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Newsletter

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AGM and President's Lecture: Rocks from Space – Can we survive their arrival? by Dr Andrew Graham at the Institution of Civil Engineers, 30th January 2017

The AGM started with apologies including those from our Patron Professor Lord Mair and François Lureau and Sandrine Monfort from IESF Paris. After reports from the outgoing President, Edmund Morgan-Warren, Honorary Treasurer Simon Greenway, and Honorary Secretary John Beck, the President's badge was passed to Dr Andrew Graham who had spent many years doing research on meteorites before becoming a chemistry teacher later in his career.

Drs Andrew Graham & Edmund Morgan-Warren

Andrew's Presidential Address reviewed records of meteorites that landed on the Earth, analysis of their chemical composition and their impact craters, together with assessments of craters on the Moon and information from rocks recovered during the Apollo landings.

Meteorites come from the region of space occupied by the inner planets, principally from the asteroid belt, between the orbits of Mars and Jupiter. Early records of meteorite falls include one in 1492 near Ensisheim in south east France and a carbon containing meteorite (Orgueil) in 1864 north of Toulouse.

Meteor crater in Arizona

Notable craters on the Earth include the "Meteor Crater" or "Barringer Crater" found in Arizona in late 19C which is 1.2km (0.75 miles) wide and 180m (600 feet) deep. Borings 300m (1,000 feet) deep found only crushed rock beneath it, implying that the impact energy to produce a crate of this size would cause the impactor, an iron meteorite, to vaporise almost totally.

Chemical analysis shows that some meteorites are composed of an iron/nickel alloy, which models the composition of the core of the Earth. Stony meteorites consist of silicates similar to those in terrestrial rocks. The surface of recovered meteorites shows the effect of severe heating and ablation of the outer surface caused by frictional heating during passage through the earth's atmosphere. Despite this the interior is unaffected and truly reflects the original structure formed at the assembly of the material 4.6 billion years ago. Hence the study of meteorites provides significant information about the formation and history of the inner solar system.

Comets were thought to be the original source of terrestrial water. However, analysis by the unmanned craft Rosetta/Philae of the deuterium to hydrogen ratio (D/H) of the water ice of comet P/67 showed it to be very different from the D/H ratio of terrestrial water.

Andrew concluded his talk with four observations:

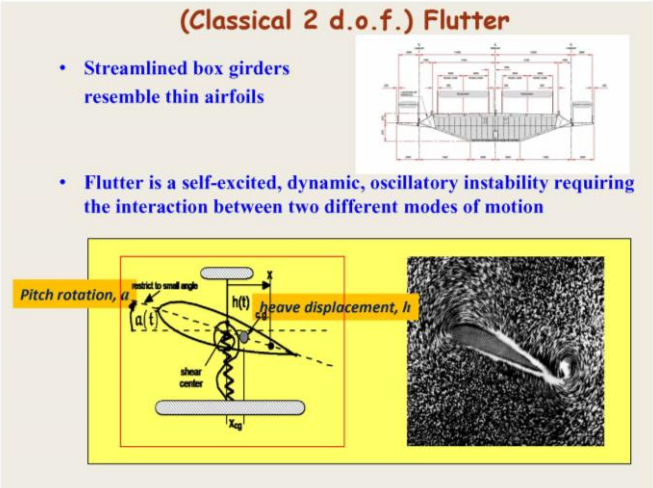
1) Earth was formed 4.6 billion years ago
2) Carbon in meteorites is not of biological origin
3) Comets are not the source of terrestrial water
4) The chance of being hit by a meteorite is extremely remote.

A vote of thanks was given by Jean Venables.

