to wait to flare but then perform the flare more quickly.
216	Heavily wing-loaded ships usually glide very much more steeply than do the light ones…. It is a result of the enormous powerplants that necessarily go with high wing loadings; when idling, those motors, nacelles, and propellers act as enormously powerful drags. Because of this steeper glide, the heavily wing-loaded ship has more upward turning to do in the flare-out. This makes it necessary to flare out even earlier, even higher…. This is one reason why heavily wing-loaded ships usually do not make the same type of landing as lightly wing-loaded ones but make their landing approach with power on…there is less upturning to do at the end.	Why some pilots like to land with power even if it results in longer landing distances—it’s “easier” to land that way because there is less need to time and judge the flare.
217	*Every small correction* [in a flare] *is also subject to the turning laws….* Hence the heavy-ship pilot cannot make a quick correction so easily; he must therefore use more accurate judgment to begin with.	
218	*The rudder does nothing in a turn that it does not also do in straight and level flight.* In *all* flying, the rudder’s essential function is the keep the airplane from yawing.	

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219	Control coordination is fundamentally a mechanical problem and can be achieved by “mechanical” flying…. Of course if you want to fly mechanically, you must understand the mechanism.	
220	The rudder…can be described as a balancing control; whenever the pilot feels off balance, he uses the rudder to restore his balance.	
	In some airplanes the turn produces a disturbance which must be counteracted by holding inside rudder.	I think this would be very airplane type-specific.
221	In all airplanes in a medium steep turn, we hold the stick to the high side against the overbanking tendency; and we could….	
222	…therefore expect…to have to hold a lot of top rudder as well, in order to counteract the adverse yaw effects of those ailerons…. In many ships you do not in fact hold such top rudder in a turn.	
	“damping” effect pf the tail fin…. Leave the rudder more or less alone and let the adverse yaw effect cancel the tail fin’s turn-slowing effect.	The fixed vertical stabilizer
	But there are airplanes that during a turn require bottom rudder…. The slower one is more likely to be of that sort. Slowness makes the radius of turn, for a given angle of bank, much shorter, and hence the curving path much curvier; this means a more pronounced sluing around of the tail and hence more “damping.” The bigger one is more likely to require bottom rudder in a turn, the fin that sits on the longer tail will be slued around more…. The one with longer tail will have the more powerful damping and hence will be more likely to require rudder….	Again, type specificity. You can visualize the aerodynamics just by looking at the airframe. It’s not the tailwheel that makes a tailwheel airplane a “rudder airplane.” It’s the comparatively slow speed of most tailwheel aircraft.
223	The student will achieve the best turn if he thinks of the rudder as a device to counteract aileron yaw and if he therefore relaxes on his rudder during those parts of the turn.	And that’s what we still teach today: coordinate turns with the rudder to compensate for adverse yaw in a turn.
224	When turns go sour…only one thing will always work—stick forward…far enough forward to relax the back pressure. As long as an airplane flies at low Angle of Attack, with the stick near the neutral position, there simply is nothing that can happen to it, short of stupidly flying into a brick wall…. An airplane with the stick near neutral will always do whatever is necessary to maintain healthy flight…. Any trouble is serious trouble when the stick is back.	For an airplane to stall, the pilot (or an autopilot) must pull back and *make* the airplane stall.
226	Sideslip has never done anybody any harm. It is an extremely safe maneuver. Loss of control is just about impossible, and even if the pilot should fail to stop the sideslip the airplane’s stability would stop it anyway.	Slips, as opposed to skids.
228	In a steep turn, the stalling speed is much higher than in straight wings-level flight. Hence all the stall warnings concerned with speed—sound of speed, feel of speed, the instrument indications of speed—are absent.	

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.

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