enough to steal the magic, anyhow. The B-24 would probably have achieved just as much fame and glory had it used a different airfoil.)

What was the secret of the Davis profile? Why did it perform so well? Because Davis had unknowingly designed one of the first laminar-flow airfoils. The shape of his airfoil, with its maximum thickness further aft than was usual at the time, delayed the development of turbulent airflow on the upper service. More laminar flow meant more lift and less drag. The untrained Davis had created something before all the engineers and researchers could. Not until the early 1940's, in the pressured research of wartime, did NACA come up with superior profiles. Once they did, the Davis airfoil vanished into history. Just two aircraft besides the B-24, a one-off flying boat and the unsuccessful B-32 bomber, ever used the Davis section. In his book, Vincenti treats the story of the Davis wing as a curiousity, an historical footnote.

But it can also be viewed as a lesson - that it is possible for a creative person to make something new or better than its predecessor. True, in this instance aerospace engineers eventually designed even better airfoils than the Davis one. And since Davis' time, sixty years of research has cultivated and harvested most of the field of aeronautics, leaving few novel ideas for an inventor to hobby-farm. But the story of the Davis wing confirms that there can be new things under the sun. Creative people have brought new technology into aviation before. Perhaps with a Paradyne or a roadable aircraft, they will again.

News and Stuff

New Executive

The new executive has been elected. They are:
President – Tim Nicholas
Vice President – John Macready
Secretary – Gerald Ohm
Program Director – Cyril Henderson
Custodian – Alex Doughty
Director – Peter Klein
Director – Tedd MacHenry

COPA AGM

The COPA national membership AGM meeting will be held in Langley next year. They are expecting 400 delegates.

New Runway at CYNJ

The new runway in Langley is pretty much ready to go, and should be available soon.

Airspace

New airspaces came into affect for 29 July 2010 as well as a outline of current changes. New charts available 19 July. Watch the Turn and Bank for more.

Regional Director Needed

A new RAAC Regional Director for BC is needed. Any nominees should be forwarded to Gary Wolf at Head office.

Airplane Pictures

Lynn Walker is working on a wall of planes. If you want your picture on the wall or have founding members' planes pictures please contact her. 8x10, 5x7, 7x8 or 4x6 frame sizes are available.

Turbi

Ray Colley and Alex Doughty are approved check pilots on the Turbi. Please see them if you want to fly. The Turbi is to be used for by members for personal use only. No istructional time permitted.
The Turbi at this time is grounded.

Enviro-guy (or gal) sought

The DAPCOM committee is looking for an Envirnomental Chairman. If you have some knowledge in this area and have a few hours to spare monthly give them a hand.

Pancake Breakfast Helpers

If you would like to help out during our pnacake breakfasts please give your name to Joan Cox, so that we may if needed. Contact her at jr_rosicox@telus.net or leave a message at 604-596-7635. The next pancake breakfast is Breakfast September 12th.

New Pilot License Reminder!

Pilots: if you have not made an application for the Aviation Booklet Licence yet you must do so before the end of the year as the old paper licence will no longer be valid in the new year and that you may not be able to exercise the privilege to fly without the new booklet form license.

TURN AND BANK

December 2010

Washers

Bill Tee

I NOW COME to the lowly washer!

Washers are simple little things usually round on the outside with a hole, usually round, on the inside although not necessarily so. Washers can also be flat, or not flat such as a Belleville [wiggly] washer or a lock washer. Lock washers are not too well accepted in the aircraft industry mainly because they have a tendency to damage the surface to which they come in contact. Also their efficiency can deteriorate with time in use. What we will deal with here is the round flat metal washer made to aircraft standards.

The washers are mainly metal [aluminum and steel] AN960 washer with a little bit of the more exotic thrown in for good measure. The aluminum alloy washers are made from 2024-T3 or T4 material and are the basic airframe washer where high strength bolts are not used or where the operating temperature does not exceed 500 degrees F. These are available in the extra light [extra thin], light [thin] and regular [thick] series. The light ones are .032 thick and the regular are .063 thick, unless less than # 10 size [3/16 dia]. Under # 10 the regular washer is .032 thick and the thin is .015. Above the #10 size the .015 washers are called 'extra light'.

Steel washers come in the same thickness range and can be made from carbon steel per MIL-S-7952 [SAE 1020 or 1025] or stainless steel per MIL-S-5059 [301 alloy] or MIL-S-6721 [321 alloy]. Although the carbon steel washers are suitably coated to make them compatible with aluminum and to delay corrosion the stainless steel washers are sometimes more desirable from a corrosion stand point. However be aware that with aluminum alloys, under the right [damp] circumstances, the stainless steel will attack the aluminum causing extreme corrosion and deterioration. This applies to nuts, bolts and screws as well as washers. A barrier [paint, etc] may be desirable between them.

