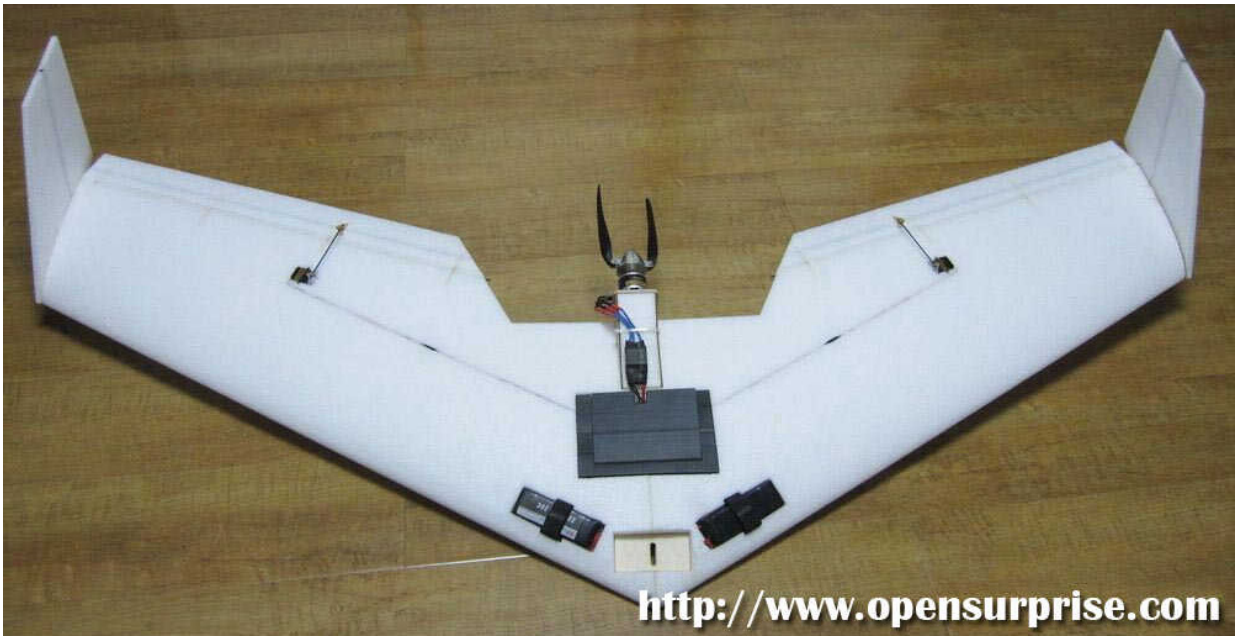
No. 334 APRIL 2014

T.W.I.T.T. NEWSLETTER



This looks like an interesting model. The source website and a series of photos that shows the construction process. Source: http://www.rcgroups.com/forums/showthread.php?t=1545112

T.W.I.T.T.
The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021

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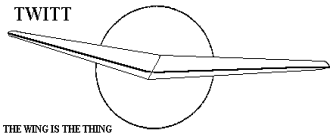

THE WING IS THE THING (T.W.I.T.T.)

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis.

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Meetings are held on the third Saturday of every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive (#1720), east side of Gillespie or Skid Row for those flying in).

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PRESIDENT'S CORNER

This is a short issue but I think you will enjoy the discussion that has developed from an earlier letter by John Gibson. I have also published this in Sailplane Builder but have not heard any further offerings to what John and Gavin are discussing. Please feel free to jump in and offer your thoughts. Don't worry about illustrations if you don't have the capability, but do express you views thoroughly so they will be understood in the context of the topic.

As you are quite aware I have recently finished my 1-26 restoration and had the opportunity to take it to the SSA Convention in Reno. Much to my surprise it showed up in a major way on page 26 (ironic, huh) of the April 2014 issue of Soaring. The editor and photographer did a heroic job in turning their convention coverage over for publication a month after the event. My thanks to them for the premium spot on the page. The next convention will be held February 18-20, 2016 in Greenville, SC, and I encourage everyone who is on the east coast or commute distance to attend and enjoy the displays along with the great series of presentations.

Not much else to report this month. As usual I can always use your input for each issue so now that flying season has returned for most of the US please send in your pictures and stories. I will say it again that this is a member driven association so without your contributions I will have to continue with more shorter versions of the newsletter depending on the amount of material.