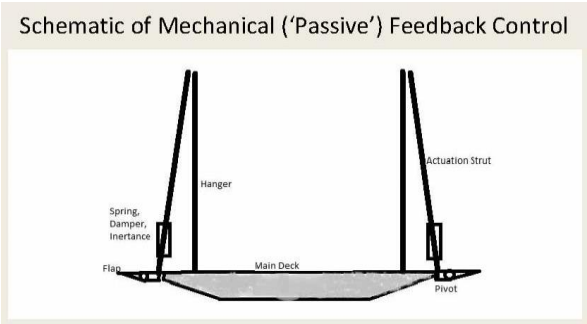
Long span bridges: aerodynamic instability, buffeting and control– Lecture by Professor Michael Graham & dinner at the Caledonian Club, 28th February 2017

Professor Michael Graham was introduced by our President, Dr Andrew Graham, as having joined Imperial College in 1990 as Professor of 'Unsteady Aerodynamics'. Was this, we wondered, the technical jargon for a 'bad hair day'? But the two were not related. Nor were the Grahams. We were treated to a scholarly summary of the story so far on long span 'intelligent bridge' design.

'Divergence' leads to the bridge deck as a whole overturning, a statical effect. 'Flutter' describes dynamic instability, in which 'heave' (up/down) and 'pitching' (twist) occur. Long span bridges need deck cross-sections which have low drag characteristics to reduce divergence. Aerofoil shapes, such aeroplane wings, achieve this but come at a price: heave is generated, and, where eccentric to the torsional centre of the deck, pitching is added. Aeroplane wings have trailing flaps, hydraulically controlled. If such active measures are fitted to bridge decks, supplemented by leading flaps, unwanted heaving and pitching vibrations can be brought under control.



We were shown video clips of the problem, as exemplified by the collapse of the Tacoma Narrows Bridge, and of possible solutions, at least at wind tunnel level, using active flaps. Bridge designers are not prepared to rely on active mechanical devices for the stability of long span bridges once constructed; only during construction (and then apparently only across *La Manche*). Passive devices offering negative feedback control over the flaps are gaining in popularity and are being further researched, using the classic forms of springs and dampers and a new device, the 'inertor' (a small high speed flywheel).



The theory that 'lift' was generated by higher air speed over the top of the aerofoil was neatly punctured: air parted at the leading edge did not emerge simultaneously

at the trailing edge. Five questions were comprehensively answered and the vote of thanks by Grahame Barwell was warmly acclaimed by the appreciative audience.

Brian Bell

President's Day 5th April 2017 – Visit to Manchester – Science & Art

Dr Andrew Graham greeted 34 members and guests, many arriving at Manchester Piccadilly station from London and elsewhere by train from where they proceeded to the National Graphene Institute (NGI). The visit followed UK-wide publicity on the work of the NGI the previous day (how did the President organise that?).

Outside and inside the National Graphene Institute

Dr Paul Wiperoj of NGI welcomed members explaining that Graphene, the world's thinnest material, was isolated in 2004 with the help of some sticky tape, by Professors André Geim and Kostya Novoselov (2010 Nobel Laureates) at Manchester University. The £61M NGI was opened in 2014 (including £11M of equipment and 1500 m2 of class 100 & 1000 clean rooms with an atmosphere more than a million times purer than air). He delivered a mind boggling explanation of the areas of work being undertaken by 200 researchers on basic studies and commercial developments, including:

- membranes for improved water filtration, gas separation and desalination
- targeted drug delivery, improved brain penetration, smart implants, DIY health testing kits and other biomedical applications
- energy storage: wearable power supplies, longer lasting batteries and supercapacitors which provide bursts of energy
- lighter and stronger composites for cars and aircraft; coatings including conductive paints; inks and rustproof coatings
- better sensors to protect crops and enhance gas / chemical and biological detection
- faster semiconductors, transistors, bendable phones and other electronics.

NGI is unique and works via an "open innovation" development programme between researchers and staff from 80 companies world wide who pay a sum (said to be £200k per person per annum, total income to NGI £12M) to participate. The bigger investors are Chinese! A £60M Graphene Engineering Innovation Centre (GEIC) (£30M from Masdar of Abu Dhabi) is planned for opening in 2018. The NGI and GEIC are part of Manchester University's technology development, which includes £300M for a new Engineering Faculty and £350M for engineering and materials development (and potential future IESF visits). The visit concluded with extensive tours of the facilities and viewing the work in progress, including "bumping into" a Nobel Laureate.