Identification of AN washers is given by the '960' designation, with the following numbers and letters. In the designation such as 'AN960D10L the AN stands for Army-Navy. "960' is the washer part or type number, 10 means the washer has a hole to suit a #10-32 bolt or screw or a #10 pin. 'D' stands for aluminum alloy '-' [a dash] stands for steel 'C' stands for stainless steel [or more accurately 'Corrosion Resistant Steel {C.Re.S}] No suffix means regular thickness 'L' means light [or thin] LL means extra light [or extra thin] Another example is an AN960D416. This would translate to an Army-Navy 960 series washer of aluminum alloy with a 4/16 or 1/4 dia hole.

Hole sizes progress by 1/16ths up to maximum size e.g. a 5/16 washer is a '516', a 3/8 [6/16] is a -'616', etc on up the line. For high tensile bolts the MS2002 series washers are used. These are available in only one thickness and either regular or countersunk configuration. The countersunk ones are for use under the heads of high tensile bolts with a significant radius between the head and the shank. A sharp edge biting into this radius would greatly reduce the fatigue resisting qualities of the fastener. If sufficient material to be bolted exists the same thing can be accomplished by chamfering the edge of the hole into which the bolt is installed. The MS series and the NAS series bolts generally require this consideration. MS 2002 washers are available in steel only [1330 or 4130 alloy]. These washers start at 1/4"hole dia and go all the way up to 1-1/2" hole dia. The size is indicated by a suffix on the end of the part number in 1/16ths e.g. MS2002-4 has a 1/4 "hole dia for a 1/4" dia bolt. -5 is for 5/16-dia bolt and -6 is for a 3/8" dia bolt, etc. For a countersunk washer substitute a 'C' for the dash e.g. MS2002C4.

A prime example of the importance of using the correct washer in the right place is illustrated by an example written up in "Light Plane Maintenance". It seems that instead of using the correct and prescribed steel washer under the head of the propeller bolts, aluminum washers were used. Although the propeller bolts were torqued as required on installation of the propeller, the torque values changed [decreased] because of the crushing of the aluminum washer. [More fatigue failures of bolts are caused by under torquing than over torquing] This situation ended in the fatigue failure of the propeller bolts and the loss of the prop from the crankshaft.

The example shown here indicates the importance of adhering to the correct part for the job. A washer may seem to be an insignificant item but in critical places its correct use cannot be over emphasized. Why use a washer? Well, there are many reasons, the most important of which is probably to protect the surface of any material from the damaging effect that can be caused by contact with the rotating nut or bolt head. A washer should always be placed under whichever item that is rotated in order to tighten a threaded fastener [a screw or bolt].

Washers can also be used as spacers or sacrificial material where corrosion is apt to take place, or in order to adjust a bolt length as required in order to tighten the nut and bolt without bottoming the thread, which can be disastrous. Washers are also valuable for distributing a fastener load over a bearing area larger than the area covered by only a nut or bolt head eg an AN970 washer as used on a wood surface. Washers probably have as many uses as the imagination can invent, but the forgoing is an overview of the main functions. Happy building and great flying!

Reprinted from the July/August 2001 issue of the Recreational Flyer

The Davis Effect

By Mark Munzel

(First Published in Chapter 85's Turn & Bank Newsletter October 1998)

SEVERAL RECENT Turn & Bank articles have introduced new ideas for aircraft - not planes that already exist, but better ones. Norm Helmer has described his concept of the "Paradyne," a craft in which air is sucked away from the top of the wings to create lift. George Gregory has explained why he believes a practical roadable aircraft design is possible. The former offered a new approach to flight; the latter argued for a new attempt to realize an old idea.

It's easy for readers, especially ones with a technical background, to be naysayers, doubting that novel ideas like these can ever become reality. Surely their proponents don't think these concepts are viable? If the ideas are so promising, why hasn't someone already discovered them or made them work? Clearly the inventors are blind to major flaws in their schemes, or are trying to do something which engineers have already attempted and found impossible. Their ideas won't work.

Or will they? There is at least one precedent that suggests they could. The following tale is condensed from What Engineers Know and How They Know It, a 1990 book by Walter G. Vincenti, professor emeritus of aeronautical engineering at Stanford University. Half of the book attempts to describe engineering in the language of social scientists. The other, more readable half contains some interesting case studies from aviation history. This one can serve as an allegory for the doubters: Sometimes, the dreamers do build a better mousetrap ... or flying machine.

In the 1930's, the standard way for American aircraft designers to select an airfoil shape for a new plane was to pick one from a catalogue of sections and data produced by NACA, the National Advisory Committee on Aeronautics. (The modern equivalent of this compilation is Abbott and Von Doenhoff's "Theory of Wing Sections.") NACA scientists had created and investigated thousands of shapes, which varied in almost every characteristic of wing geometry that could be imagined.

Consolidated Aircraft in San Diego was interested in low-drag wing sections during this era. The potential applications included long-range flying boats for civil and military service. Engineers from Consolidated built models of those NACA sections that promised little drag in cruise, and tested them in a Cal Tech wind tunnel.