LETTERS TO THE EDITOR

(ed. – This is a little off topic but I thought I would include it since there might be a member out there with German language skills that would be willing to take on such a project.)

Hello Andy,

I got my latest T.W.I.T.T. Newsletter yesterday (Thank You!). I'm working on a new article for a future issue (or issues), which I will get to you as soon as I write it--helping a veteran friend of mine has been occupying a lot of my time recently. I also have a question:

I know--through correspondence--Peter and Doris Strelzyk, one of the two former East German couples who escaped to West Germany in a homemade hot-air balloon in September 1979 (the 1982 Disney movie *Night Crossing* depicted their escape). They wrote a book called *Schicksall Ballonflucht: Der Lange Arm der Stasi* ("Fateful Balloon Flight: The Long Arm of the Stasi" [see: http://www.amazon.de/Schicksal-Ballonflucht-Doris-Strelzyk/dp/3886793303]), which chronicled their experiences before, during, and after their escape, including attempts by the East German secret police (the Stasi) to kidnap one of their sons and to burn Peter's electrical shop. They would like to have their book published in English, but I have been unsuccessful in finding a translator for them (I speak no German and they speak no English; I translate my letters to them and theirs to me using FreeTranslation.com www.freetranslation.com). Would there be any German-English fluent T.W.I.T.T. members interested in this? If so, it would be an easy step for the book to be POD-published (Lulu.com www.lulu.com and CreateSpace.com www.createspace.com are good choices) in English.

The citation doesn't give a page count that I can see, but its dimensions are 21.6 x 14.2 x 2.4 cm (1 inch, of course, being 2.54 cm). Whatever its page count is, the page count of the English translation would be ~1/4 to ~1/3 less, as English can express the same ideas with greater brevity than German (*without* losing any meaning). Any interested reader can contact me at blackshire@alaska.net , and I will send them the Strelzyks' postal address.

Jason Wentworth

Greetings, all:

For those whom may be interested, the "regenerative electric flight" presentation at the website below has been updated, in particular to reflect the latest technologies in DC power conversion. A further update is envisioned for the Labor Day 2014 ESA western workshop in Tehachapi, CA. Faculty, please feel free to share any or all with your students.

I look forward to seeing "regen" aircraft in flight soon, whether at model or full scale.

The "configuration aerodynamics" presentation has also been updated.

http://www.howfliesthealbatross.com/

Phil Barnes
<pelicanag@aol.com>

CONGRATULATIONS

Bruce Carmichael was presented with the OSTIV Plaque with Klemperer Award by Dan Armstrong (left) at a restaurant near his home on March 15, 2014. Bruce had been unable to travel to the SSA Convention in Reno to accept the Plaque with Award which was presented by OSTIV President, Loek Boermans and SSA Chief Operating Officer, Denise Layton. Bruce and his wife Margie were in good spirits and joined a lively conversation about both new developments in soaring technology and reminiscences about friends and events from the past. Doug Fronius, Murry Rozansky, and Dan and Janice Armstrong joined Bruce and Margie at lunch.

The OSTIV Plaque with Klemper Award honors a person for the most noteworthy scientific and/or technical contribution to soaring flight in recent years. Since 1958, the OSTIV Plaque is presented in combination with the "Klemperer Award" derived from the benefits of the "Wolfgang B. Klemperer Memorial Fund". The Klemperer Award of $500 is administered by the Soaring Society of America Trustees.

(ed. – See the picture of Dan Armstrong presenting the award to Bruce on the following page.)

Lift and Circulation

By Gavin Slater

The article by John Gibson gives an excellent overview of the researchers and the concepts they used to produce a "practical lift theory". After an introduction there is a section titled "Lift and circulation" Near the end of the first paragraph John states that"...however large the aircraft, circulation explains its lift". There follows a review of the history of the development of the theory which includes a statement of the fundamental lift theorem : "Lift per unit span = circulation strength x air density x velocity"

The second section of the article is "False lift explanations and their correction" The third entry reads as follows: "The '"Newtonian reaction"' fallacy is coupled with pushing air downwards. Testing of aerofoil in two-dimensional flow wind tunnels (on model wings spanning the tunnel to eliminate tip effects) proves that the air approaches in an upwash followed by a reversal to the original level with no net downwash". Lets look at Ref. 1 by Glauert, a classic text.