The building is unique for a research institute in having a viewing gallery from the adjacent public street. The building includes a preserved sandstone sink excavated from the building site which included the remains of the Albert Club, founded for Manchester's community of middle class Germans involved in the cotton trade. Friedrich Engels became a member in 1842 and it was while living in Manchester that he experienced the horrific conditions people worked in, which inspired his book *The Condition of the Working Class in England*. Along with the remains of some cotton workers' terraced houses, the ruins of the club were discovered in 2013 on the site of

the National Graphene Institute, and graphene Nobel laureate Sir Kostya Novoselov, together with his students, removed the sink to ensure it remains as a permanent reminder of Manchester's industrial past.

Whitworth Art Gallery

The group travelled the short distance to the Whitworth Art Gallery, also part of the university. The gallery was founded over 120 years ago as a resource to inspire the textile industry in NW England, as a source of pleasure and enjoyment for Manchester's citizens and to provide opportunities to learn about the visual arts. The gallery is named after industrial magnate Sir Joseph Whitworth (1803-1887), who transformed mechanical engineering with his invention of the universal screw thread and left his fortune for charitable and educational purposes.

Tapestry and archive at Whitworth Art Gallery

After a buffet lunch a guided tour enabled the group to visit the newly opened £14M extension and the current special exhibitions including a superb collection of engravings by Marcantonio Raimondi and Raphael; an Andy Warhol exhibition; pen and ink drawings by Deanna Petherbridge; an evocative display of photographs of Bombay 1976 to Mumbai 2016 by Sooni Tata Poteala; and a wonderful display of revolutionary textiles from 1910 to 1939 illustrating the changes taking place in textile design which was brought to an end by the outbreak of war.

The group departed satiated with future science and art (having been missed by another meteorite at the Whitworth—the last landed in 2014).

David Lloyd

Improving Infrastructure Life using Advanced Composite Materials – lecture by Prof Sam Luke & dinner at the RAF Club, 26th April 2017

Prof Sam Luke

West Gate Bridge

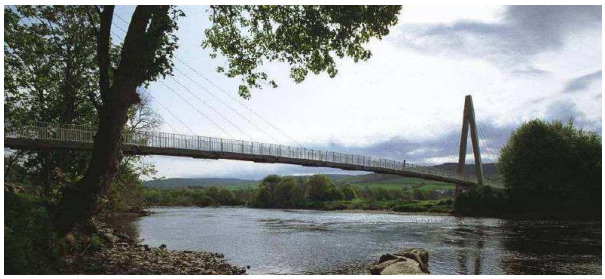
Professor Luke began his presentation by outlining the position of civil engineering consultancy worldwide, noting especially that of recent years, smaller consultancies have amalgamated or have become absorbed into large multi-national groups. Jacobs is such a group, with a global workforce of 50,000, of whom 8,000 are in the United Kingdom. It commands a vast range of expertise and engages in projects covering defence, aerospace, pharmaceuticals, nuclear technology, energy, and infrastructure.

Britain's early industrialization engendered a range of infrastructure which was cutting edge at the time, but the relentless growth in economic activity and technical progress, and the effects of wear and tear, have demanded innovative approaches both to maintenance and to enhancement of the

carrying capacity of ageing structures to meet modern requirements. Some 35% of the transport infrastructure, for example, is over 100 years old, including many of the 40,000 bridges for which Network Rail is responsible.

The management of assets has become a major engineering activity in its own right and is specified in the ISO Standard 55000:2014, to realize the best value of assets in terms of level of service, costs and risks.

The optimization of material properties by means of composites to achieve this end is not new: Mouchel introduced reinforced concrete in the 1890s, and in the last few decades the development of fibre-reinforced polymer (FRP) composite materials has revolutionized the construction of military vessels, aircraft, high-performance vehicles and structural members. Advantages of composites include a high strength to weight ratio; durability and corrosion resistance; good fatigue, creep and fire resistance; fast low-cost installation and reduced life cycle maintenance. Research carried out under a number of cooperative programmes including ROBUST, ASSET and MAINLINE has led to very productive uses of composites in the civil infrastructure. Professor Luke gave some striking examples of the enhancement of existing structures and the construction of new assets. Hythe Bridge in Oxfordshire, a cast iron structure built in 1870 has been reinforced using a pre-stressed carbon fibre composite to provide a 40 tonne capacity, and the lane capacity of the West Gate Bridge in Melbourne has been increased using carbon fibre composite. The Aberfeldy footbridge in Scotland, one of the oldest all-composite bridges built in 1992, has been followed by other structures including Mount Pleasant Bridge, Lancashire, which uses FRP decking with steel girders, and the West Mill Bridge in Oxfordshire which incorporates plastic composites in the load-bearing beams, side panelling and the bridge deck.



