Human Powered Aircraft
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Dr Brooks brought a personal involvement in Human Powered Aircraft (HPA) to present what was more of a 'masterclass' than a mere lecture. He supplemented information (highlighted here in **red**) with YouTube videos (go to the bottom of this document for links) and during the evening passed around the audience examples of HPA hardware which exhibited many of the technical properties essential for modern designs. The evening's programme charted progress achieved, described influencing developments, and presented a very encouraging picture of the challenges on offer. His personal involvement clearly focused on encouraging the continuing expansion of the sport.

He began with a review anchored in ancient interest, citing the myths of Daedalus and Icarus, and the much later practical studies of Leonardo Da Vinci. He attested the first human assisted aircraft to fly was in the 1930s, and attributed it to German aeronautical science pioneers Lippisch and Villinger. In 1948 a technical paper published in the UK (B. Worley, Can man fly? Aeronautics, February, 1948) determined the feasibility of human powered flight, and its conclusions promoted the creation of the RAeS Man Powered Aircraft Group in 1957. Consequential to this, a challenge was proposed by Henry Kremer, an industrialist, who put up a substantial prize for the first aircraft to perform a figure of eight mile around 2 pylons ½ mile apart. This incentive led to the first authenticated flight from flat land, and purely under human pilot power, by **SUMPAC** (Southampton University Man Powered Aircraft) on 9 November, 1961. It was flown by Derek Piggott at Lasham, Hants.

The Kremer prize was won, eventually, by Paul MacCready's Gossamer Condor team in 1977. They used a radical concept compared to forerunners, by building an ultra-light airframe using wire bracing, a very large wing area and flying very slowly. He also incorporated reverse wing warping (to alleviate spiral divergence in turns), and used a foreplane for overall pitch and roll control. Following the initial success, a new Kremer Prize was offered, for an aircraft that successfully crossed the English Channel. Against expectation that this would challenge designers for many years, MacCready's Gossamer Albatross flew from the UK to France barely two years later (in 1979).

Progress has been sustained since then, and by 1988 human-powered aircraft had been built which, with a top class athlete/pilot, would fly at 30mph and cover 78 miles or attain 3 hours endurance. This led to more prizes being sponsored by Kremer (and as previously, these are administered by the RAeS Human Powered Flight Group):

- The Marathon prize (£50,000) - complete 26 miles in 1 hr (using a prescribed course)
- The Sports prize (£100,000) – calls for a flight (in both directions, and in a minimum wind speed) around a 1.5km triangular course, within a certain time.

At the present time, over a decade after being introduced, the prizes are unclaimed.

HPA flying had been most spectacularly celebrated in the annual **Birdman** competition at Lake Biwa, in Japan. The presenter's link (below) to a YouTube film of a competitor attaining over 18km was spectacular. He choose also to showcase the efforts of the Canadian **AeroVelo** team (led by Todd Reichardt) with videos too of the vast four-rotor **Atlas machine** winning the long standing Sikorsky helicopter prize, and his unique flexible-wing **ornithopter** as it completed a human sustained flight (although it needed an assisted take-off).

UK progress has been considerable, albeit not record-breaking, with applications encouraged by competitions addressing simpler goals that can be fulfilled on small aerodromes. He attributed the

2012 UK Olympics, and the 50th anniversary of the first authenticated human powered flight (in November 2011) to have stimulated this new approach, and to have succeeded in attracting teams to multi-disciplinary flying competitions.

The 50th anniversary was celebrated by bringing **Airglow** (built in 1990) out of storage. It was restored and test flown by two pilots, one of them being the speaker, and the aircraft proved much more practical to operate than had been expected.