Chapter VII of Ref. 1 is "The Aerofoil in Two Dimensions". The first paragraph reads in part : "If X and Y are the components of the resultant force acting on the body , the fluid will experience an equal and opposite reaction from the surface of the body in addition to the pressure which acts normal to the bounding curve C ". The "body" is the wing. See Figure 1 (Notations on the figure reference equations in the text.) The curve "C" is arbitrary and is used for a generalized analysis. Half the lift is from momentum and half from the pressure around "C". In Chapter IV, Circulation and Vorticity, Glauert uses a similar but more detailed analysis to determine the lift on a cylinder with circulation.

Because this is from a textbook using a lot of calculus the full import is beyond a letter to the editor as well as beyond the writer. In the general mathematical analysis the lift force is divided equally between the change in momentum of the air and the pressure surrounding the air mass. Because the air passing through C has its momentum changed it seems clear that Glauert is referring to a Newtonian reaction. For an analysis directed at aircraft flight we turn to Ref.2

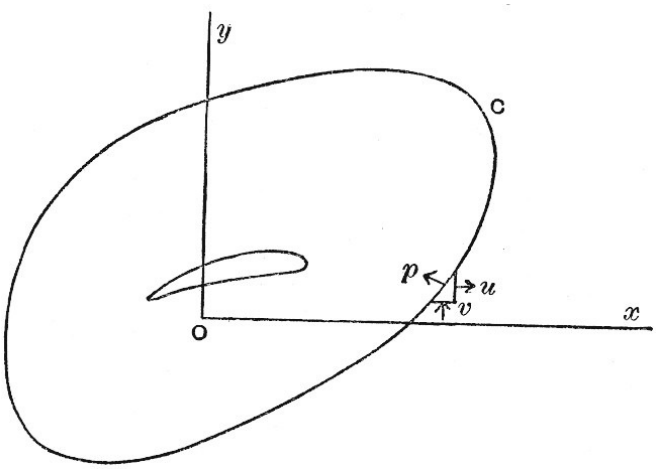

Figure 1

Section 98 of Tietjens is titled : "Derivation of the Lift Formula of Kutta-Joukowsky on the Assumption of a

Lifting Vortex". Starting near the end of the first paragraph: "It is understood that a lifting vortex is not a physical reality but that it is a very useful concept for the theory of airfoils". From the third paragraph: "It is now comparatively simple to derive the lift formula by means of the momentum theorem, whereby the shape of the integration surface employed determines which part of the total lift is caused by pressure and which part is caused by momentum.[ ]...The resulting momentum is directed downward since the velocity in front of the airfoil has an upward component which is changed to a downward component behind."

The analysis goes on to show that in the case where the wing is bounded above and/or below as when flying above the ground the lift is accounted for by the pressure portion of the integral. This is because pressure on a horizontal surface creates a force which is vertical and thus in the direction of lift.

Section 101 of Tietjens: "The Velocity Field in the Vicinity of the Airfoil". The first paragraph reads in part: "... it was seen that at a large distance in front of the wing the momentum corresponds to half the lift.[ ]. Lanchester deserves great credit for having given a physical explanation of this phenomenon as early as 1897. He based his considerations on the fact that in order to obtain a lift it is necessary to accelerate air particles downward continuously."

Viewing the downwash from a wing as a flow can give a wrong impression. The pressure of a gas is the transfer of momentum from the gas molecules to objects in contact with the gas. The atmosphere is like a spring. Deflecting it momentarily will propagate a force in the form of a net momentum of the gas molecules in the direction of the force. It is not necessary for the flow to appear like the downwash below a helicopter in a hover.

Section 108 of Tietjens: "Transfer of the Airplane Weight to the Surface of the Earth". This section presents figures and analysis to show the result depicted in Figure 2. The final section finishes (calculations omitted) : "Calculating the pressure integral over the entire surface of the earth...the lift L is completely carried by the ground in the form of increased pressure."

The same condition exists in a wind tunnel. The lift on the wing is the vertical component of the momentum transferred from the air to the wing. An equal and opposite force is transferred to the wind tunnel by the momentum transfer from the air to the tunnel.

The direct application of Newtonian laws to fluid flow resulted in the nonlinear Euler and Navier-Stokes equations.

