Journal & Proceedings of the Royal Society of New South Wales, Vol. 135, p. 1–15, 2002
ISSN 0035-9173/02/01001–15 $4.00/1

Antipodean Aeronautica

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Abstract: December 17, 2003 will mark precisely one hundred years since the first powered, controlled, sustained, heavier-than-air, human flight. A few months ago, on September 11, 2001, air travel was suddenly stopped throughout the USA. Although only a temporary grounding, the effects have been far reaching. Aviation has figured very prominently in so many aspects of life during the past century and is an appropriate subject for review. The scope of this address covers some of the aeronautical ventures in Australia during the nineteenth century. The events discussed include both the elation due to success and the all too often desolation of failure, with an emphasis on Australia and its position in relation to Europe. As the subject matter for this address has been extracted from research notes for an article proposed for 2003, the period covered will extend only to the end of 1903. For almost this entire period, aviation was really for the birds; for much of the populace, it was a joke. Several of the events I will describe exemplify the public's perception of human flight in the 1800s and beyond.

Keywords: aeronautics, Australian, Hargrave

INTRODUCTION: THE ANTIPODES

Australia – the Great South Land – the last continent to be discovered by Europeans. That place on the Globe most directly opposite Europe. Antipodes is defined as "those who dwell directly opposite to each other on the globe, so that the soles of their feet are, as it were, planted against each other" (Simpson and Weiner, 1989). Is Australia so different to Europe? Australia has often been perceived as the antipodes, in more ways than just the obvious, opposite side of the world. At least a couple of European novelists certainly wrote so.

Robert Paltock wrote about The Life and Adventures of Peter Wilkins – a Cornish man: relating particularly his shipwreck near the South Pole (Paltock 1751). During his ordeal of thirty years, Wilkins met and married a Gawrey – one of the flying people who inhabited the Antipodes. This tale was published in 1751 in England, and has been subsequently republished in Australia in 1979.

Not to be outdone by an Englishman, Nicolas Edmé Restif de la Bretonne wrote La Découverte Australe, par un homme-volant, literally, the discovery of the southern part of the globe, by a flying man (Restif 1781). This too was an adventure novel, set in the Antipodes, the southern land, Australia. Restif sent the hero flying to the other side of the world, where he came upon even more flying people. Their wings were not dissimilar to the Glumms and Gawren of Peter Wilkins, except they also had a parasol arrangement above their heads. Apparently this was another wing, and not a parachute or sunshade! Restif's novel was published in 1781, and he could very well have been influenced by the French translation of "Peter Wilkins". Weird creatures did await the Europeans, although most were found to jump, rather than fly.

Aeronautics is defined as "matters or facts pertaining to aerial navigation", or more simply, sailing the atmosphere (Simpson and Weiner 1989). In 1783 the Montgolfier brothers constructed a hot air balloon in which Francois Pilâtre de Rozier made several tethered flights. On November 21 of that year he was accompanied by Francois Laurent, Marquis d'Arlandes on what was the first human voyage through the air. They floated across Paris in a flight, which lasted 25 minutes (Mackworth-Praed 1990). It had at first been suggested that convicts should be used as the first human cargo, but de Rozier protested, believing free citizens would be more appropriate as the first aeronauts. Just five years later Captain Arthur Phillip landed at Sydney Cove with the First Fleet. European events then began to dominate Australia. Overcrowded gaols, famines and political unrest in Britain led to the creation of the colony of New South Wales.

The most visible aspect of the colony was the transposition of British convicts. Often cast into hulks on English waterways, and set to work each day, the colonial scene must have appeared antipodean – or virtually so. Although still required to work for His Majesty when arriving in the Colony, the opportunity of a Ticket of Leave, a Pardon and sometimes a grant of land provided many British "poor" with a completely new, if not voluntary start.

The sixth governor of New South Wales, His Excellency Major-General (later General) Sir Thomas Makdougall Brisbane Bt., K.C.B, K.C.H., had a keen interest in science and brought out two astronomers in 1821 to begin the local quest for scientific knowledge (Pike 1968). Twenty-two years later news arrived from England of experiments in artificial flight. Natural flight was described as the emulation of animal flight, whereas artificial flight was what we would now consider the norm, aircraft with wings fixed in position. The news from England led to local correspondents describing their various ideas on aerial navigation. Another decade and a half passed before the Australian colonials saw their first examples of aerial navigation, in 1858.

So, what could possibly be antipodean about aeronautics?

THE REALITY OF ANTIPODEAN FLIGHT

French and English rivalry did not stop with the founding of the colony of New South Wales. A French aeronaut advertised his intentions to make a balloon flight in Victoria in 1853, but nothing more appears to have been done (Argus 1853). The first successful navigation of Australian skies occurred on February 1, 1858, over the eastern suburbs of Melbourne. An airship, or balloon, named the Australasian, piloted by an Englishman, William Dean, ascended from Cremorne Gardens (Argus 1858a). Later that same year, on December 13, Dean was accompanied by C.H. Brown as they made the first balloon flight over Sydney (Argus 1858b; Sydney Morning Herald 1858). It must therefore appear strange indeed that an 1856 headstone in St Stephen's Cemetery, Newtown, should be adorned with the carving of a balloon. The headstone marks the grave of an eleven-year-old boy, Thomas Downes. He was the first Australian to die as a result of an aviation mishap, almost fourteen months before any free flight was accomplished in Australia. The inscription declares the last resting place of Thomas Downes, "who was accidentally killed in the Domain at the ascent of a balloon". A Frenchman, Pierre Maigre advertised his reputation as a balloonist, apparently gained before coming to Sydney. Upon his arrival, he had a balloon constructed locally and was keen to demonstrate his skills as an aeronaut.

