Highlights and Margin Notes in
Wolfgang Langewieshe's

Stick and Rudder: An Explanation of the Art of Flying
Chapter 3 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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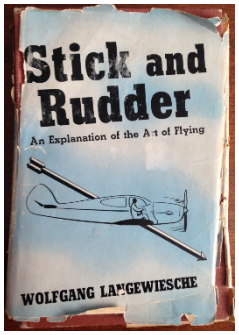
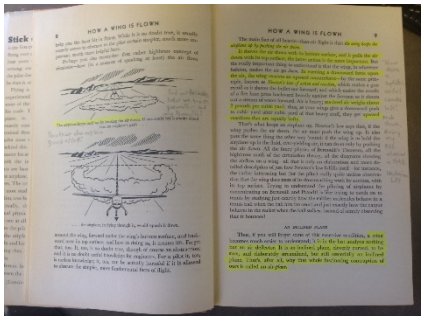
I earned my Private Pilot certificate in May 1985, shortly after purchasing a 1946 Cessna 120 that I used to build most of my experience toward my Commercial certificate. After separating from the U.S. Air Force I went to a local FBO in Boonville, Missouri part-time for about a month and earned my Instrument rating, my Commercial and my Flight Instructor certificate. About that same time I happened across a beat-up first edition/ninth printing (1944) copy of Wolfgang Langewiesche's *Stick and Rudder: An Explanation of the Art of Flying* at a yard sale for 20 cents. I bought it, took it home, and devoured its wisdom.



My marked-up and well-read copy of Stick and Rudder

See:
https://en.wikipedia.org/wiki/Wolfgang_Langewiesche
https://www.amazon.com/Stick-Rudder-Explanation-Art-Flying/dp/0070362408

Further back, an essay that has had a life-long influence on me is Dr. Mortimer Adler's "How to Mark a Book," (thank you, Mrs. Mak and your Junior English class at Kailua High School 1977-78) . Like *Stick and Rudder*, Adler's famous essay was also written in the early 1940s. So when I discovered *Stick and Rudder* quite accidentally in 1988, just five years out of college myself, I applied Adler's advice and marked the heck out of the flying techniques book—yellow-lining key points and making annotations in the margins not only to highlight what Langewiesche said, but also *what I was thinking* as I read his words.



See http://chuma.cas.usf.edu/~pinsky/mark_a_book.htm

My marked-up, well-read copy of *Stick and Rudder* has been sitting un-reviewed for many years on my home office bookshelf. I committed to re-reading and renewing this great book to review the author's wisdom, but also to see if there's anything I'd add—*or anything I've forgotten*—in my highlights and margin notes.

So, here are my notes on Wolfgang Langewiesche's essential classic: ***Stick and Rudder***:

Part I: WINGS

Chapter 3: "Lift and Buoyancy"

Page No.	Highlighted Text (Langewiesche's words)	My margin notes
45	The engineer has a clear-cut definition of lift. Lift is that component of the total air force acting on a wing which acts at right angles to the direction of flight.	
	In steady flight, the lift of an airplane is always equal to its weight.	
47	The airplane that has not quite enough lift for its weight	