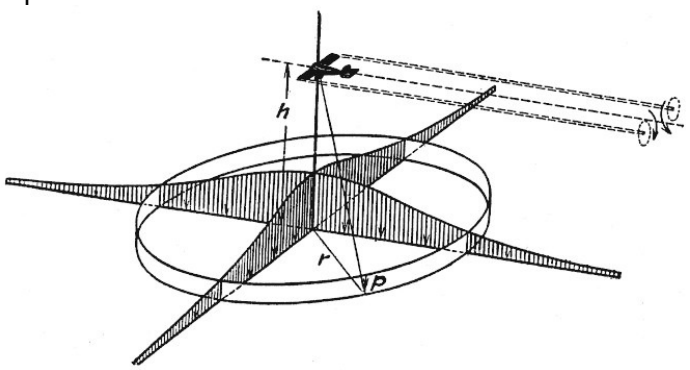

Figure 2. Transfer of airplanes weight to ground.

On May 24,2000 the Clay Mathematics Institute announced the Millennium Prize Problems. Each of seven problems was allocated a $1 million prize for a solution. One of the seven has since been solved. The Navier-Stokes equations are among the six, which remain unsolved.

The "practical lift theory" detailed in John's article resulted from superimposing linear flows which produced an analog of the actual flow around a cylinder with circulation caused by rotating the cylinder. This representation could be solved for the forces on the cylinder and then remapped to the shape of a wing. The result allowed wing lift to be represented as a function of circulation as shown by the fundamental lift theorem above. However, wing lift is not caused by circulation.

Lift on a physical wing is produced because the wing forces the air down.

References

1) The Elements of Aerofoil and Airscrew Theory, H Glauert , 2nd Ed, 1948

2) Applied Hydro- and Aeromechanics , O.G. Tietjens,1934, Based on the lectures of L. Prandtl (text reviewed by Prandtl)

(ed. – John Gibson's response to Gavin's thoughts.)

Circulation, or What?

Gavin's article shows a commendable attempt to unravel lift theory facts from fancy, but if his two conclusions are right, a century of aerodynamic research, teaching in universities and great expenditure by industry was wasted on guesswork. In fact circulation is real, measurable and creates lift, as was found in 1926 by skeptical UK scientists). My article was not my own view, but expressed unarguable facts established beyond doubt long ago. This note illustrates some physical facts about what goes on around aerofoils, to be read in conjunction with the article. (Read Ref. 1 for an excellent history of all this.)

Most people are familiar with the effects of circulation on a spinning ball departing from a simple ballistic path. Its circular shape on its own could only generate a plain drag force. It is the airflow circulating around it, dragged by viscous friction, that creates the lift force diverting its path, as Magnus knew a century and a half ago. Its existence around a wing in flight can be seen in two-dimensional flow streamlines in a wind tunnel by smoke trails as in Figure 1.

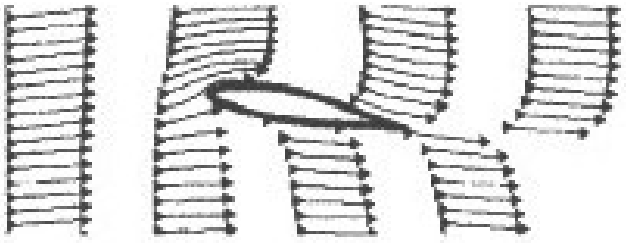

Figure 1. Streamline velocities and circulation.

It speeds up the flow over the top to a higher velocity than underneath, its influence decaying inversely with increasing distance from the surface until the streamlines are parallel where the air pressure is the undisturbed ambient. The NASA education website showing two-dimensional flow has a distant view option that extends the plots well forward and aft, far enough to see the beginning of the upwash ahead of the aerofoil and its eventual end. A straight edge placed on the start and finish of a streamline will be level, showing no net downwash. Usually a tunnel floor and roof will be too close to prevent some interference, but corrections are always applied to the measurements to correct them to true two-dimensional results.

Lanchester's 1890s stroke of genius was the idea of a wing with a span wise sheet of Helmholtz vortices each contributing to the total circulation, adding velocity to the free stream above the wing and decreasing it below combined with the streamline fluid motion theories of Euler, Bernoulli and others from the mid-1700s. The earliest aerofoil lift analysis was by Kutta in 1902 on a Lilienthal-type circular arc section carrying such a vortex sheet. Following on Lanchester's ideas, Joukowski mapped the already calculable pressures on a Magnus rotating cylinder into an aerofoil shape such as Figure 2 *(top of next page)* from about 1910 or earlier. Today it looks quite

Figure 2. Joukowski aerofoil.

normal, but it was a revolution in aerofoil design which up to then was little more than bending sticks to a curve, with a little thickness added to enclose some structure. The mapping was altered during WWI at Goettingen to provide more rear thickness, providing the greatly superior Fokker fighter aerofoil in Figure 3, seriously embarrassing UK, French and US pilots.