The method employed for filling balloons in the nineteenth century was to raise the empty balloon by a cord attached to its apex, as shown in figure 1. That cord was attached to another cord, which was strung between two poles. The two wooden poles stood somewhere between twelve metres and twenty-one metres high, depending upon the particular newspaper reports. The poles were secured in place by several guy ropes. In Maigre's case, a fire of straw and wine spirits was lit in an iron furnace beneath the open lower part of the balloon such that the resulting hot air filled the limp envelope.

On December 15, 1856, Maigre intended to make his hot air balloon ascent from the Sydney Domain. This would have been the first ascent in the Colony. The event had been well publicised and a crowd of five thousand rose to twelve thousand by late afternoon. Once the balloon was inflated, Maigre positioned himself on the framework beneath, but the balloon failed to rise more than a few feet. The rope attached to the top of the envelope was still secured, tangled in fact. Unfortunately the time taken to release the rope also permitted the air inside the balloon to cool. No flight ensued and the crowd became unruly. Members of the public had paid to watch, and depending on their proximity to the balloon, the prices ranged from five shillings to one shilling. Maigre escaped, although his hat was destroyed (Sydney Morning Herald 1856a). The crowd burned the balloon, the large poles, seats and anything else they could find. Two young boys were injured when one of the poles came crashing down. One of those, eleven years old Thomas Downes, suffered a fatal fracture of his skull. Accusations were brought against several sailors, who had been in the crowd, but the inquest found that the would-be aeronaut, Maigre should be chastised. He had offered a balloon flight for the entertainment of the public, but failed to deliver (Sydney Morning Herald 1856b).

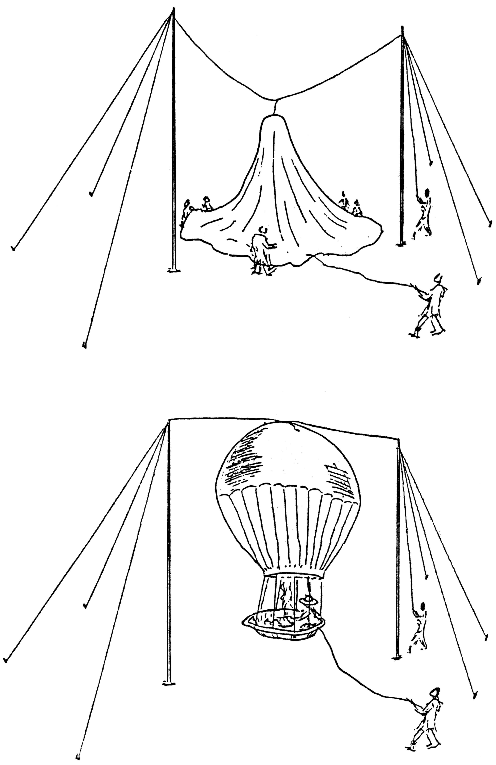

Figure 1: Author's sketch of balloon being inflated.

INSURER'S NIGHTMARE

The Australasian balloon was purchased by Messrs Green and Brown towards the end of 1858, from George Coppin. Coppin was the Manager of Melbourne's Theatre Royal and had imported the balloon from England. The balloon's envelope was twelve metres in diameter, constructed with varnished fabric and had a capacity of 878 000 litres of gas. In Sydney, on Monday April 18, 1859 it ascended from an open space down from the General Post Office (GPO), behind the premises of Abraham Polack, between George and Pitt Streets. This balloon was inflated with coal gas, not hot air. The gas was provided by the Australian Gas Light Company (Sydney Morning Herald 1859a; Argus 1859).

The aeronauts were William Green and Alfred William Wardell, both visitors from England. Green was a nephew of Charles Green, one of the famous aeronauts of the nineteenth century. A number of pilot balloons were released during the afternoon. They remained visible for quite a while and kept the crowd interested, as well as showing the aeronauts their likely aerial path. The balloon and its passengers began to ascend at 5 minutes past 5 o'clock in the afternoon and at first travelled westward. The balloon then drifted towards the east, but began to descend rapidly and landed in the yard of the Woolpack Inn. John Boyd's Woolpack Inn was situated on the eastern side of George Street, next to Campbell Street, in the Haymarket (Sands 1859).

Green had been cautious about their movement eastward, and tried to land in a paddock near Haymarket. That attempt was unsuccessful, but they had lowered the safety line, which was caught by four helpers in the Woolpack yard. The aeronauts considered that yard unsuitable for emptying the balloon of its gas and called to their earthbound assistants to let the line go. All their pleading was to no avail. Green still wanted to go up again and land in the paddock he had earlier selected, and persuaded Wardell to disembark. However, the balloon was now quite definitely on the ground and not going anywhere else. Wardell then began the process of deflating the balloon.