Enter a self-taught inventor named David R. Davis. Davis had worked for a few aircraft companies in the 1920's, but trained engineers and designers had forced people like him from the industry by the following decade. Undaunted, Davis approached Consolidated president Rueben Fleet in 1937, with a new "in" - an airfoil of his own design, claimed to be more efficient than any before it. Davis said he had developed his new section from mathematical formulae based on the fundamental rules of aerodynamics. Of course, he would only give Consolidated the equations for a price. To prove that he really had something to offer, Davis allowed Consolidated to test a model of his airfoil section. Shockingly, the Davis shape was better than any NACA profile the company had tested. On a graph of lift vs. angle of attack, Davis' airfoil had a slope 6% steeper than that of the previous best section studied at Cal Tech. At the same time, the Davis design had less drag for given lift values, and a lower drag minimum.

Davis and Fleet signed a deal: Davis got money, Consolidated got the wing formulae. Once Consolidated's engineers saw the formulae, they panicked. The formulae were based on fundamental aerodynamics only in the most tenuous way. Davis had performed a geometrical transformation of the flow of a frictionless fluid stream around a rotating cylinder (that's the Magnus effect, for the geeks the audience). There was no true relationship between this flow pattern and the ideal shape of an airfoil, but Davis was postulating one. Worse, his transformation contained two important constants. Davis had chosen the values to be +1 and -1 - not by experiment or mathematical proof, but by reasoning what the correct values might be. Davis' airfoil design was really just a wild guess at a good profile shape, created with complicated mathematics.

But it was a good profile, all the same. Absurd as they were, the formulae yielded a superior wing section for a long-range aircraft. By the time Consolidated had its new airfoil, the world was becoming a dangerous place. Before the company could build any aircraft with the new section, to see if its "real" performance matched that promised in the wind tunnel, the US Army Air Corps called. The Air Corps wanted Consolidated to help build Boeing B-17 bombers for the upcoming war. Rueben Fleet instead proposed that Consolidated produce a bomber of its own design, using the new "Davis wing" airfoil. The new plane was built as the B-24 Liberator ... and built, and built. Eventually, 18,482 B-24's were completed, more than any other US warplane before or since. They served as long-range bombers, U-Boat hunters, and transports through World War Two and after. B-24 operators included the US Army Air Force, Navy, and Coast Guard, plus the air forces of Britain, Australia, and China. Canada flew the type, too - indeed, Boundary Bay and Abbotsford were the home bases of a Liberator aircrew training school, and the "big hangar" at Boundary was built to shelter the four-engined craft.

Another user, the Indian Air Force, retired its last one from service only in 1966. Today, a few PB4Y's, single-tailed Navy derivatives of the B-24, are still flown in the US as fire bombers. (It should be noted that the B-24's success wasn't due exclusively to the Davis wing. No equivalent NACA-winged aircraft was ever built for comparison, to show whether the Davis airfoil gave the B-24 any real advantage. Mass production, rough maintenance, dents, ice, and bugs probably distorted the wing's shape

What was the secret of the Davis profile? Why did it perform so well? Because Davis had unknowingly designed one of the first laminar-flow airfoils.

RECREATIONAL AIRCRAFT ASSOCIATION OF CANADA
Vancouver Chapter 85

General Meeting
Tuesday 2 November 2010
(there were no minutes taken at the December Wine and Cheese)

Executives Attending: John Macready, Tim Nicholas, Rob Prior, Carol Foley, Gerald Ohm, Eric Munzer, Gerard Van Dijk, David Marsden. In all, 29 persons attended.
Presentation: President Tim called the meeting to order at 20:35
Visitors: None
Correspondence: Letter from MetroVancouver re: Metro Vancouver Parks Committee tour.
Treasury: Carol Foley reported the balances, and gave the Secretary a hardcopy which will be attached to the filed copy of these minutes.
Membership: David reported we have 74 members as of tonight.
Buildings: None
Vice-President: Annual general banquet Saturday March 26th, 2011. It is at the same location as last year. November 11th at 11am, there is an event at Delta for Remembrance Day.
Chapter Aircraft: The Turbi is grounded at this time. It is not generating the power it usually does after the new prop. A compression test was done and the numbers were not good. Raymond will put together information regarding the expenses for the Turbi.
DapCom: Terry has said that the November meeting will be his last. A new DAPCOM chairman is needed.
RAAC: They are still looking for a regional representative for BC. If you're interested submit your name to either the President or Secretary.
Newsletter:
Programs: Tim and Sean will be covering his trip to the Yukon.
Old Business: Tim brought information regarding the borescope. Price range was $600 to $2300. Eric Munzer motioned that the Club purchase the $2300 unit. Raymond Colley seconded. 22 for.
New Business:
none.
Adjourn: At 21:23