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Editorial

The new season has got off to a good start with the lecture on Eugenic Darwins and the very illuminating public lecture by Professor Siveter on Virtual Fossils.
It is sometimes easy to complain about the apparent decline in interest in science and engineering in schools. However the article by Michael McEllin shows what can be achieved given commitment and support.

Members

We welcome the following members who have joined the Society since the previous Bulletin: Derek Pitt, Andy Buchan, Ken Wade, Chris Maddock, Christine Maddock, Theo Aaron, Keith Armstrong, Michael Lewis, Sylvia Hemmings and Heather Gent

Forthcoming Events

The National Science and Engineering week in 2013 will be on 15 -24 March when the theme will be “Inventions and Discoveries”. The aim is to shine the spotlight each March on how the sciences, technology, engineering and maths relate to our everyday lives, and helps to inspire the next generation of scientists and engineers with fun and participative events and activities.
At the same time the “Big Bang Fair” - the largest celebration of science, technology, engineering and maths for young people, takes place at the Excel from 14 – 17 March.

News/Comments

Meanwhile the Literature Festival closed the Cheltenham festival season and whilst there was very serious little science, there was at least a very entertaining session with Ben Miller talking about the ten most spectacular things in science that everyone needs to know as chosen for his book “It’s not Rocket Science”. The Music festival included four events exploring the science of what it takes for the human body to sing or play a musical instrument whilst the Science event covered its usual wide range of topics: several sessions relating to climate change/environmental issues and a number of health/age related topics including depression and the depressed brain, aging and dementia.

Visit Reports

‘Tank Museum’ at Bovington

Date 25th July 2012

This was joint visit by the Cirencester Science and Technology Society, the Hankerton History Group and The Fairford Classic Car Club.

Transport to the museum was by coach from Cirencester. We were welcomed by the visits coordinator who introduced us to Roger who was to be our guide. Roger gave us several options as to what we wished to see. The group chose the development and history of the Tank. The tour started by examining the criteria which governed the design as seen by the ‘Landship Committee in 1914. The bulk of the committee were naval officers and inevitably the first design followed the experience they had in relation to a sea-going ship. Weight did not matter, but armour and firepower did. Personnel needed in present day terms seemed very excessive when 8 or 9 members of crew were necessary to operate all the features, however this was the way the Navy did it.

Roger took us through initial ideas and the testing grounds and finally to the first battle on the Somme in the First World War. Whilst many tanks broke down the effect was salutary on the German Forces, but the ground although initially won was lost again due to lack of follow up on the part of the infantry. The idea of a tank was seen to be a success and rapid development soon took place.

The first tank was named ‘Little Willie’ as a jibe at the Kaiser. This was followed by a family of tanks of similar design until the famous ‘Liberty’ tank near the end of WW1

Clearly most tank innovation takes place during wars although many ideas for armoured cars and general transport based on the tank came in the interwar period.

WW2 brought many new designs including the German Tiger series and the museum has the only one in the world which is in working order. This was captured in Tunisia. Also featured is a Panzer which has also seen battle service.

Allied forces are represented by tanks from every country which took part: USA, Canada and of course the UK. Churchill, Sherman, Matilda, Pershing, Paton are all there.

Post-war and current designs are there: Chieftain, Centurion, the American M60, and the Russian T72, amongst many others.

We were treated to a live demonstration of the early and current tanks in an arena with a mock battle. The Centurion was particularly impressive with its stabilised gun platform.

This is a ‘World Class’ museum with very sophisticated presentation and well worth a further visit.