As Wardell began to open the valve to release the gas, he was overcome by the fumes, which had escaped through a 1.2 metre long rent in the balloon's envelope. He was carried, half fainting to an adjoining shed. The crowds gathered around the balloon and into the yard through a narrow gateway. They also sat on the roofs of the sheds surrounding the yard. Large amounts of gas from the tear and the open valve soon filled the air.

Things then suddenly took a turn for the worse. A spectator sitting on the roof of one of the sheds along George Street side of the yard, struck a match, or lucifer, and threw it into the yard below. Whether he intended mischief, or was just mindlessly amusing himself had not been determined. The resulting series of explosions caused numerous burns and other injuries as the frenzied crowd tried to escape. One witness described the flames as "flying fiery serpent"s (Sydney Morning Herald, 1859a). Some escaped into Durand's Alley (which no longer exists), while others scrambled over the stables into George Street. The police and firemen were in attendance and had done an amazing job of maintaining a semblance of order. After the explosion that task of keeping order was virtually impossible.

Those sitting on the roofs of the sheds were first to be burnt, although none of the reports identified the culprit as being one of those so injured. Several small children were trampled under foot and five or six were taken to the nearby medical doctor. Although about a dozen people were injured to varying degrees, amazingly none of their wounds were mortal. William Green had invested heavily in this balloon, which had been secured in the middle of the yard by a few courageous men. The flames were all around and eventually the carriage of the balloon caught alight. Then they realized they could not save the balloon, even though the envelope had been purposely cut open to expedite the release of the gas. The balloon quickly disappeared in an enormous final explosion.

With all of the damage and injuries from the explosions, it would have been appropriate to set up a collection of some description. Such a benefit was offered by the management of the Prince of Wales Theatre, where Green had been expected to make an address about the balloon ascent. Other important people in Sydney discussed the possibilities of raising a subscription. The Australian Gas Light Company agreed to remit the costs associated with filling the balloon. The twist in this story was that the benefits were all directed towards Green and Brown, who had lost their balloon! A pity about the poor burnt wretches and those injured in the rush to escape the explosions.

Green wrote a letter to the newspaper, offering thanks to the citizens of Sydney for their great kindness before and after the ascension. He was, however, rather critical of the great number of people who viewed the proceedings from free vantage points around the GPO. For "a small fee others watched the ascension, while residents of wealth and position mingled with those unpaying poor"! (Sydney Morning Herald 1859b).

A GOOD IDEA

One of the earlier, local residents who became interested in aeronautics was William Bland. He had been asked by Francis Forbes to investigate the possible theft of an airship design. Forbes had written several letters to Sydney newspapers in 1843 about his proposed airship (Sydney Morning Herald 1843). He made a model, but failed to take it any further, before discovering someone in England had proposed a similar airship. Forbes had disclosed his ideas to friends, but still thought he had the exclusive rights to the use of those ideas. Bland was a friend and Forbes asked him to look into the matter during a visit to England. The author is not aware of the results of Bland's enquiries. He did, however, bring his own aeronautical design to public notice, following the germination of the idea in March, 1851. Drawings were created and dispatched to a professional engineer friend in England one month later. In 1852 he exhibited a model of his Atmotic Ship at the Crystal Palace in London. It was displayed at the Paris Universal Exhibition, in 1855. This craft was to be a large semi-rigid airship, inflated with hydrogen. It was to be powered by a steam engine, driving four bladed propellers at each end of the airship. Bland referred to these propellers as "windsails" and described them by their direction of action as "propellents" and "repellents" (The Empire 1860). We now use the terms "pusher" and "tractor". "Tractor" is the configuration of most modern light aircraft, with the propeller in front.

HARGRAVE

"Theft of ideas" was a concept that later concerned Lawrence Hargrave, and this subject will be discussed a little later. His is a name that looms large in Australia's aeronautical history. Hargrave's interests were much wider than just aeronautics, but this Address shall only touch upon some of his aeronautical work. Hargrave's very first recorded interest in aeronautics was a sketch of an airship, which was drawn about 1872. The second idea for a flying machine was produced soon thereafter, but it was not until 1884 that he presented his first paper before the Royal Society of New South Wales (Hargrave 1884a).

Hargrave proposed a theory of natural flight. Observations of worms, fish and birds provided the basis for what he called the trochoided plane theory. His first attempt at constructing a flying machine along the lines of his trochoided plane theory, was successful in 1884. The machine featured a large, flat flight surface, with slight dihedral and a smaller, diamond shaped wing in front, as depicted in figure 2. Between those two wings, Hargrave positioned a couple of flappers, which provided the forward thrust (Hargrave 1884a).

In a 1909 issue of the London Illustrated News, two photographs appeared of the latest French experiments on aerial torpedoes. The close up photograph of the aerial torpedo showed it to be almost an exact replica of Hargrave's 1884 model! This was intended to be launched at enemy balloons, and included a blade in place of the Hargrave foreplane (diamond shaped wing), which would tear the balloon and send it crashing down (London Illustrated News 1909).

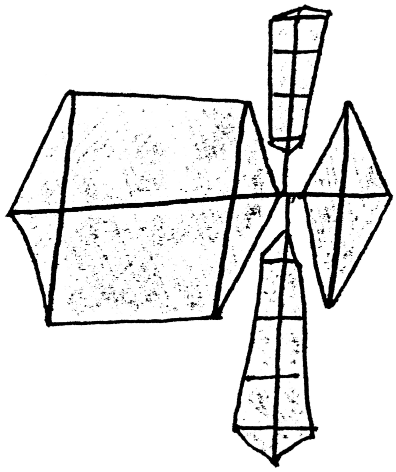

Figure 2: Plan view of Hargrave's 1884 flapping machine (Hargrave, 1884b, reproduced courtesy of the Powerhouse Museum, Sydney).