Aberfeldy Footbridge

West Mill Bridge

At the conclusion of the presentation, the vote of thanks by Mike Leeming, who had worked with Professor Luke in engineering consulting, was enthusiastically endorsed by members and guests.

Edmund Morgan-Warren

Voyage to Bruges – 17th to 21st May 2017

Bruges was founded in Roman times but flourished in medieval times through trade with England and mainland Europe and work on textiles, including English wool. At times in its history it was controlled by France or Spain. The first printed book in English was printed in Bruges by William Caxton in 1473. The waterway from Bruges to the sea silted up, was restored by storms, but silted up again by early 16C. Then Zeebrugge became the port and Bruges declined. Lace became the main local export, but this declined in

20C. Bruges escaped damage in WW1 and WW2, despite the British attack at Passchendaele in 1917 which aimed to capture Bruges and Zeebrugge, which was a base for German submarines.

We were a party of 45 Voyageurs. Most had travelled from London by luxury coach. Our hotel was in the centre of town on a site dating from 17C. We had four group visits, the first starting with a walking tour of the old town.


Voyageurs outside Hotel Navarrra


View towards belfry

Our start point, the Markt (market square), is dominated by an 81m high belfry. Most buildings here are 19C reconstructions in neoGothic style. The oldest building in the Markt has a globe on its roof as part of an early system to coordinate time between towns for railway operations. From the Markt we continued to the nearby Burg square enclosed by the city hall, Basilica of the Holy Blood and various administrative buildings. It is also the site of a former cathedral of St Ignatius and St Donatian's, whose preserved foundations and various religious artefacts we viewed in the basement of the Crowne Plaza hotel, built in 1980.



Old buildings in the Markt

Nearby is a house where the exiled future Kings Charles II and James II of England held court before the restoration of the English Monarchy. As a gesture of thanks for their help, Charles II granted the fishermen of Bruges the right to fish in English waters in perpetuity (in practice until the UK joined the Common Market in 1973). Our tour continued through narrow streets unchanged for centuries. We crossed bridges over and followed around various canals, passing the palace of Groothuis which had the monopoly on supplying barley for beer.

Our second group visit was to a diamond museum, containing comprehensive information with exhibits of all things related to diamonds and their properties. There was a demonstration of sawing, cleaving, bruiting and polishing diamonds. The diamond trade employs 30,000 people in Belgium and accounts for 8% of its exports. An afternoon boat trip on the canals—the third group activity—allowed us to hear and see more about the city.


Boat trip on the canals


Lacemaking

A highlight of the Voyage was a visit to the De Halve Maan Brouwerij (the Half Moon Brewery). Our guide described the sequence of the brewing process, as done now with modern equipment, and drew our attention to its 3 km pipeline installed in 2016 to pump beer to a bottling plant in an industrial park, which has enabled brewing to continue in the city centre where truck movements are restricted. The 315mm diameter carrier pipe contains two beer lines, two flush lines and a leak detection cable. The brewery

funded its cost of 4 million euros with a crowdfunding campaign, which encouraged locals to invest with a set amount of free beer for their lifetime. Moving upwards, he showed us older equipment no longer used. The visit concluded with a grand view from the roof of the brewery and a substantial lunch with glass of beer.