Bunny Lee-Smith

Challenging the Next Generation of Engineers

Michael McEllin, EDF Energy

Two years ago my fourteen-year old daughter arrived home from school one day and announced to her stunned parents that she intended to build a micro-light aircraft – and fly in it. On further investigation it turned out that a consortium of secondary schools in Stroud, Gloucestershire, led by Marling School [1] had won a bid in the “Build-A-Plane” project, managed by the Royal Aeronautical Society [2] and sponsored by Boeing. The remit was clear: the students had to do as much as possible by themselves. The older students (year 12/13) would also manage the project, including recruiting team members, reporting to sponsors, doing publicity and, ultimately, marketing and selling the plane. However, “engineers” would be recruited from practically the whole age-range of the schools involved – and the inclusion of girls in the project was a specific aim. Even for those who could not join up as active members, the high-profile and exciting nature of the project would advertise the challenge of real engineering to the rest of the student community. And – oh yes – the project team wanted to hear from parents with relevant engineering experience, who could act as mentors and supervise “build-sessions”. Would I be interested? I most certainly would!

My own company, EDF Energy, like many major engineering employers (including Boeing), has been concerned for some time that the supply of good engineering graduates would not be adequate to meet its future requirements. We therefore encourage employees to get involved with the Government-sponsored Science-Technology-Engineering-Mathematics (or “STEM”) Ambassador Scheme [3].

Unfortunately, potential engineers (and scientists) seem to be lost fairly early in their school careers. Few get to hear very much about engineering as a career unless they have relatives in the profession. My own experience as a STEM ambassador confirms this: Gloucestershire and Avon have a high concentration of high-tech companies, particularly in aerospace and nuclear, but in some of my school visits I find relatively little awareness that many of the best-paid local jobs are in engineering. These days, most children make choices about GCSEs at the age of fourteen that will strongly constrain their future education and career choices – and in some cases STEM options are closed down.

The STEM Ambassador scheme aims to fix some of these problems by facilitating contacts between schools and professional engineers, scientists and mathematicians. The schools can enrich their pupils’ learning experiences with a breath of the real world: demonstrating the relevance of what they are teaching. The ambassadors show the pupils that real STEM careers are much more varied and interesting than they or some of their teachers ever realised, and we can all have some fun along the way. Teachers give consistent feedback that our visits are remembered and discussed – and perhaps one or two seeds are planted in fertile minds.

I therefore had little problem in getting the agreement of my employer for regular early departures from work to help supervise after-school build-sessions. Substantial material support has also been given by other local organisations, including sponsorship by local engineering companies for purchase of aeronautical-standard tools, and the provision of hangar space and Web hosting at a nearby gliding club. In addition, a local aircraft repairer, Roger Targett [4], agreed to give his time as the registered independent inspector required by the Light Aircraft Association (which certifies home-builds as airworthy).

The micro-light kit itself (a “RANS Coyote S6 S2”) had been well selected for the purpose, having a traditional 3-axis design based on metal framework structure. (That is to say, it looks like a smaller, two-seat version of the common light-aircraft structural layout.) This provides many opportunities to learn basic practical engineering techniques – lots of challenge, but nothing beyond the capabilities of the confident and competent amateur builder. (Critical welds – such as those around the cockpit cage – had already been performed by the supplier.) We did, fortunately, have the benefit of a school technician, Nick Summers, who had previously maintained Phantoms for the RAF and could also provide supervision continuity across all build sessions, along with two other volunteer mentors who had each celebrated their retirements from professional careers by building kit-planes. My own practical experience, as a former sailplane owner and pilot, was less impressive, though it had included annual “certificate of airworthiness” maintenance. However, a violin-making hobby meant that I was very used to handling tools in high-precision work on expensive and delicate materials, and I hope that my professional involvement in safety engineering allowed me to communicate appropriate attitudes. Training sessions in the school’s Design and Technology rooms got everyone competent in the basic aeronautical metal-working skills, though much of the real training was “on-the-job” – i.e. demonstrate the task, then do it, at first under very close supervision.

It is, nevertheless, frankly, all a bit daunting when you open the large kit boxes. Where on Earth do you start? You follow the instructions, of course, and begin with the simple things. Much of the construction work involves straightforward techniques, such as drilling and riveting. The students quickly learn, however, the utmost importance of drilling cleanly in the right place, cutting to exactly the right length, and taking care not to leave the slightest notch from which a crack might grow. They also learn how to protect against corrosion caused by incompatible metal contacts. Measurements are checked and cross-checked before taking irreversible actions and at the end of every session each student describes and signs personally in the construction manual for the work that they have performed.