Hargrave never really let go of this trochoided theory and it stopped his progression in aerodynamics to some extent. Figure 3 depicts Hargrave's 1884 model of a spring powered, mechanical worm. However, it should now be of interest to know that animal locomotion is again being researched. One of those new areas of research involves the creation of a synthetic Lamprey, or eel-like animal. During the 1990s this "creature" was being developed by Joseph Ayers, at the Marine Science Center, Northeastern University, Boston, USA (Adams 1998). Proteus the Penguin Boat has been developed in America at the Massachusetts Institute of Technology (MIT) to demonstrate fish type propulsion. Rather than the now familiar propeller, this vessel was propelled through the water by the action of two foils. The foils were positioned at the stern (rear) of the boat, not unlike twin rudders. They were capable of side-to-side flapping as well as twisting motions, which were synchronized through computer control to obtain the best propulsion. Professor Michael Triantafyllou and James Czarnowski originally developed Robo Tuna in the early 1990s during their study of fish propulsion. (Triantafyllou 1995; Baker 1997).

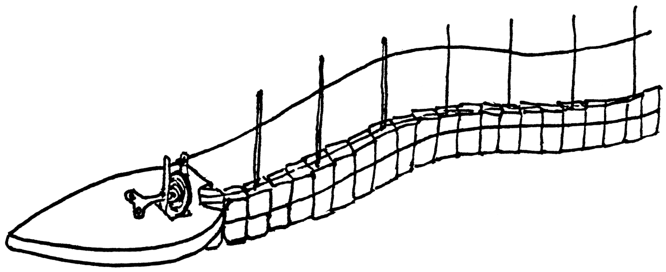

Figure 3: Spring powered, mechanical worm (Hargrave 1884b, reproduced courtesy of the Powerhouse Museum, Sydney).

More recent work at MIT has included experiments with robotic fish, powered by real muscles. Microprocessor controlled electric signals to frog muscles positioned along each side of the artificial fish were alternately contracted and then relaxed. The resultant side-to-side flapping motion of the fish tail provided forward thrust. One of the benefits is virtually silent, efficient propulsion. (Samuel 2001).

Another area of investigation involves shape memory alloys in place of muscles. Work is progressing at Texas A & M University, but accurate comparison against propeller-driven vehicles will apparently have to wait for 2003. Such comparison between the two methods of propulsion are too complex, until an untethered version of the fish-mimicking propulsor can be constructed (Graham-Rowe 2001).

Hargrave's first successes were achieved with model aircraft, driven variously by propellers and flapping wings. By 1887 he had designed a man-powered ornithopter. He conducted a series of tests to determine the lift and drag on a flat surface, moving through the air at different speeds and angles of incidence. The equipment he used for these tests was called a whirling arm. It would have looked something like a modern rotary clothesline, but with only one or two outstretched arms. At the end of one of those arms he placed a flat plate, measuring 0.3 m by 0.3 m. An arrangement of rope, pulleys and lead weights turned the arms at various, adjustable speeds. He designed and built a clever instrument for measuring and recording the forces on that plate as it was moved through the air (Hargrave 1887). The results could have been of more use to Hargrave, but he failed to complete sufficient tests on the flat plate. He also did not test any curved surfaces on the whirling arm, which may have been of greater value than the experiments he did perform with candles and silk tufts (Craddock 1994). The candles and silk tuft experiments merely showed the existence of a vortex beneath the curved surface.

Probably his greatest fame was achieved through kite flying. During 1893 he began to develop the box kite.

Two events in 1894 confirmed Hargrave's importance. In May and June he constructed a full sized glider after hearing about the work of Otto Lilienthal in Germany. Hargrave made several attempts to fly his glider at Stanwell Park. At forty-three years of age he decided that it was more important to maintain life and limb intact, than for him to achieve flight. The hang glider was too light and unwieldy, although he thought it too heavy, at about twenty-two kilograms (Hargrave 1894).

AN ANTIPODEAN BASIS FOR EUROPEAN AIRCRAFT

The other event of 1894 set Hargrave firmly on the world stage of aeronautical history, although today it appears trifling. On November 12, 1894 he succeeded in leaving the ground, beneath a train of four box kites. A flight to 4.9 m above the sand on Stanwell Beach demonstrated the suitability of his box kite structure for stable flight. The box kite became the norm for aircraft structures in France and England during the first decade of powered flight. Members of the Lawrence Hargrave Centenary Committee attempted a repeat of this event in 1994 at Stanwell Beach, but the winds did not achieve the necessary velocity to lift more than the kites alone.

Hargrave detailed the aims of the kite lift experiment at Stanwell Beach, in a letter to Henry C. Russell, Government Astronomer at the Sydney Observatory. Hargrave had previously borrowed a hand anemometer from Russell and was again in need of one for these experiments. "If I can get the velocity of the wind and the head resistance I shall know what thrust my engine would have to give in order that I might let go C and transform my kite into a flying machine" (Hargrave 1894). The reference "C", was the attachment of his tether on the beach, as shown in figure 4.