Tour of the brewery

View from roof of the brewery

Separately, voyageurs enjoyed many of the musuems, sights and sounds of Bruges, including ascent of the 366 steps to the top of the belfry; guided tours of windmills on the outskirts of town; a 'paddle steamer' cruise by canal to the village of Damme-with a working mill beside the canal; a harp recital by Luc Vanlaere, who performed on a range of other instruments; a statue of Madonna and Child by Michaelangelo in the Church of Our Lady brought from Siena by a Flemish merchant; paintings in the Groeningemuseum and Arentshuis; a lace museum with demonstration of bobbin lace making; a chocolate museum with a history of cocoa and chocolate; a folklore museum; and Jerusalem church and museum commemorating a pilgrimage to the Holy Land. All too soon it was time to go home, but not before the last dinner, when Jean Venables presented a card and gift to thank Andrew and Helen Graham on our behalf.

IESF Unofficial Ski Group 5th-12th February 2017

This year the Ski Group headed to new pastures, flying into Venice and then taking a three hour coach transfer north to Corvara, a picturesque village, hidden in the Italian Dolomites. On the day we arrived the clouds were low and above 1000m the rain turned to snow and the coach driver had to put on chains to make it over the last pass before the steep descent into Corvara. The clouds remained low throughout Monday and it wasn't until Tuesday that the magnificent spectacular Dolomites were revealed. We were then able to enjoy the scenery and excellent skiing for the rest of the week, although on several occasions the tops of the mountains were obscured by clouds. Unfortunately our senior skier took a fall on the run home on Monday afternoon and suffered a fracture of the tibia. Michael Leeming returned to the UK where his tibia was screwed back together again and recovery, although slow, is progressing well. The skiing included an anti-clockwise circuit of the famous Sella Ronda, a 42km ski and lift circumnavigation of the three highest peaks and also the Hidden Valley run descending from over 2,800m to 1500m over 10km, with the last 500m being towed by horses and sleighs—fifty skiers at a time holding onto ropes trailing from the sleigh! Walking was very popular this year and excursions took place every day, 5-8km using snow shoes when necessary. We had sole occupancy of the very comfortable Chalet Verena but no hot tub this year (sorry to disappoint some of our readers), although a group of our ladies managed to find a mixed nudist spa in town!

Ron Walker

ICE & RICS Carol Service - 5th December 2016

The annual Inter-Institution Carol Service was held at St Margaret's Church, Westminster on Monday, 5th December. A packed house enjoyed an hour of traditional carols and readings culminating in the singing of the Twelve Days of Christmas; lords a leaping and ladies dancing.

Following the service most people adjourned to the ICE headquarters in Great George Street for a traditional mulled wine and mince pies reception where young and old mingled together to start the festive season. IESF were well represented with forty plus members and guests. Following the reception, there was an informal IESF buffet supper where a convivial evening was had by all.

This is a new venture in the IESF calendar. It was such a success that it is planned to repeat it on 4th December 2017.

Paul Gerrard

The President's Badge

The idea to have a President's badge emanated from the partners of Sir Fredrick Snow, including Brian Scruby and Arthur Brown (the "Snow Men" who were all past presidents), in the 1970s. Alec Leggatt and his late wife Valerie, an amateur jeweller, developed the design, which was executed by a jeweller at Goldsmith's College for a cost of around £600.

The design shows the land masses of Great Britain and France, either side of the English Channel and symbolized by the Clock Tower of the Palace of Westminster (now the Elizabeth Tower) and the Eiffel Tower, respectively. These icons are linked by the French Tricolour surmounted by the Union Jack, and the sun depicted high in the sky. The design includes the initials "icf" in gold lettering, and the whole design is framed with the inscription, "PRESIDENT OF THE BRITISH SECTION - SOCIETE DES INGENIEURS CIVILS DE FRANCE" - a permanent reminder of our origins as "The French Civils". Apparently a spelling error was noticed in the finished article, resulting in extensive reworking and a colourful atmosphere with the maker!

The hallmark on the reverse of the badge is also of interest. As well as the leopard's head for the London assay office, the lion passant for sterling silver and the date letter, the hallmark includes the Queen's head to commemorate the silver jubilee of Her Majesty's accession, 1977. There is no maker's mark.

Edmund Morgan-Warren (with thanks to **Alec Leggatt** for his recollection of the history of the badge).

Our thanks are due to those who have contributed to this newsletter. The editor welcomes contributions on matters that relate to the objectives of the Société.
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