In spite of this, a few construction errors were made, in some cases because we were a little too quick to believe we had fully understood the instructions. However, we identified and corrected our own mistakes. After the frame was completed the independent inspector commented on the “high standard of construction” when giving the sign-off for covering the structure. There has never been any compromise on structural integrity, but, inevitably, there are a few areas where not being quite sure how to get a tricky job right first time means that one or two things would be done differently and better next time. We hope the experience has given students the opportunity to pick up the self-critical attitudes important to anyone doing safety-related work.

In fact, it became clear early on that simply interpreting the plans and instructions is no easy task, involving the application of much engineering common sense. Hence, it is not unusual to find that a good part of a typical two-hour build session is taken up with discussions between mentors and students about correct interpretation of the plans, or consideration of the precise implications and activities required to “Rivet part A to part B”. Occasionally, when we identified clear inconsistencies or possible errors, we decided that a reference back to the supplier was essential before drilling or cutting. (On a very few occasions we discovered later that we had misinterpreted the instructions and corrections had to be made.) This was an important learning point: everyone had to maintain a questioning attitude, because the plans and the instructions, even when technically correct, may still mislead the unwary or overconfident. Like most aircraft designs, ours had been through a number of phases of modification, and the kit had optional variations. Reconciling the parts in hand, the correct revision of the plans, and the instruction manual

was sometimes challenging. In other cases, we could discuss why the design had to be the way it was. At times we were able to conclude that a little more design foresight might have made it easier to put together.

There remain design-choices traditionally left to the home-builder. This includes some aspects of instrument panel layout. Although the kit supplies an adequate set of instruments to operate the aircraft (and the panel is cut to take the altimeter, airspeed indicator and “turn-and-slip” indicator where they have the best visibility) the positioning of other instruments and switches is to some extent a matter of preference, and will be influenced by intentions for fitting additional options such as radios and GPS navigation. Hours were therefore spent discussing panel layouts. What might we or future owners wish to add? Where are the sight-lines for the most important instruments and switches? How do we keep the compass sufficiently far away from the steel in the cockpit cage? Where do we put the master switch? (It has to be easily accessible to both occupants in an emergency, but not so accessible that you might accidentally switch it off. One of the mentors recounted how, while relieving himself into a bottle during a long flight in a small cockpit over difficult landing country, his trouser bottom flipped off the master switch unnoticed, leading to a short period of *severe* pilot distraction after the radio and all the electrically powered instruments on the panel went dead. Fortunately, engine electrics are on a different circuit. You have to think of the improbable and even downright embarrassing scenarios!)

So how have they done? The original challenge from the sponsors was to construct the aircraft within a year. In retrospect, that was impracticable – two years is more reasonable. One of the great learning points for the students was that project plans rarely play out the way you expect. For some, early enthusiasms inevitably waned and the Friday build-session had to be dropped. In addition, one of the schools in the original consortium had to pull out of the project when it failed to recruit the critical mass into their build-team. Hence, we delivered fewer working hours per week than originally expected. The withdrawal also meant that the fuselage team suddenly found that they needed to take on the building of one of the wings. The schedule had to slip, but on the other hand some of the keenest students enjoyed seeing a different aspect of the construction. The harsh winter conditions of 2010/11 meant that our almost unheated hangar on a high Cotswold airfield became too cold, so we had to pause while a disused classroom was converted into a workshop. Though warm, it was too small to attach the wings, so in Spring 2011 it was back to a larger hangar, which also proved to be unusable through the coldest parts of the 2011/12 winter. That location had to be vacated before work could restart, so we were again searching for new workshop space. A local company offered us a home conveniently close to the schools, but unfortunately not with such easy access to a runway for flight testing. Finding an operational base is the next project challenge.

Publicity is also part of the deal with the sponsors. In 2011 and 2012, for example, we took the aircraft to the Fairford Royal International Air Tattoo, where groups of students presented their work to a knowledgeable and, I think, impressed public. Look out for us and other schools on the Challenge at future air-shows. We have also featured in the South West regional TV news. Our own web site and photo gallery [5] records some of the project history.