ANTIPODEAN POWER

Hargrave also developed the rotary engine. In such engines, the crank shaft remains stationary, while the cylinders rotate. Even now, the idea of stationary crankshaft and rotating cylinders seems antipodean. This was a good idea, and according to Shaw (Shaw and Ruhen 1988 p. 179), quite original. Hargrave provided the details of his rotary radial engine by way of an address to the Royal Society of New South Wales, on August 7, 1889 (Shaw and Ruhen 1988, p. 188). The Seguin Brothers in France later devised a similar engine, the Gnome, which became the standard for many aircraft in World War One.

The area of increasing interest to Hargrave during the 1890s, was "soaring" kites.

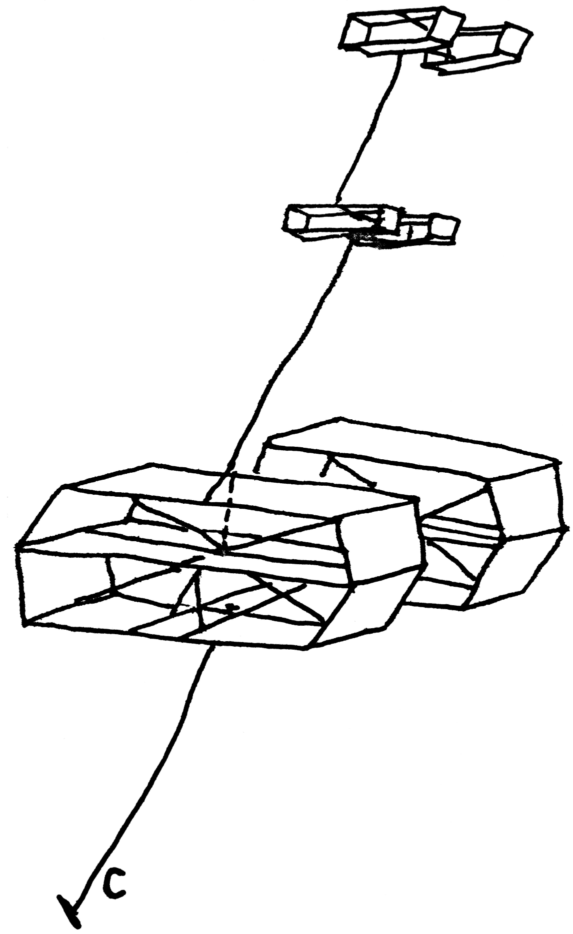

Figure 4: Sketch of proposed kite lift (Hargrave 1894, reproduced courtesy of the Powerhouse Museum, Sydney).

SOMETHING FOR NOTHING

Humans have always pondered the wonder of bird flight. So much so, that inventors have tried to replicate "natural flight" in a number of ways. Firstly, by trying to copy the flapping motion of their wings – this is an ongoing journey, even to this day. However, "as far as practical applications go, flapping flight has few at present – a fact that appears to bother none of the team members" (Chandler 2002). The quest for human powered, natural flight continues. The second way was to try and understand the concept of "soaring", as ably demonstrated by eagles, vultures and the albatross. This concept was not understood for quite a while, but since those early times we have learned more about the passage of wings through the atmosphere. Figure 5 shows the relative gliding performance for several examples of flying machines, from the simple hang glider to the modern, high performance sailplane. The latter, like its animal world equivalent (the eagle) seems able to defy gravity. Indeed, that was how some of these creatures were seen to perform by early aeronautical experimenters.

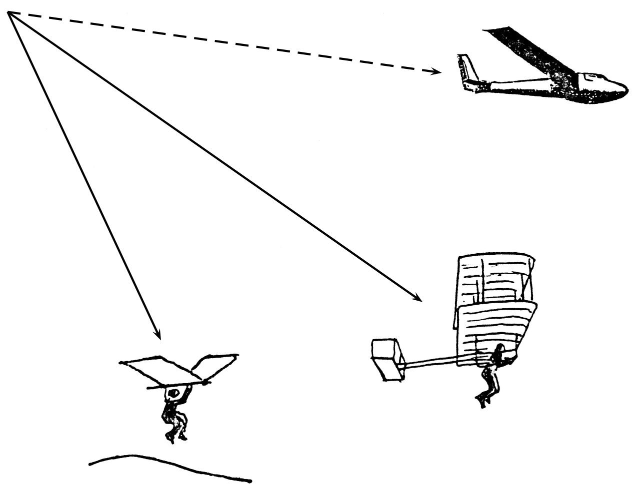

Figure 5: Author's diagram showing gliding performance of various aircraft.

They termed the concept "soaring" or "aspiration" to describe the apparently amazing ability of these birds to maintain or even gain altitude from a wind that blew horizontally. The reality is, as shown in figure 5, that unpowered aircraft all act under the force of gravity, but at rates dependent on their aerodynamic efficiency. So, the ability to "soar" depends somewhat on the shape of the wing, but predominantly on the existence of an upward component of the wind.