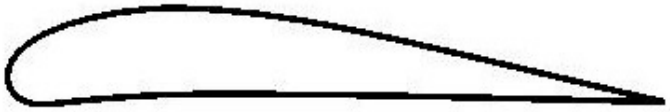

Figure 3. Goettingen profile.

Later Lanchester extended his vision to the lifting vortex remnants coming off the trailing edge along the span, reassembling into two complete trailing vortices, Figure 4 (next page).

In fact this is not completed until a few span-lengths behind the wing, Figure 5. Rotating in opposite directions, their downwards components create a non-imaginary descending flow between the tips commencing well ahead of the wing, reducing its angle of attack and its lift. The nose attitude has to be tilted up relative to the flight path to restore the lift, which angles the lift rearwards causing induced drag and a reduced vertical lift component. It also reduces the stabilizing efficiency of the tail plane, which experiences smaller angle of attack variations than the

wing. Equal quantities of air are deflected upwards outboard of the vortices' in an upwash

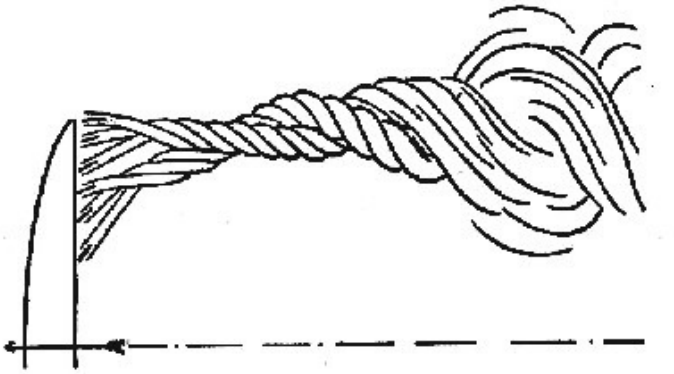

Figure 4. Lanchester's sketch of trailing vortex flow.

spreading to a distance of a span or more on each side, a fact made use of by the V-formation of some birds when on long journeys. The vortex bodies simply stream out horizontally.

Figure 5. Reassembly of trailing vortices.

Prandtl, discoverer of the boundary layer in 1904 and director of the world-leading aerodynamics research at Goettingen, was entirely familiar with this and illustrated it in his book, Ref. 2. He would certainly be startled to hear that circulation doesn't exist or has no effect on lift, or to read Gavin's quoted text about his Figure 1. The idea of equally sharing the lift between pressure and momentum effects makes no sense whatever. The streamline flows pass an aerofoil more or less horizontally with their paths already shaped by the pressure field ahead of it to flow smoothly over the surfaces without being pushed off course by momentum exchange, and on which they can exert only a pressure normal to the skin and friction drag along it. Newton's second law, expressed much more usefully in the form written by Euler as "Force equals mass times acceleration", applies a centripetal force across the flow, not along it, to curve it up or down by the pressure gradients across them, Figure 6.

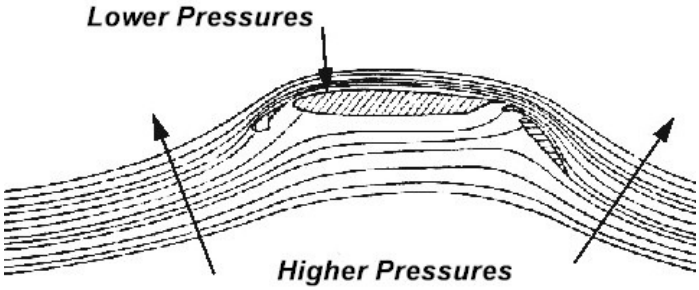

Figure 6. Streamlines at high lift.

This law is one of the three physical principles in the Euler equations of fluid flow, but the aerofoil only feels forces from the streamlines passing next to the surface. That is why lift calculations on aerofoils are interested only in these streams. The curve "C" is just an arbitrary closed line along which the circulation strength can be measured by nothing more than the line integration of the velocity times the distance along it, which has a constant total value. This proved the accuracy of the K-J lift theorem long ago.