About sixty pupils have been involved at various times, and a hard-core of committed students stepped up to all the challenges, for example, by giving recruiting talks about Build-A-Plane to fellow pupils in order to keep the team up-to-strength, and doing very long days at weekends on display stands. Some of these core project members are now

seriously considering engineering as a career, and in my opinion will be very attractive candidates for future employers.

As of September 2012, the plane is now virtually complete. Unfortunately, some minor technical hitches – including a supplied part that did not fit – meant that we could finish so everything had to go on hold for the summer vacation and we could not start flight testing as hoped.

What happens now? We fly it! (This is now expected in autumn 2012.) After flight testing, all those involved will have their chance to try out the passenger's seat, then the plane will be sold and the proceeds used to fund another Build-A-Plane project team. (Six kits are currently in construction in the UK [6] and there is a waiting list. We understand from Boeing that there is now considerable interest in extending the Challenge to other countries, including Australia and the USA.) In my opinion, Boeing and the Royal Aeronautical Society are to be congratulated for their imagination in setting up this inspiring scheme. Some of the students have found a vocation, and even those who do not become engineers will have learned important practical and 'people' skills that will be of great value to them and to their future employers. On a personal basis, it has been a lot of fun, and I have been very impressed with what the students are able to achieve, given the right support. My own daughter, who has stayed with the project throughout, will always be proud of the claim she intends to make that the first time she flew, it was in an aircraft that she had helped to construct herself.

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1. http://www.marling.gloucs.sch.uk, accessed 1/5/2012.
2. http://aerosociety.com/Careers-Education/buildaplane, accessed 1/5/2012.
3. http://www.stemnet.org.uk, accessed
4. http://www.targettaviation.co.uk/, accessed 1/5/2012.
5. http://www.buildaplanestroud.com, accessed 1/5/2012
6. http://www.boeing.co.uk/ViewContent.do?id=41663, accessed 1/5/2012.

Tailpiece

The Ig Nobel Prizes honour achievements that first make people laugh, and then make them think. The prizes are intended to celebrate the unusual, honour the imaginative — and spur people's interest in science, medicine, and technology. Every year, in a gala ceremony in Harvard's Sanders Theatre 1200 splendidly eccentric spectators watch the winners step forward to accept their Prizes. These are physically handed out by genuinely bemused actual Nobel Laureates.

The 2012 Ig Nobel Prize Winners were:

Phycology Prize – A Erland, R Zwaan and Guadalupe for their study "Leaning to the Left Makes the Eiffel Tower Seem Smaller".
Peace Prize – SKN Company (Russia) for converting old Russian ammunition into diamonds.

Acoustics Prize – K Kurihara and K Tsukada for creating the "Speachjammer" – a machine that disrupts a person's speech by making them hear their own spoken words at a very slight delay.

Neuroscience Prize – C Bennett, A B Miller and G Wolford for demonstrating that brain researchers, by using complicated instruments and simple statistics can see meaningful brain activity anywhere – even in a dead salmon.

Chemistry Prize – Pettersson and Rwanda for solving the puzzle of why in certain house in the Swedish town of Andersloy people's hair turned green.

Literature Prize – The US Government General Accounting Office for issuing a report about reports that recommends the preparation of a report about reports about reports.

Physics Prize – J Keller, R Goldstein, P Warren and R Ball for calculating the balance of forces that shape and move the hair in a human ponytail.
Fluid Dynamics Prize – R Krechetnikov and H Mayer for studying the dynamics of liquid-sloshing to learn what happens when a person walks while carrying a cup of coffee.

Anatomy Prize – F de Waal and J Pokorny for discovering that chimpanzees can identify other individual chimpanzees from seeing photographs of their rear ends.

Medicine Prize – E Ben-Soussan and M Antonietti for advising doctors who perform colonoscopies how to minimize the chance that their patients will explode.