Hargrave thought he had found the secret of soaring flight during the 1890s and developed a number of experiments to demonstrate that. He observed a rotating region of air beneath a cambered (or curved) wing. Hargrave believed (wrongly) that forward thrust was provided through the action of that vortex upon the undersurface of the wing. Imagine driving along in an open top sports car, with the resultant wind rushing past the windscreen, and then curling around and apparently blowing back towards the rear (or your side) of the screen. That is what Hargrave saw, and believed that that wind was actually pushing the wing (or sports car) forward. We now understand something more about drag and fluid mechanics, but Hargrave's thesis and "experiments" were unfortunately confirmed for him. His idea was genuinely antipodean, and caused him to suffer derision from America in particular. What he had proposed, and claimed to have proved experimentally, was in direct conflict with the laws of physics. Others correctly stated that there had to be some vertical component of wind to sustain such soaring flight. Of some more recent interest was an American experiment on an

F106B, Delta Dart aircraft, to utilize the vortex identified by Hargrave. The experiments were part of a study into the use of a movable leading edge flap instead of camber, to reduce transonic drag. The flap would be deflected to its greatest downward extent upon touch-down, at which time the "Hargrave" vortex would appear and increase drag, reduce lift and help slow the aircraft (Flight 1985).

Hargrave's soaring kites were created to demonstrate that such wings could make headway into the wind. The arguments that followed Hargrave's claim about these kites, were about whether the wind was really blowing in a perfectly horizontal direction. Hargrave was wrong in his assumption, and he effectively wasted time and effort with these kites. They are however very interesting.

These kites were flown, dangling from a cord stretched between two poles stuck in the sand. The poles were made from oregon, 41 mm in diameter and 7.3 m high. They were spaced 14.6 m apart and held in position by guy ropes. This arrangement is shown in figure 6 and provided a perfectly safe environment for testing delicate kites.

After so many balloon flights in Europe, it appears somewhat strange to see that only Australia (and perhaps Ireland) maintains an ongoing use for those tall poles – Australian Rules Football. The Irish have included a cross-bar for Gaelic Football.

Development of the so-called "soaring" kites occupied a good deal of Hargrave's time during the 1890s. He produced an alphabetic series of such kites, from A to Q. Some of the wing profiles or aerofoils ("aerocurves", as described by Hargrave) are shown in figure 7. The work he did with these kites was published and distributed around the world by way of the Journal of the Royal Society of New South Wales (Shaw 1988, p. 188). Undoubtedly the Wright Brothers had access to this material by way of Octave Chanute and the Smithsonian Library. It is interesting to compare some of the aerofoils employed in the Wright's aircraft with those of Hargrave, although some of the more interesting aerofoils were not considered so by Hargrave, and consequently not included in his published material. The Wrights did their own experimentation and development, because they found they could not trust some of the material provided by other experimenters.

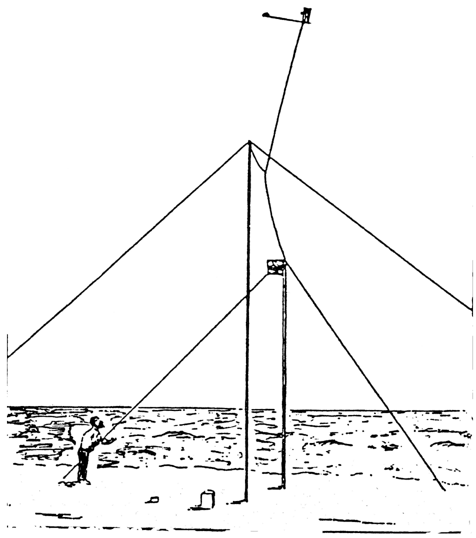

Figure 6: Testing apparatus for soaring kites (Hargrave 1897).

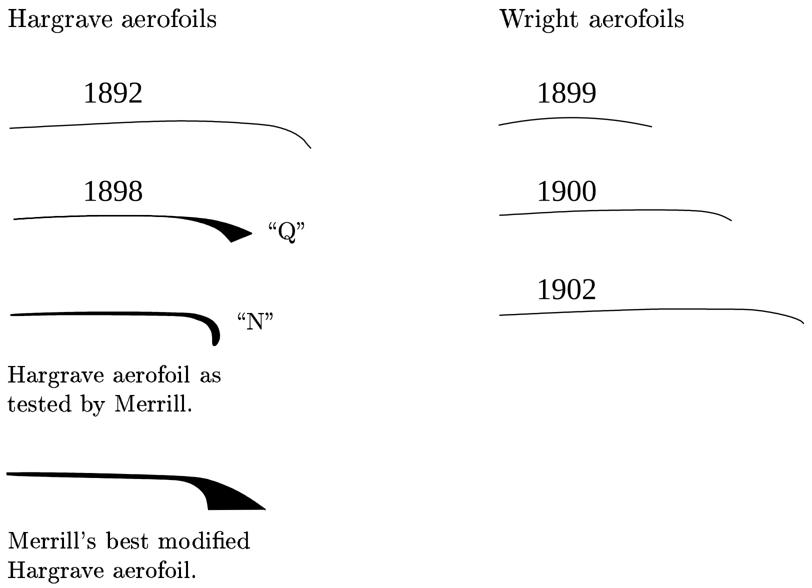

Figure 7: Author's interpretation of several Hargrave and Wright aerofoils.