Airglow (UK HPA) at Lasham 2012

(Photograph copyright Fred To)

The main stimulus so far in the UK has been the RAeS-organised Icarus Cup in 2012 and 2013. Rules drafted by the RAeS have since been adopted by the FAI and the BHPFC (British Human Powered Flying Club) was created in 2014 to run flying competitions and develop the activity as a sport. The RAeS group continues to administer the Kremer prizes and to provide technical support, meanwhile the BHPFC has organised competitions in 2014 and 2015. The major UK HPA designs were reviewed and explained in his presentation:

Bath University entered a machine in the 2012 event at Lasham, but wing torsional failure caused its retirement. It was well received overall however, as it exemplified innovation. The design used servo-operated controls, and a simple and effective fuselage frame.

Southampton University's HPA (SUHPA), also a student project, was designed to meet Kremer sports competition requirements. It incorporates a bike, thus has a driven wheel for take-off, and the cruise power level requires an athlete rather than a pilot. The aircraft was tested with a remote pilot in a following car, using radio/servo-operated aircraft controls.

John Edgely (designer of the Edgely Optica) and his team have flown the **EA12** canard design, which is controlled by a rocking and pitching foreplane. It was flight tested using auxiliary electric power, and thus not eligible for HPA competitions, but John has now designed the all-HPA **Aerocycle**, which took part in the 2015 Lasham BHPFC contest.

Betterfly is a HPA built over 7 years by David Barford, a McLaren employee whose carbon-fibre expertise has led to a lightweight, large wing, aircraft with a modest power requirement. It uses a sidestick elevator/rudder controller with cable runs, and is proving intuitive and easy to fly. It also has a large diameter wheel for grass operation.

Human powered flight competitions are now taking place all over the world, often including university projects, and he highlighted one sponsored by the **Korean government** where a dozen or more machines lined up. He predicted an international FAI world human powered flight contest in the next 4 years, and expressed the belief that a human powered flight Olympic event would take place within his lifetime.

Committee member Barry Jacobson, himself familiar with HPA activities, commented on the breadth and quality of coverage, and the speaker's enthusiasm and expertise. It was a summing up that received warm support from the 120 attendees at the meeting.

Lecture notes by Mike Hirst

The presenter suggested these web-site references:

http://www.humanpoweredflying.propdesigner.co.uk/
http://www.bhpfc.org.uk/
http://aerosociety.com/About-Us/specgroups/Human-Powered/Downloads

These are the YouTube videos links used in the presentation:

The first authenticated HPA flight. Derek Piggott flying the Southampton University Man Powered Aircraft (**SUMPAC**) at Lasham. (9 November, 1961).

http://www.youtube.com/watch?v=f6M9K98So0o

Cool Thrust CT-2.2 RockHopper in the 29th Japanese **Birdman** Rally at Lake Biwa. Flew over 18 km piloted by Sosuke Tanaka. (July 2005).

www.youtube.com/watch?v=8AKTw-u19w0

University of Toronto Snowbird team's Human-Powered **Ornithopter** attained a world first on this outing by sustaining both altitude and airspeed for 19.3 secs. (2 August, 2010)

https://www.youtube.com/watch?v=DM9GJ3JOJv0

AeroVelo's huge Atlas Human-Powered Helicopter captured the AHS Sikorsky Prize with a flight duration of 64.1 secs: altitude achieved 3.3 metres – inside a large building. (13 June, 2013)

https://www.youtube.com/watch?v=syJq10EQkog

Airglow (built in 1990) being test flown (9 November, 2011)

https://www.youtube.com/watch?v=eRyyKQQtYqg

EA12 – John Edgely's original HPA with electric power augmentation

https://www.youtube.com/watch?v=HyRpZP-KJco

EA12 re-designed as the **Aerocycle** in 2015 Lasham BHPFC contest

https://www.youtube.com/watch?v=syWVQzImKuA

Korean government sponsored competition (2013)

https://www.youtube.com/watch?v=TGpFMg-wzwg

Japanese team "F" flying a 1.5km triangle at 27mph (22 October, 2012) – split screen with on-board and external cameras and presenting real-time telemetry data

https://www.youtube.com/watch?v=pYQHvfdJckA