	behaves like a falling stone; it goes down slowly at first, and then faster and faster, picking up *additional* downward speed every moment because gravity keeps tugging at the 500 pounds of unsupported stuff.	
47-48	As the airplane begins to sink, it finds a cushion of new lift; and what creates this cushion is the airplane's sinking! Sinking creates lift.	Actually, it's because the airplane will seek the trimmed speed (actually AoA) for which it is trimmed. As it descends it accelerates; as it accelerates it pitches upward to return to the trimmed AoA…the trimmed value of lift!
48	Sinking increases the angle of attack…the angle of attack becomes greater, more lift is made. The loss of speed has destroyed some lift; now the increase in Angle of Attack restores that lift.	What I just said, but more wordily. I think WL got it backward…speed will initially *increase*, not decrease, as the airplane descends.
	The airplane reaches a sinking speed at which the Angle of Attack is so high that the lift is again equal to its weight; again fully supported by lift. It found new equilibrium in descent.	
	The same process works the other way 'round. Whenever for any reason the airplane has more lift that it has weight, it balloons upward; it changes its own relative wind and thus reduces its own Angle of Attack. The airplane thus regains equilibrium in climbing flight.	Same note as pp. 47-48…trimmed for AoA, trimmed for lift.
49	Much of the same sequence of events happens when an airplane flies through rough air.	Turbulence = changes in AoA
	...an airplane flies into an updraft. When the upflowing air first meets the wings, the Angle of Attack becomes temporarily rather high. A tremendous surge of lift develops.	
	Motion of the airplane makes the wind of flight blow at the wing from slightly above, thus reduces the Angle of Attack. Equilibrium is restored….	
	…downdraft. When its wings first meet the downfllowing air, the resulting Angle of Attack is temporarily quite low, the lift is not enough to hold the airplane up, and the airplane sinks: but by sinking it increases its own Angle of Attack and thus restores its own lift.	Self-relieving forces. Why we hold *attitude* instead of *altitude* during a turbulence encounter.
	All the time, both in the updraft and the downdraft, the attitude of the ship was strictly level.	
50	When the wings are stalled, the equilibrium-seeking process just described will not work.	
	When a wing is stalled, an increase in Angle of Attack will not lead to more lift, but to less lift.	Not *no* lift, just *less* lift, with increased drag. A stall is not the point when lift is no longer developed, just where increasingly less lift is developed while drag increases to rise…the airplane can't climb out of the drag well with the reduced lift it generates.
	The proper definition of a stall—"a flight condition in which further increase in Angle of Attack leads to a decrease in lift."	
	That's what causes that well-known feeling, in a stall, that the bottom is dropping out from under you: the bottom *is* dropping out from under you!	
50-51	Why an airplane spins…whenever a wing dips down, it always thereby increases its own Angle of Attack. The extra Angle of Attack thus causes an extra lift; the extra lift tends to stop the wing from dipping down farther.	Lateral stability
	As soon as the wing has stopped going down, however, the whole effect disappears; it does not tend to bring the wing back up. Does not tend to restore it to normal condition.	
51	But, once the airplane is stalled, this effect reverses itself! When one wing goes down and thus increases its Angle of Attack, it thereby finds *no* cushion of new lift, but on the contrary it destroys even more of its own lift and keeps wanting to go down.	
	At the same time the other wing, in going up, reduces its Angle of Attack and may thereby actually unstall itself, gain lift, and keep wanting to go up.	Spin = asymmetric lift, one wing stalled
	The more a wing drops, the more it wants to drop.	

	That is how a stall may become a spin. Both wings are stalled. One wing dips down; by going down it stalls itself still more and thus keeps going down and thus keeps itself stalled. At the same time the other wing keeps having more lift, going up, and getting even more lift.	
52	The "flyingness" of the airplane—how far at any moment it is removed from stall or, if you cut its throttle, how far it could keep floating without a loss of altitude.	The first lightplane AoA indicators were marketed as a "lift reserve indicator"
	"Have I got too much lift?" means "Am I going to float too far across the field before she is willing to stop flying and to sit down and *stay* down?"	
	"Firmness of Sustentation"… "Have I got enough lift?" means…"Is she going to stop flying and settle out from under me before I have crossed the airport boundary fence?"	
53	Translating "lift" as "Excess speed over stalling speed."	
	Remember an airplane has no *one* stalling speed. The speed at which an airplane will stall varies with its load, with the maneuver in which it is engaged, and with air conditions.	
	"The Zoom Reserve"…a zoom is a very steep climb.	
	As it slows up, the pilot must of course increase its Angle of Attack by bringing the stick back; otherwise the zoom would level out and stop.	
	"I have lots of lift" may simply mean, then: "I have enough speed, and am flying at a low Angle of Attack, so that if I started a zoom at this moment, I could make it long and steep before I would stall."	Later generations called it "energy management"
	"I have very little lift" may mean: "I am in a flight condition which would lead to stall almost right away if I now started a zoom."	
	"Potential Excess Lift"	
54	"I have lots of lift" thus means: "I am in a condition where, simply by pulling my stick back, I could double or triple my lift force if I wanted to.:	Increasing AoA means increasing back pressure
	"I have very little lift" means: "I am in a flight condition where I could get only a feeble surge of excess lift, and a feeble upward curving of my flight path even if I now pulled my stick all the way back."	
	"I haven't any lift at all" means: "I am in a flight where, if I pulled the stick back a little farther, no additional lift would be produced, but on the contrary the wings would stall."	
	"Remoteness from the stall"…accurately, "Lowness of Angle of Attack."	
	What the pilot is concerned about is not really his lift. The very fact that his airplane is not dropping out of the air proves that he *has* lift. What he is concerned about is the Angle of Attack which gives him that lift.	
	"lost of lift" means "low Angle of Attack"	
	"very little lift" means "high Angle of Attack"	
	In normal maneuvering he wants "lots of lift". But when approaching for a three-point landing—which is really a stall brought about when the airplane is flying at 6-inch altitude above the ground—then he wants "not too much lift."	
55	Call it *buoyancy*	
	In fast flight…low Angle of Attack…the airplane has much more buoyancy than in slow flight…. In "mushing" flight the airplane has almost no buoyancy.	
	Angle of Attack is not a "theoretical" concept; it is the central thing of all flying.	

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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