PARAGLIDERS AND PARAMOTORS

Charles Gibbs-Smith described Hargrave as not really an aeronaut, but rather "chauffeur driven" (Gibbs-Smith 1985) in his works towards the conquest of the air. That statement was at first intriguing, as Gibbs-Smith described chauffeurs as those in pursuit of lift and thrust, regarding "the flying machine as a winged automobile, to be driven into the air by brute force of engine and propeller." The author now suspects that Gibbs-Smith was correct in describing Hargrave as "chauffeur driven". Hargrave's work with kites and their necessary subservience to the vagaries of the atmosphere went a long way to forming his "chauffeur driven" attitude.

After the publication of his successes with soaring kites M and N, an American newspaper published a sketch of an enlarged version of one of the kites, with a human cargo (Hargrave 1898). Hargrave sketched in 1899 another contraption that clearly showed where he was leading (Hargrave 1899). After the success of the 1894 tests with the train of four box-kites at Stanwell Beach, he proposed that similar arrangements of kites could be used for powered flight. The sketch is reproduced in figure 8, with only the bare details shown. He kept this concept in mind for another dozen years. Two photographs of a model he constructed to demonstrate this idea were published in 1911 (Daily Telegraph 1911). This later model featured a single box-kite, flexibly joined to a very simple structure containing pilot, engine and tricycle undercarriage. Although the 1911 model incorporated a rigid lifting surface, there is certainly a strong influence on the modern paramotor. Hargrave's idea went to sleep for eighty years!

The modern paramotor utilizes a parachute instead of the box-kite, or even a soaring kite, but the concept is Hargravian.

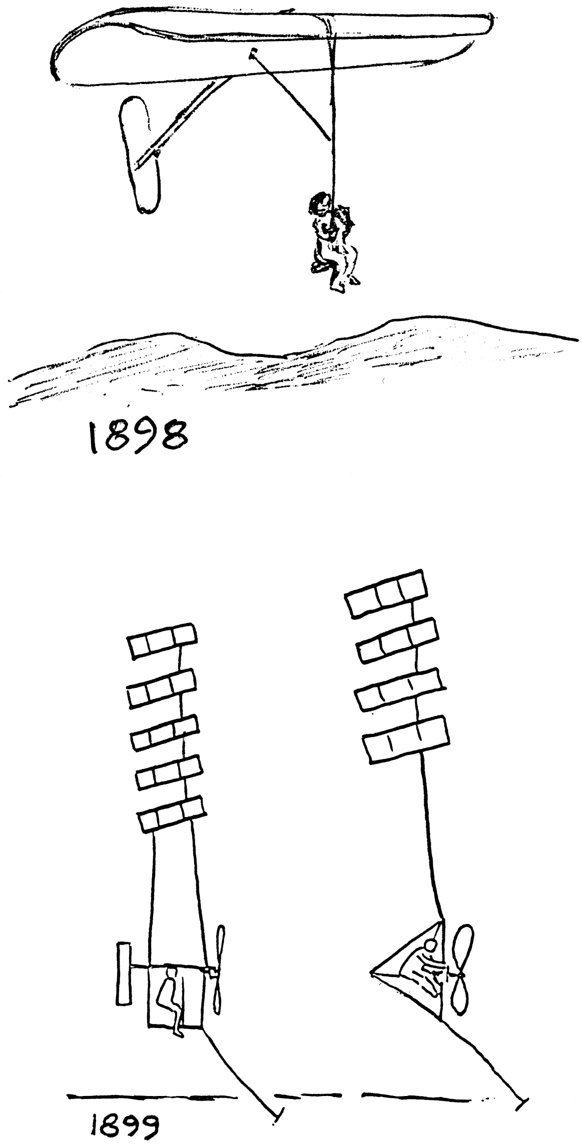

Figure 8: Hargrave's paramotors (Author's sketches, based on Hargrave soaring kite, 1898 and Hargrave's notebook entry, 1899, reproduced courtesy of the Powerhouse Museum, Sydney).

PATENTS

Returning to the earlier subject of theft of ideas, Hargrave's name is often remembered in the context of patents. On several occasions he sought the opinion of Norman Selfe, who was a well-respected engineer in Sydney. The opinions sought by Hargrave concerned the patentability of some of his ideas. Selfe was generally supportive, but Hargrave never took up any patent. He considered that inventors invent and they should be permitted to continue to do so. Patents put a hold on invention and stop the exchange of ideas. Two other prominent Australian aeronautical pioneers, Henry Sutton and later, George Augustine Taylor expressed similar thoughts. It was through Hargrave's annoyance with the patent system, that he reported the findings of his research in the Journal of the Royal Society of New South Wales. Once a patentable idea had been published or demonstrated in public, there was no opportunity for another person to patent that idea. Hargrave wanted other researchers to take his ideas and use them to discover the secret of flight. Yes, he wanted to fly, himself, but he was even more interested in someone succeeding. What an antipodean idea!

The first two Australians to be published in the Journal of the Aeronautical Society of Great Britain, were Henry Sutton and Charles Whittell. Sutton was born at Ballarat, Victoria on September 3, 1856. One of six children, he was keen to learn and by the age of fourteen had read all of the scientific books in the well-stocked Ballarat Mechanics' Institute. He made observations of the flutter of insect wings against smoked glass, which culminated in his theory of bird flight. He was a gifted inventor, who designed and built telephones less than one year after Alexander Graham Bell. He shunned patents, because he wanted to "benefit fellow workers in science" (Nairn 1976). He was acclaimed as one of the best lecturers at Ballarat School of Mines, where he taught electricity and applied magnetism, in the 1880s. Sutton took up the quest to discover the secret of flight and presented his results in "On the Flight of Birds and Aerial Navigation" and "Second paper on the Flight of Birds" both published in the Annual Report of the Aeronautical Society of Great Britain in 1878 (Sutton 1878). The Aeronautical Society of Great Britain is now the Royal Aeronautical Society.