The French environmental campaigner Christian Moullec and his geese train for this weekend's Bex airshow in Switzerland Photograph: Dominic Favre/EPA

Figure 7. Birds surfing the upwash.

No proof of the "pushing air down" hypothesis (it is not a theory") has ever been offered in a century. Its believers seem unaware of the initial upwash shown

active in Figure 7 (previous page) or why it doesn't create negative lift in the manner of the lift supposedly created by the downwash.

My article briefly describes how a combination of a viscous boundary layer and its essential separation at the sharp trailing edge starts up the circulation and then keeps it going while there is forward motion, Figure 8 shows in physical reality in a water tunnel what the streamlines would do in the absence of viscosity, simulated by a water flow rate so low that it turns the sharp trailing edge without separating, resulting in no lifting force. Figure 9 shows what actually happens with a starting vortex shed off the trailing edge and inducing the lifting vortex to start up.

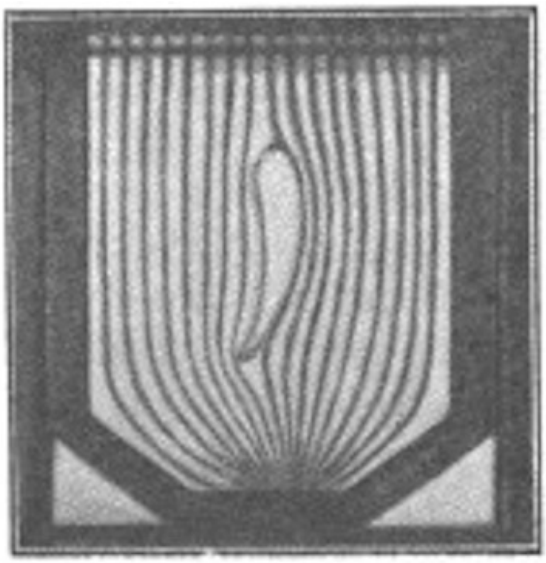

Figure 8. Simulated inviscid flow.

Leaving the air pillar in Gavin's Figure 2 to the last, it obviously cannot act as a support strut and has nothing to do with lift. Any pressure wave ejected through the undisturbed lower streamlines, but without disturbing them, travels at roughly 1000 feet per second. An aircraft at 5000 feet doing 600 knots would be a mile away at 45 degrees to it by the time the wave hit. To carry the lift it would then have to rebound back in a concentrated pillar, but would never catch up even if it could be directed to the aircraft. Since commonly a little over 100% of the lift comes from "suction" on the top surface with light suction on much of the lower surface, it is quite hard to imagine how such a strong jet force could arise anyway. Even normal ground effects are insignificant at much above a few semi-spans.

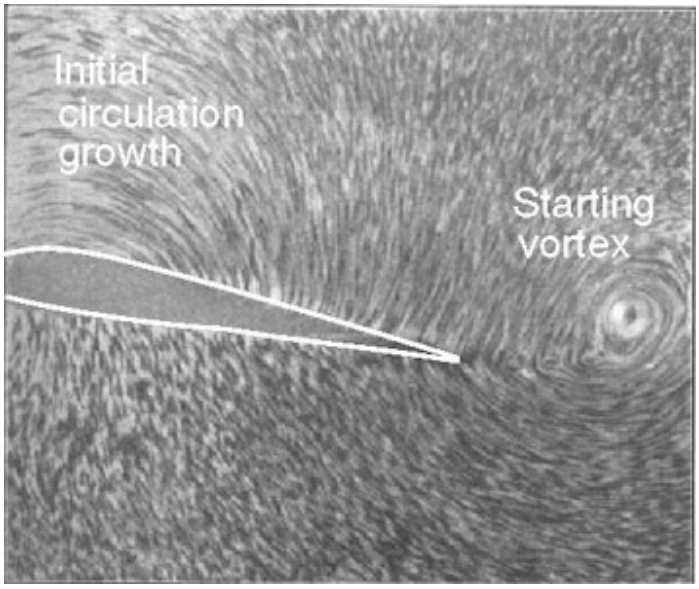

Figure 9. Circulation initiated by a starting vortex.

John Gibson, 19th March 2014

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1) A History of Aerodynamics, John D Anderson, 1997
2) The Essentials of Fluid Dynamics, L Prandtl, 1949 (English translation)

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