Henry Sutton's first paper described his concept for a flying machine, based partly on animal locomotion and a simple kite. The machine was to be driven by a propeller and "lifted" by two sets of paddles. These paddles were supposed to oscillate around the vertical shaft protruding above the upper wing. The individual panels of those paddles were set at forty-five degrees to the horizontal, and were supposed to provide lift, just like a kite. I do not believe he got any further with this concept. Sutton's second paper was about bird flight.

Hargrave's anti-patent comments appear to have been revived in the latter years of the twentieth century. Amazingly, the basis for the first "open source" consumer product, came from someone in the computer business. Richard Stallman left MIT in 1984 to set up the Free Software Foundation. His concern was with commercial software companies and their use of patents and copyright to maintain their source codes as secrets. Stallman believed such actions "choked off the free flow of ideas." In almost Hargravian terms, "if computer scientists could no longer learn from one another's code, the art of programming would stagnate" (Lawton 2002)

The first example of "open source" is OpenCola, which was created as "a promotional tool to explain open source software." The instructions for making this cola drink are freely available, unlike those better known examples. "Anybody can make the drink, and anyone can modify and improve on the recipe as long as they, too, release their recipe into the public domain." Hargrave believed that inventors cannot help themselves, they just want to invent. In the more recent example of software creation, "the kudos of a successful contribution is its own reward" (Lawton 2002).

THE FUTURE ANNOUNCED

As I have shown with Hargrave's inventions, a number of ideas appear well before their time. However, identifying future trends or inventions is not simple. The Illustrated Sydney News published an article in 1891, describing the writer's concept of flight one hundred years' hence. "This is truly a wonderful age, this year 1991. When one contemplates the vast strides made during the last hundred years, and sees the dreams of our forefathers actually realized – the masterpieces of art and invention, the discoveries in science, and, above all, the genius that has subdued and brought into practical use that limitless power, electricity – it appears to the ordinary mind that perfection has been attained, and that human ingenuity can go no further. And then, when we read of the customs and inventions of the people of the 19^{th} century, of their cumbersome methods of locomotion on land and sea, and their crude attempts to navigate the air, it is difficult to imagine how they could have found life, with all its troubles and inconveniences, more than bearable" (Illustrated Sydney News 1891). The picture accompanying this article, featured a craft with highly tapered, fabric covered wings which appeared capable of flapping. The fuselage was streamlined and a small cabin was located on the top. There was the hint of a propeller at the very tail of this craft, and the picture was set above Sydney. The artist had drawn a bridge across the Harbour, and a large statue on Fort Denison, but there were no high buildings, only chimneys.

The "dreamer" described speeding through the air at 150 miles per hour at an altitude of 1 000 feet. He only woke from the dream when confronted with the thought of a mid-air collision between two such flying machines. From this it appears that prophecy is very difficult. These speeds and altitudes were reached before and during World War One, less than thirty years after the article was published. The most accurate part of the dream appears to have been the horror of mid-air collisions!

One Sydney resident, who decided to do more than merely dream was N. R. Gordon. He designed and built a steam powered, flapping wing flying machine during 1894 (Daily Telegraph 1894). This craft was taken to the cliffs above Chowder Bay, in Sydney Harbour. A set of tram tracks was laid to assist with the take-off. Gordon appeared to have been coerced into the position of attempting flight well before he was really ready, but everything went ahead. After a number of hours spent in preparation and building up steam pressure, Gordon decided to test the craft without a pilot. Just as well he made that decision, as the craft rolled along the tracks, over the edge and flapped to pieces on the beach below (Sydney Morning Herald 1894).

AUSTRALIA'S ANTIPODEAN ATTITUDE

The centenary of Lawrence Hargrave's famous kite lift experiment at Stanwell Beach was celebrated in 1994. A re-enactment of the tethered flight was attempted, but the hoped-for southerly failed to materialize. The wind was not the least of disappointments that year, as the Australian Treasury removed Lawrence Hargrave's image from the $20 banknote!

ANTARCTIC CONCLUSION

As some of my earlier remarks mentioned some imaginary adventures in the Antarctic, it is appropriate to conclude with a quote from that same place, almost exactly one century ago. This is a quotation from one of Captain Robert F. Scott's expeditions to the Antarctic, when in February, 1902 they inflated and flew a captive balloon. The hydrogen-filled balloon was named Eva, and had been manufactured at the R.E. Balloon Factory, Aldershot, by women under the supervision of Colonel Templer. R.W. Skelton, engineer on the expedition, wrote "It would perhaps be rash to say anything about the future of ballooning in polar regions, for when we once more reach civilization, we may find flying machines en route for the poles" (Skelton 1907).

Perhaps no flying machines were on their way to the poles, but it was not long before December 17, 1903 and the success of Orville Wright.

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(Manuscript received 30.4.2002)